DEVELOPMENT AND VALIDATION OF THE SPORT IMAGERY ABILITY MEASURE

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Abstract

Mental imagery is widely accepted by sport psychologists, coaches, and athletes to be a useful psychological technique in the training of athletes for excellence (Hall, 1998; Janssen & Sheikh, 1994). If imagery training is to be maximally effective, practitioners need to establish an understanding of the athletes' ability to image. To achieve this, it is necessary to assess imagery ability in a reliable, valid, and comprehensive manner (Moran, 1993). As yet no multi-modal, multi-dimensional, sport specific test has been fully validated. The purpose of this thesis is to describe the development, reliability, and validation of an assessment tool for use in imagery research and training programs, the Sport Imagery Ability Measure (SIAM).

The original SIAM is a 72-item task-oriented imagery ability measure. Participants decide on a sport specific version of each of six generic sport-related scenes and image each scene for 60 seconds. After imaging each scene, they respond to 12 items that assess five imagery dimensions (vividness, control, ease of generation, speed of generation, duration), six senses during imagery (visual, auditory, kinaesthetic, olfactory, gustatory, tactile), and emotion. Responses are made on 10-cm analogue scales. Each 10-cm line separates two opposing anchor statements for example, *no feeling* and *very clear feeling* (tactile). Twelve subscale scores are calculated by adding together the relevant dimension or sensory item scores for the six scenes.

The first phase of Study 1 involved logical analyses of the SIAM including domain representative measure development, comprehensibility, face, and content validation. Test construction involved the development of an item pool and format design. The measure was reviewed for comprehensibility by five secondary school students. Six sport psychologists, familiar with the use of imagery ability measures,

served as sources to face and content validate the SIAM. Each expert examined the draft measure and completed a set of review questions on an attached proforma. Following the examination of the experts' responses, relevant changes were made to this version of the SIAM. The second phase of Study 1 involved 474 participants of both genders completing a redrafted version of the measure. School, university, and club athletes were included in the sample. The internal consistency scores (Cronbach's alpha) for each of the 12 subscales indicated adequate reliability with values ranging from .63 (ease) to .8 (olfactory). To test the temporal stability of the SIAM, 47 university students completed the measure a second time after a 4-week interval. Results revealed moderate but significant subscale test-retest correlations, varying from .44 (speed) to .83 (gustatory). The SIAM did not demonstrate any bias in relation to social on the Shortened Marlowe-Crowne Social Desirability Scale. An exploratory factor analysis items did not resolve to a clear structure. Factor analysis on the subscale totals showed a clear two-factor structure with non-visual sense modalities as one factor and dimensions plus vision as the other. The emotion subscale did not load above .5 on either factor.

The SIAM was revised by reducing scored scenes from 6 to 4, randomising items, and incorporating the fitness scene as a practice activity. The measure was then examined for reliability, criterion validity, and factor structure. In Study 2, 633 participants, ranging in age from 12 to 55 years and including 334 males and 299 females, completed the revised SIAM. The Cronbach alpha values indicated good to very good internal consistency with coefficients ranging from .66 (speed subscale) to .87 (gustatory subscale). Test-retest reliability results for 58 participants over a 4-week interval revealed moderate to very good correlations for the specific subscales, varying from .41 (auditory) to .76 (gustatory). The findings suggested that the revisions to the original measure contributed to improved reliability.

The factor structure of the revised SIAM was examined with structural equation modelling. Models based on individual items did not result in a good fit, so models derived from subscale scores were evaluated. The two-factor model from Study 1 did not reflect strong indices of fit. Three alternative models produced fit statistics that were comparable and broadly acceptable (e.g., Conroy, Motl, & Hall, 2000; Cramer, 2000). Based on the evaluation of the fit data and a logical review of the model structure, it was decided that the three-factor model involving auditory sense grouped with the other single organ senses of taste and smell, visual/dimensions, and bodily feeling had the greatest conceptual coherence as a representation of sport imagery ability.

To test the criterion validity of the revised SIAM, subscale differences between elite (n = 272) and non-elite athletes (n =361) were examined. National and state level athletes were grouped as elite, and the district, local, and school athletes grouped as non-elite. The results of the set of independent samples t tests indicated significant differences between the groups for the vividness, control, visual, kinaesthetic, and emotion subscales. Resultant effect sizes for differences between the athlete groups were all in the small range. Overall, athletes participating at a higher competition level reported that they are better able to generate and manipulate the visual, kinaesthetic, and emotional characteristics of the images related to their sport, consistent with expectations.

The purpose of Study 3 was to determine the convergent and discriminant characteristics of the revised SIAM. Convergent and discriminant validity evidence was examined by comparing the SIAM with tests examining (a) self-reported general imagery, including vividness and control; (b) movement imagery; (c) objective imagery ability; and (d) non-imagery cognitive functioning. Individual subscale scores of the SIAM were correlated with subscale and total scores of the following measures:

Shortened Form of the Questionnaire on Mental Imagery (SQMI); Vividness of Movement Imagery Questionnaire-II (VMIQ); Gordon Test of Visual Imagery Control (GTVIC); and Multidimensional Aptitude Battery (MAB - Spatial Ability and Verbal Comprehension). Participants (*N* = 436) from high schools, university physical education courses, and elite sports groups completed the six measures over two sessions. Small to moderate correlations (.27 to .48) were found for the SIAM control, vividness, visual, and kinaesthetic subscales with a number of the related dimension and modality variables of the other imagery measures, providing support for the convergent validity of these subscales of the SIAM. Very low to small correlations (.01 to .20) were typically reported between the SIAM subscales and (a) the cognitive ability measures and (b) unrelated dimension and modality variables of the other imagery measures, supporting the discriminant validity of the SIAM. In spite of the small correlations found between SIAM subscales and the various imagery measures, the findings were generally representative of the predicted pattern of relationships.

Study 4 involved the comparison of the SIAM's subscale scores with data derived from a qualitative analysis of the sport imagery characteristics of athletes. Participants were 33 state-level junior and senior water polo players and coaches that included 19 males and 14 females (*M* = 17.91 years). Each athlete was required to read through and familiarise themselves with a common water polo performance situation and use the procedure of concurrent verbalisation (CV) to describe their imagery relating to involvement in this type of situation. This procedure was repeated with four different water polo scenarios. The athletes also completed the SIAM. Descriptive statistics were reported for the visual, kinaesthetic, tactile, and auditory modalities, and experience of emotion for the CV task, and corresponding SIAM subscales. The results showed that the visual sense was the dominant modality for both CV and the SIAM.

Similar distributions of scores existed for the other identified senses and emotion within both the CV task and the SIAM subscales. Small to very small, non-significant correlations were found between the two measures for all modalities for the total sample. Overall, the examination of concurrent evidence provided only limited support for the validity of the SIAM. The findings of the four studies are discussed in terms of measurement, theoretical, and applied implications.

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TABLE OF CONTENTS

ABSTRACT II

ACKNOWLEDGEMENTS VII

TABLE OF CONTENTS VIII

LIST OF TABLES XIII

LIST OF FIGURES XVI

LIST OF APPENDIXES XVII

CHAPTER 1: INTRODUCTION 1

CHAPTER 2: LITERATURE REVIEW 4

Introduction 4
Definitions 4
Theories of How Imagery Works 14
Psychoneuromuscular Theory. 15
Symbolic Learning Theory 17
Attentional-Arousal Set Theory 18
Bioinformational Theory 19
Triple Code Theory 21
Psychological State Hypothesis 22
Applied Model of Imagery Use in Sport 23
Measurement of Imagery Ability 26
Components of Imagery Ability 27
Classification of Imagery Ability Measures 31
Tests of Imagery Ability Used in Sport Psychology 37
Psychometric Issues Related to Imagery Ability Tests 52
Reliability 52
Validity 57
Evidence Related to the Construct Validation of Imagery Ability Measures 62
Relationship Between Imagery Ability Measures 63
General Subjective Measures 63
Objective Measures 65
Movement-Based Measures 66
Relationship Between Imagery Ability Measures and Other Psychological Variables 69
Cognitive Abilities 70
Memory 72
Social Desirability 76
Other Psychological Attributes 77
Factor Structure 79
Imagery Ability Assessment and Motor Performance 85
Motor Performance Research Involving General Imagery Ability Measures 86
Motor Performance Research Involving Study Specific Imagery Measures 91

Motor Performance Research Involving Movement Imagery Ability Measures...... 93
Imagery Ability Assessment and Sports Performance.. 99
Sports Performance Research Involving General Measures of Imagery Ability.... 100
Sports Performance Research Involving Qualitative Assessment Of Imagery 108
Sports Performance Research Involving Measures of Imagery Use 110
Sports Performance Research Involving Measures of Movement Imagery 113
Sports Performance Research Involving Measures of Sport Imagery.................... 122
Summary.. 125

CHAPTER 3: DEVELOPMENT AND RELIABILITY OF THE SPORT IMAGERY ABILITY MEASURE (SIAM) 130

Introduction 130
Development of the Sport Imagery Ability Measure... 130
Test Construction 131
Comprehensibility 132
Face and Content Validity.. 133
Examination of Reliability and Factor Structure.. 133
Methods 134
Participants 134
Measures.. 135
Personal details information sheet...135
Sport Imagery Ability Measure (SIAM)..135
Shortened Marlowe-Crowne Social Desirability Scale (SM-C SDS)..............135
Procedure.. 136
Analyses 137
Results 139
Descriptive Statistics for the SIAM Subscales and Scenes 139
Internal Consistency, Test-Retest Reliability, and Social Desirability of the SIAM Subscales. 141
Item Analysis.. 142
Exploratory Factor Analyses 142
Subscale Inter-Correlations 145
Discussion.. 147
Relationships with Research and Theory 147
Descriptive Data 147
Reliability.. 149
Subscale Inter-Correlation... 151
Factor Analysis... 153
Summary 157
Future Research... 158
Implications for Practice 160
Conclusion.. 161

CHAPTER 4: RELIABILITY, FACTOR STRUCTURE, AND CRITERION VALIDITY OF THE REVISED SPORT IMAGERY ABILITY MEASURE (SIAM) 163

Introduction 163
Revision of the Sport Imagery Ability Measure.. 164
Internal Consistency, Test-Retest Reliability, Factor Structure, and Criterion Validity ... 166
Method 168

Participants ... 168
Measures ... 169
Personal details information sheet ... 169
Revised Sport Imagery Ability Measure (SIAM) ... 169
Procedure ... 169
Statistical Analyses ... 171
Results ... 173
Descriptive Statistics for the Revised SIAM Subscales ... 174
Test-Retest Reliability and Internal Consistency, of the Revised SIAM Subscales ... 175
Subscale Inter-Correlations ... 177
Confirmatory Factor Analyses ... 178
Evidence of Criterion Validity ... 184
Discussion ... 185
General Conclusions ... 186
Descriptive Statistics ... 186
Reliability Data ... 187
Subscale Inter-Correlation ... 191
Factor Structure ... 193
Evidence of Criterion Validity ... 196
Relationships to Existing Theory and Conceptualisations ... 204
Methodological Issues ... 209
Implications for Research and Practice ... 212
Summary of Conclusions ... 214

CHAPTER 5: EVIDENCE OF THE CONVERGENT AND DISCRIMINANT VALIDITY OF THE REVISED SPORT IMAGERY ABILITY MEASURE (SIAM) ... 217

Introduction ... 217
Method ... 219
Participants ... 219
Measures ... 221
Personal details information sheet ... 221
Revised Sport Imagery Ability Measure (SIAM) ... 221
Shortened Form of the Questionnaire on Mental Imagery (SQMI) ... 221
Gordon Test of Visual Imagery Control (GTVIC) ... 222
Vividness of Movement Imagery Questionnaire-II (VMIQ-II) ... 222
Multidimensional Aptitude Battery (MAB) ... 223
Procedure ... 224
Statistical Analysis ... 226
Results ... 227
Descriptive Statistics for all Convergent and Discriminant Validity Measures ... 227
Relationship of SIAM Subscales with Convergent and Discriminant Validity Measures ... 229
SIAM Vividness Subscale. ... 231
SIAM Control Subscale. ... 232
SIAM Ease of Generation Subscale. ... 233
SIAM Speed of Generation Subscale. ... 234
SIAM Duration Subscale ... 235
SIAM Visual Subscale. ... 236

SIAM Kinaesthetic Subscale. 237
SIAM Auditory Subscale. 238
SIAM Tactile Subscale. 239
SIAM Olfactory Subscale. 240
SIAM Gustatory Subscale. 241
SIAM Emotion Subscale. 242
Discussion 243
Relationship of Findings to Theory and Research 244
Descriptive Data 244
Relationship of the SIAM and Imagery Variables 247
Relationship of the SIAM and Non-Imagery Variables 259
Methodological Issues 262
Instrument-Related Issues 263
Experimenter and Administration Related Issues 269
Participant Related Issues 274
Implications for Research 276
Measuring Imagery Ability in Sport 276
Testing Theories and Models 278
Implications for Practice 279
Conclusion 281

CHAPTER 6: EXAMINATION OF THE CONCURRENT VALIDITY OF THE SPORT IMAGERY ABILITY MEASURE (SIAM) 282

Introduction 282
Method 286
Participants 286
Measures 287
Personal details information sheet 287
Revised Sport Imagery Ability Measure (SIAM) 287
Water Polo Imagery Concurrent Verbalisation (CV) Activity 287
Procedure 289
Treatment of Data and Analyses 291
Results 294
CV Transcripts Language Units representing Imagery Characteristics 295
Inter-Rater Reliability 296
Descriptive Statistics for the Concurrent Verbalisation (CV) Data and the Revised SIAM 298
Relationship Between CV Imagery Characteristic Percentages and SIAM Subscales 300
Discussion 301
General Conclusions 302
Relationships to Research and Theory 306
Methodological Issues 315
Implications for Research 319
Implications for Practice 321
Conclusion 322

CHAPTER 7: GENERAL DISCUSSION 325

Introduction 325

Summary of Findings 326
Development and Reliability of the Original SIAM 326
Revision of the SIAM 327
Confirmatory Factor Analysis 328
Criterion Validity 329
Convergent and Discriminant Validity........ 329
Concurrent Validity........ 331
The SIAM in Relation to Conceptualisations of Imagery in Sport........ 333
Definitions........ 333
Theories and Models 334
Status of SIAM in Measuring Imagery Abilities in Sport 337
Future Research Involving the SIAM........ 342
Revision and Psychometric Evaluation of the SIAM........ 342
Experimental Investigations........ 346
Theory and Model Development........ 347
Applied Use of the SIAM........ 352
Assessment of an Athlete's Imagery Abilities 352
Evaluation of Imagery Training 353
Manipulation Check of Imagery Content........ 354
Identification of Components of Imagery 354
Concluding Comments 355
REFERENCES........ 358
APPENDIXES 386

LIST OF TABLES

Table 2.1A: Review of Existing Imagery Measures. Part A. 38

Table 2.1B: Review of Existing Imagery Measures. Part B. 41

Table 3.1: Means and Standard Deviations for SIAM Subscale and Scene Scores for the Total Sample and the Specific Subgroups 140

Table 3.2: Internal Consistency Coefficients, Test-Retest Reliability, and Correlations with Social Desirability for SIAM Subscales (N = 474) 141

Table 3.3: Rotated Factor Pattern Matrix for SIAM Subscales (N = 474) 144

Table 3.4: Inter-Correlations of the SIAM Subscales (N = 474) 146

Table 4.1: Means, Standard Deviations, and Skewness for Revised SIAM Subscale Scores for the Total Sample and the Participation Level Subgroups 174

Table 4.2: Internal Consistency Coefficients and Test-Retest Reliability for Revised SIAM Subscales 176

Table 4.3: Inter-Correlations of the Revised SIAM Subscales (N = 633) 177

Table 4.4: Goodness of Fit Indices for CFA Individual Item Model for the revised SIAM 180

Table 4.5: Goodness of Fit Indices for CFA Models for SIAM Subscale Data 182

Table 4.6: Summary of Differences between Elite and Non-elite Groups 184

Table 5.1: Descriptive Statistics for all Convergent and Discriminant Validity Measures 228

Table 5.2: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Vividness Subscale 231

Table 5.3: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Control Subscale 232

Table 5.4: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Ease of Generation Subscale ... 233

Table 5.5: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Speed of Generation Subscale . 234

Table 5.6: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Duration Subscale.................... 235

Table 5.7: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Visual Subscale 236

Table 5.8: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Kinaesthetic Subscale 237

Table 5.9: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Auditory Subscale.................... 238

Table 5.10: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Tactile Subscale....................... 239

Table 5.11: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Olfactory Subscale................... 240

Table 5.12: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Gustatory Subscale 241

Table 5.13: Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Emotion Subscale 242

Table 6.1: Examples of Language Units Representative of Imagery Ability Characteristics 295

Table 6.2: Inter-Rater Reliabilities for Initial and Final Concurrent Verbalisation Analysis Methodologies 297

Table 6.3: Means and Standard Deviations for CV Imagery Characteristics
Percentages 299

Table 6.4: Means and Standard Deviations for Revised SIAM Subscale Scores 300

Table 6.5: Correlation Between CV Imagery Characteristic Percentages and
Corresponding Revised SIAM Subscale Scores 301

LIST OF FIGURES

Figure 3.1: Proposed hierarchical model of imagery ability. 155

Figure 4.1: Specified individual item CFA model for the revised SIAM 179

Figure 4.2: EFA derived two factor model (M1) including standardised estimates ... 181

Figure 4.3: Specified Three-Factor Subscale Model (M3) for revised SIAM data including standardised estimates 183

Figure 7.1. Model of imagery ability in relation to sport 351

LIST OF APPENDIXES

Appendix A: Sport Imagery Ability Measure (SIAM) 386

Appendix B: Expert Evaluation Proforma for SIAM 395

Appendix C: Summary of Expert Reviews 398

Appendix D: Shortened Marlowe-Crowne Social Desirability Scale 401

Appendix E: Examples of information and consent forms 403

Appendix F: Individual Item EFA of the SIAM 406

Appendix G: Revised SIAM 410

Appendix H: Shortened Form of the Questionnaire on Mental Imagery 418

Appendix I: Gordon Test of Visual Imagery Control 422

Appendix J: Vividness of Movement Imagery Questionnaire-II 425

Appendix K: Spatial and similarities subtests of MAB 429

Appendix L: Water Polo Imagery Concurrent Verbalisation (CV) Activity 438

Appendix M: Example of CV transcript 441

Appendix M: SIAM Administration Instructions 445

CHAPTER 1: INTRODUCTION

Sport psychologists, coaches, and athletes typically accept that mental imagery is a valuable psychological technique in the training of athletes for excellence (Hall, 1998; Janssen & Sheikh, 1994). If imagery training is to be maximally effective, practitioners need to establish an understanding of athletes' ability to image. To achieve this, it is first necessary to assess imagery ability in a reliable, valid, and comprehensive manner.

Practitioners can benefit from knowledge of the individual differences in athletes' imagery ability in relation to both the development and evaluation of imagery training programs. Imagery ability information can aid in the selection and placement of participants within an imagery program (Moran, 1993) and in the identification of specific imagery dimensions and sensory modalities that warrant emphasis during implementation and review of the program (Vealey & Walter, 1993; Weinberg & Gould, 1999). Valid imagery ability measures can highlight these individual differences (Hall, Pongrac, & Buckolz, 1985), help demonstrate changes in imagery abilities as an outcome of training programs, and contribute to a clearer understanding of the dominant characteristics associated with imagery ability.

Initial development of imagery ability tests began with the work of Betts (1909). Since that time a large number and variety of measures purporting to assess either a general factor or specific factors of imagery ability have appeared (Anderson, 1981a; Moran, 1993; Richardson, 1994; White, Sheehan, & Ashton, 1977). The developers of many measures often pursued unsystematic approaches to the selection of the dimensions or modalities assessed (e.g., Lane, 1977; Switras, 1978). The measures generally focus on one or two specific dimensions and modalities of imagery ability, particularly the visual modality and the vividness dimension. Although information regarding the reliability of imagery ability measures has been both regular and relatively consistent, many of the existing measures have failed to provide adequate validity data relating to their development and continued usage.

Imagery assessment studies have resulted in a wide variety of reported research findings. The main procedures undertaken by researchers are to distinguish between groups in terms of imagery ability or to correlate imagery ability with performance on another variable. Reviewers of imagery assessment measures have urged caution in interpreting results, because basic psychometric properties need to be substantiated (Ernest, 1977; Hall et al., 1985; Hiscock, 1978; Kaufmann, 1983; Moran, 1993; Richardson, 1994; White et al., 1977). Several authors have concluded that the initial construction and development phase of imagery ability measures requires additional attention, if future research is to report imagery ability characteristics, or changes in imagery abilities resulting from interventions, accurately (Kaufmann, 1983, Katz, 1983, Perry & Morris, 1995, Tower, 1981).

Construct validation is a vital component of any instrument development program. It is the procedure in which researchers empirically examine the theory used to develop the instrument, and the ensuing findings used to revise both the instrument and theory (Marsh, 1996). The construction of multidimensional psychological instruments requires initial design grounded in reputable theory. Subsequent evaluation necessitates item and reliability analysis, factor analysis, tests of convergent and discriminant validity, and use of the measure within a quantifiable research framework (Gill, Dzewaltowski, & Deeter, 1988). An on-going dilemma in the development of many sport psychology instruments has been their restricted use in practice and lack of implementation of accepted test construction procedures (Ostrow, 1996).

The purpose of the current research is to develop and evaluate a self-report, multi-dimensional, multi-modal measure of sport imagery ability. Initially, this entails examination of current theories, models, and definitions of imagery, which will provide a foundation on which to assemble the instrument, so that it appropriately reflects relevant interpretations of this complex process. The appraisal of existing measures and the review of the relevant investigations involving the use of these measures will allow for the design of the new measure to suitably reflect the positive attributes of imagery tests used in both research and practice. Construction and refinement of this measure will primarily focus on following established psychological instrument development practices (e.g., Marsh, 1998), to achieve the acceptable psychometric standards (McKelvie, 1994) that have appeared to be lacking in other imagery ability measures.

A reliable and valid measure of sport imagery ability could provide sport psychology practitioners with an assessment device that can generate useful information regarding the design of imagery training programs to suit individuals' strengths and weaknesses. Information about imagery ability characteristics can also help researchers improve their understanding of imagery processes. The acquisition and dissemination of knowledge about how imagery functions will assist in the resolution of the current theoretical and assessment concerns in the fields of both sport and general psychology. Finally, outcomes of the findings associated with the psychometric evaluation of a new measure of sport imagery ability may lead to the initial foundation of a conceptualisation of sport imagery capable of rigorous evaluation within both research and applied situations.

CHAPTER 2: LITERATURE REVIEW

Introduction

As with many similar subjective psychological phenomena, no single description of the imagery process constitutes a uniformly accepted conceptualisation. A broad range of definitions and theories exist that differ relative to the situation in which they were developed. This review briefly examines conceptualisations from general psychology and presents a more detailed examination of the theoretical perspectives regularly discussed within the field of sport psychology.

Literature examining the measurement of imagery ability is reviewed to highlight the key issues related to test development. These include the nature of assessable components, frameworks for the design and classification of measures, the relationship between imagery measures and other cognitive processes, and the specific structure of existing test instruments. The psychometric properties of the imagery measures that consistently appear in research literature related to motor skills and sport are considered.

Research examining individual differences in imagery ability and motor skills, or with a specific emphasis on athletic performance and imagery ability, is then summarised. The key focus of this section of the review is to determine the applicability and potential contribution of a new measure of imagery ability within the field of sport psychology. To conclude the literature review, I present the aims of the present thesis.

Definitions

The primary goal in reviewing the major imagery definitions and conceptualisations is to clarify their role in the establishment of a theoretical framework for the development of a measure of sport imagery ability. Currently, only minimal consensus exists as to which conceptualisations represent accurate descriptions of the phenomenon. Richardson (1983a) concluded, after analysing a large collection of existing definitions, that the term imagery is ubiquitous and used for the purposes of both description and explanation. He suggested that the term typically referred to "either a class of inferred cognitive constructs or processes or a class of more or less percept-like experience" (p. 36). The definitions and conceptualisations considered in the following section will focus primarily on the cognitive processes associated with mental imagery.

Limited consistency is apparent in the formulation of definitions of mental imagery from within the field of cognitive psychology. The focus of each definition varies dependent on the purpose for which the imagery description is used. Finke (1989), whose work examined information retrieval using mental images, defined mental imagery as "the mental invention or recreation of an experience that in at least some respects resembles the experience of actually perceiving an object or an event, either in conjunction with, or in the absence of, direct sensory stimulation" (p. 2). Paivio (1971) also working within the field of learning and memory proposed a description oriented toward neurological functioning within which imagery is "used to refer to a memory code or associative mediator that provides spatially parallel information that can mediate overt responses without necessarily being consciously experienced as a visual image" (pp. 135-136). Richardson (1994) has suggested that the intention of this definition was to contrast the verbal and visual aspects of imaginal processing emphasised within Paivio's dual code theory of imagery functioning. Contrasts based on use within the existing set of imagery definitions has limited the utility of many descriptions and caused possible confusion in the adoption of conceptualisations within research.

Other researchers have provided operational definitions of imagery as an important component in their development of imagery theory. In relation to bioinformational theory, Lang (1979a) described imagery in the context of the brain's information processing abilities. An image, as defined by Lang is "a finite information structure which can be reduced to specific propositional units" (p. 109). Subsequent examination of Lang's theory lead to the description of imagery as a process involving the activation of networks of stimulus and response propositions stored as coded information in long-term memory (Hecker & Kaczor, 1988). Lang (1979b) has suggested that images are strictly controlled by "a finite propositional structure (and not the analogue representation suggested by phenomenology)' (p. 495). Lang has presented substantial research emanating from the key elements of his original conceptualisation of imagery, an approach that remains necessary in development of accurate definitions of mental imagery.

Anderson (1981a) also presents an operational or working definition, but from the perspective of imagery assessment, rather than theory development.

> "Imaginary experiences" will refer, at a minimum, to awareness of sensorylike qualities in the absence of environmental stimuli appropriate to the sensation. This will usually involve awareness of visual qualities, but not always. Along with the minimum requirement of sensory awareness, imaginary experiences may also include thought segments that are part of, or that occur in the context of, the imaginal sensory awareness. (p. 151)

Formulation of the definition involved the assumption that imagery is a constructive behaviour, actively undertaken. Anderson was quite clear in pointing out that the primary role of the definition is in aiding the practitioner and investigator in the design and selection of appropriate instruments for imaginal assessment.

Of existing definitions, the classic description of mental imagery formulated by Richardson (1969), is a description of the imagery process that provides an important foundation for the development of many measures of imagery ability (e.g., Shortened Questionnaire Upon Mental Imagery). Irrespective that the development basis of the definition was within the field of general psychology, it has maintained consistent acknowledgement in the sport psychology literature (e.g., Janssen & Sheikh; 1994; Martin, Moritz, & Hall, 1999; Murphy & Jowdy, 1992; Perry & Morris, 1995). This definition, or one or more of its composite elements, has also served as a commencement viewpoint for a variety of imagery studies (e.g., George, 1986; O'Halloran & Gauvin, 1994) and constituted a base for more elaborate discussions of imagery functioning (e.g., Martin et al., 1999; Murphy & Jowdy, 1992). The definition has lost little relevance or validity in the 30 years since its creation.

> Mental imagery refers to (1) all those quasi-sensory and quasi-perceptual experiences of which (2) we are self-consciously aware and which (3) exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts, and which (4) may be expected to have different consequences from their sensory or perceptual counterparts. (Richardson, 1969, pp. 2-3)

Murphy and Jowdy (1992) considered this definition to be of great value in relation to sport imagery. They outlined three key features of the definition concerning the nature of imagery within a sporting context. The first is the mimicking of the sensory or perceptual experience, such as the "feeling of movement". The second is that the individual is conscious of the experience in that they may purposefully generate an image of a familiar sporting venue, for example. The third feature is that the experience occurs without known stimulus antecedents, such that no track or competitors need to be present to imagine an athletic event. Perry and Morris (1995) suggested that the Richardson definition does not adequately distinguish imagery from other cognitive processes. For example, whereas Murphy and Jowdy (1992) interpreted the reference to conscious awareness within the definition as a way to differentiate imagery from dreaming and daydreaming, Perry and Morris (1995) argued that daydreaming typically occurs in a fully conscious state. They have suggested that the concept of volitional control of images constitutes a more appropriate distinction. Generally, the Richardson definition does provide sufficient complexity and flexibility to allow for its use as a suitable descriptor of the characteristics of images experienced in the sporting domain.

In addition to his definition of mental imagery, Richardson (1969) also described four types of imagery, several of which have relevance to the present thesis. They are (a) afterimagery, (b) eidetic imagery, (c) thought or memory imagery, and (d) imagination imagery. Of greatest relevance to sport imagery, and indeed discussed briefly within the sport psychology literature, are the latter three types of imagery. Eidetic imagery refers to a percept-like imagery, based on exposure to a recent stimulus that does not require a fixed gaze, but does require some form of attentional focus. Descriptions of the image details are in the present tense, under voluntary control, and may remain available for an extended period of time (Morris & Hampson, 1983; Richardson, 1969). Green (1994) suggested that this form of imagery is of great use to athletes with respect to performance enhancement and stated "the eidetic form of imagery, as used by athletes, recreates a multi-dimensional experience that encourages the integration of all sensory modalities" (p. 44). Richardson's (1969) and Morris and Hampson's (1983) interpretations of eidetic imagery inferred that imagery of this type is only experienced by a limited number of individuals (predominantly children) and is operating as a form of retrieval imagery dominated by the visual sense. Its applicability within the sporting context is limited. Green (1994) described eidetic imagery more as a form of memory or thought imagery.

Memory or thought imagery is the most common form of imagery practised on a regular basis in everyday life (Richardson, 1969). It is experienced by most individuals, relates to both the present and to anticipatory events, is voluntarily produced, operates within all sensory modalities, and is produced with varying degrees of vividness and control over its content (Richardson, 1994). It is this form of imagery that has the greatest significance in the sporting context. Green (1994) specifically discussed the functions of thought imagery in relation to athletic performance. He described processing examples such as imagery of the execution of specific sporting skills or imagery relating to the more holistic involvement of an athlete within a particular sporting contest. From an imagery assessment perspective, Richardson (1994) maintained that thought imagery is the imagery type predominantly examined within self-report measures of imagery ability.

Imagination imagery is the final category Richardson described. He suggested that this form of imagery usually involves images of new construction generated from memorial elements. The images tend to be novel, substantial, clear, and vivid. They differ from memory images primarily on the basis that the imager has never previously experienced the exact events detailed within the images. Imagination imagery has received no direct attention within the sport psychology literature. In the applied context, however, it seems that images dealing with unique experiences, such as winning an important event, or mastering a difficult new element of a routine, could be categorised as forms of imagination imagery.

Several straightforward definitions of mental imagery from the sport psychology literature relate directly to the mental experience. Moran (1993), as a component of his examination of imagery assessment in sport, referred to two simple definitions of the term. The first, originally presented by Matlin (1989), described mental imagery as "the capacity to represent in the mind experiences of things that are not physically present" (Moran, 1993, p. 156). The second definition, developed by Solso (1991), described mental imagery as " a mental representation of a nonpresent object or event' (p. 267). Moran (1993) also emphasised that imagery should not be restricted to the visual sense, but should incorporate multiple sensory inputs. An inappropriate trend observed within areas of the sport psychology literature, even in quite recent texts (e.g., Cox, 1998; Wann, 1997) has been the defining of imagery from the visual perspective only, through terms such as visualisation, mental picture, or the mind's eye (Morris, 1997). Hardy, Jones, and Gould (1996) avoid this problem by focussing on the sensorial nature of imagery, in describing imagery "as a symbolic sensory experience that may occur in any sensory mode" (p. 28). This set of definitions has tended to oversimplify a complex concept that is becoming of ever increasing importance within sport psychology.

Vealey and Greenleaf (1998) have also produced a functional definition that is as follows: "Imagery may be defined as using all the senses to recreate or create an experience in the mind" (p. 201). This definition is best understood when considered in conjunction with their extended discussion of the three key characteristics associated with sport-oriented imagery. These elements are in part derived from their definition and include (a) imagery as recreating or creating an experience, (b) imagery as a polysensory experience, and (c) imagery occurring in the absence of external stimuli. Although Vealey and Greenleaf's definition is relatively distinct from that of Richardson's (1969), their broadened conceptualisation of the term includes several elements related to his earlier definition. Finally, it is Vealey and Greenleaf's emphasis of the re-creation and creation of the imaginal experience that distinguish it from other definitions, and their presentation of a broader conceptual framework provides their description with a distinctive quality.

Denis (1985) has formulated a definition that highlights the dynamic and creative properties of images:

> Imagery is a psychological activity which evokes the physical characteristics of an absent object (either permanently or temporarily absent from our perceptual field). It is worth emphasising here that imagery is not restricted to recollection of the appearance of static objects, but it extends to moving objects, objects undergoing

> transformations, in other words, to dynamic events. The scope of imagery is not limited to recalling objects or events that have been perceived in the past (recent or distant past) but imagery also refers to objects or events that have not yet been accomplished. Imagery allows people to anticipate future (or even purely theoretical) events. (p. 4S-5S)

This definition has shown itself to be a popular conceptualisation, specifically through its alignment with the extensive imagery research work of Hall and his colleagues (e.g., Hall, 1998). The definition is useful in the manner in which it considers the specific properties of an image, possibilities for which an image may be useful, and the involvement of other cognitive processes such as memory. The detailed nature of this definition provides a substantial basis for the possible development of instruments to assess individual differences in the dimensional and sensorial characteristics of imagery ability.

Distinguishing between commonly used terms relating to imagery within sport psychology research has been the focus of several authors (Murphy & Jowdy, 1992; Perry & Morris, 1995). The terms regularly used with the least discrimination are imagery, mental rehearsal, and imagery rehearsal (e.g., Corbin, 1972; Driskell, Copper, & Moran, 1994; Richardson, 1967a). Mental practice according to Corbin (1972) is the "repetition of a task without observable movement, with the specific intent of learning" (p. 94). It is important to acknowledge that in mental practice, imagery may not be used at all, and that mental practice could include non-image based strategies, such as verbal rehearsal or self-talk. For the purposes of this review, in which imagery is of primary importance, a distinction outlined by Murphy and Jowdy (1992), which considers imagery as a mental process and mental practice as a particular non-physical rehearsal or practice technique used by athletes, is most useful. Aligned with this distinction is the definition of mental rehearsal, presented by Hardy et al. (1996), as "the employment of imagery to mentally practise an act" (p. 28). The emphasis here is also on mental rehearsal as a technique rather than imagery as a process.

Developed within an applied sport psychology context, Suinn (1976, 1983, 1993) used the term imagery in relation to his imagery rehearsal procedure known as visuomotor behaviour rehearsal (VMBR, 1976). According to Suinn (1976):

> The imagery of visuomotor behavior rehearsal apparently is more than sheer imagination. It is a well-controlled copy of experience, a sort of body-thinking similar to the powerful illusion of certain dreams at night. Perhaps the major difference between such dreams and VMBR is that the imagery rehearsal is subject to conscious control. (p. 41).

Another important component of Suinn's analysis of the imagery construct is the multi-modal nature of visuomotor behaviour rehearsal and its relation to mental experiences. Suinn described VMBR as "a covert activity whereby a person experiences sensory-motor sensations that reintegrate reality experiences, and which include neuromuscular, physiological, and emotional involvement" (1993, p. 499).

Additional important elements of Suinn's (1984) VMBR program are that the process of imagery is holistic and multi-sensory involving the reintegration of experiences derived from visual, auditory, tactile, kinaesthetic, and emotional cues (Murphy, 1990). The process also involves the specific use of imagery by individuals in completing the rehearsal of sporting involvement (Murphy, 1994). As a form of imagery rehearsal, VMBR has shown itself to be adequately detailed, systematically analysed, and a popular technique within sport psychology practice. When examined as an imagery conceptualisation, the quality and depth of the description of VMBR facilitates the incorporation of pertinent content within the design of a measure examining a broad range of imagery abilities.

Recently, Simons (2000) presented an excellent analysis of the process of using imagery as a psychological skills training technique. The information of relevance to the definition of imagery emanated from his concluding thoughts on the manner in which athletes process imagery. Simons described the process as:

> Imagery is intriguing for its close relationship to perception and action. It is such a rich memory system, matching the complexity of information presented by the environment and contained in the execution of motor skills. Images bind personal thoughts and emotions to experience, and they have qualities far beyond simple stimulus/response propositions.........Imagery can be creative, allowing one to experience attitudes and actions mentally in ways that have not yet been encountered in real performance. (p. 92)

This description of sport-oriented imagery succinctly highlights many of the important conceptual characteristics contained within the conceptualisations outlined previously. It is necessary that future imagery investigations align applied interpretations of the phenomenon with those definitions formulated from research findings and the analysis of theory.

For the purpose of this research, it was vital that a thorough and complete definition supported the theoretical framework underlying the development of the imagery ability measure. This provided a specific focus for the content and format of the test items generated for this new measure. The following definition may be considered a compilation of specific elements of relevance from the definitions of Richardson (1969) and Denis (1985), the conceptualisations of Suinn (1976, 1983, 1993) and Vealey and colleagues (1993, 1998), and the applied interpretation of Simons (2000). The emphasis for the present description centres upon the nature of mental imagery in relation to involvement in sport. Imagery in the context of sport may be considered as the creation or recreation of an experience generated from memorial information, involving quasi-sensorial, quasi-perceptual, and quasi-affective characteristics, that is under the volitional control of the imager, and may occur in the absence of the real stimulus antecedents normally associated with the experience. This definition is obviously not unique when examined on the basis of its collective elements, what is distinctive is the attempt to create a useful association of the key components of existing definitions into an operational framework relevant to the assessment of sport imagery ability.

Theories of How Imagery Works

Much of the literature that examines the imagery process in relation to physical activity has highlighted the theories proposed as explanations of the operation of imagery in facilitating performance (e.g., Hall, 2001; Murphy, 1990; Perry & Morris, 1995; Weinberg & Gould, 1999). In a review of mental practice research, Grouios (1992) listed twelve theories as interpretations of the relationship between mental practice and enhanced motor performance. In conducting the current review, I examined a range of theories discussed within a diverse collection of sport psychology and human movement research and theoretical review material (e.g., Corbin, 1972; Feltz & Landers, 1983; Grouios, 1992; Hinshaw, 1991; Richardson, 1967). A number of the theories have been detailed minimally, whereas, a specific set of theories appear to be consistently represented within the examined literature (e.g., symbolic learning, bioinformational, psychoneuromuscular).

For the purposes of this review, the analysis of theories focuses on the discussion of their conceptual association with the procedures involved in assessing sport imagery ability. Moran (1993) highlighted a pertinent problem existing between theory and measure development and stated that the "theoretical advances by cognitive psychologists in understanding the nature and properties of imagery have not yet been translated into the domain of imagery assessment, where the self-report paradigm reigns supreme" (p. 166). Integral to this thesis was the scrutinising of the relevant features of the most regularly reviewed theories and determining possibilities for the constructive representation of their key elements in the context of the measurement of sport imagery ability.

Generally, the research literature detailed four main theories as explanations for the relationship between imagery and physical performance (e.g., Hall, 2001; Murphy & Jowdy, 1992; Perry & Morris, 1995; Suinn, 1993, 1997; Weinberg & Gould, 1999). These are the: (a) psychoneuromuscular theory (Jacobson, 1930, 1932), (b) symbolic learning theory (Sackett, 1934), (c) attentional-arousal set theory (Schmidt, 1982), and (d) bioinformational theory (Lang, 1977). In addition, I review two alternative explanations, the triple code model (Ahsen, 1984) and the psychological state hypothesis (Weinberg & Gould, 1995). Finally, the recent presentation of the applied model of mental imagery use in sport (Martin et al., 1999) constituted an important conceptual representation that acknowledged the importance of imagery ability as a variable and therefore, warranted review.

Psychoneuromuscular Theory.

The psychoneuromuscular theory, initially discussed by Jacobson (1930, 1932), is a derivation of the ideomotor principle of imagery (Carpenter, 1894). Jacobson (1931) proposed that low-level nerve impulses generated during imagined movement are similar to those patterns produced within the actual movement, but of a smaller magnitude. In addition, Jacobson maintained that the generated images are representative of covert motor activity. Although no specific movement occurs during the imagery, the low level nerve impulses help create a 'muscle memory' (Vealey & Greenleaf, 1998) of the correct firing sequence of the muscles, which in turn should make the execution of the movement easier (Janssen & Sheikh, 1994).

The theory has been supported by a number of imagery rehearsal studies (Bird, 1984; Jacobson, 1931; Hale, 1982; Suinn, 1976) in which the primary aim has been to monitor the motor-efferent patterns generated while participants imagine specific physical movements or sport activities. Suinn (1980) reported that for a downhill skier, the electromyography (EMG) activity of the thigh muscles recorded during sport-oriented imagery (skiing a downhill run) matched the EMG activity expected during the physical execution of the sporting task. Hale (1982), following the investigation of EMG and ocular activity in relation to the imaging of a biceps curl, suggested that the minute localized EMG and ocular innervations provide both visual and kinaesthetic feedback to the motor cortex and subsequently enhance the motor schema of that movement. Evidence that confirms the existence of visual and kinaesthetic electrical responses to imagery tasks also provides basic support for the proposal that athletes may be capable of subjectively quantifying the strength of their imagined responses for both the visual and kinaesthetic modalities.

A number of researchers have highlighted concerns with this theory. Feltz and Landers (1983) concluded, following an extensive meta-analysis of existing mental practice research, that (a) the inadequate quantitative analysis of the theory, (b) the failure to include any task performance measures in addition to the measurement of muscular activity, and (c) the fact that muscle innervation was not always localised to the muscle groups of the imagined movement restrict the usefulness of the theory in explaining how imagery enhances sport performance. Hecker and Kaczor (1988) criticised the inadequate explanation of the role of modality feedback within the theory. Their final analysis suggested that the theory is more a "description of an important aspect of imagery rehearsal.........rather than an explanation of the processes involved in improved performance" (p. 364). The psychoneuromuscular theory assists minimally in substantiating the proposal of sport imagery as a multi-modal, multi-dimensional cognitive activity. The theory describes imagery processing in the context of only one or two modalities, and without any acknowledgment of the generational aspects of the phenomenon. Therefore, in summary, I do not consider this explanation to be a significant contributor to the conceptual basis underlying the development of a measure of imagery ability in sport.

Symbolic Learning Theory

Symbolic learning theory is primarily concerned with the cognitive process associated with imagery. Sackett (1934) posited the initial explanation of how the theory operated. It was proposed that imagery allows the performer to symbolise the required movement sequences in the brain, and through rehearsing these symbolic components, facilitate performance. Sackett also maintained that skills that are cognitive in nature are easier to code than primarily motor skills (Janssen & Sheikh, 1994). Recent discussion of the theory by Vealey and Greenleaf (1998) lead to their conclusion that the use of imagery strengthens the "mental blueprint" that facilitates the processing of the skill to an automatic status.

Several mental rehearsal studies have been able to demonstrate consistent support for the symbolic learning theory by showing that imagery is more effective on tasks with large cognitive components than on purely motor tasks (Hird, Landers, Thomas, & Horan, 1991; Ryan & Simons, 1982; Wrisberg & Ragsdale, 1979). The results of the meta-analysis presented by Feltz and Landers (1983) indicated that effect size was much larger in studies that were based on cognitive tasks than studies involving motor or strength tasks. Hecker and Kaczor (1988) detailed the existence of possible problems with the theory. They suggested that although the theory can account for the use of mental practice in initial skill acquisition, it fails to explain how imagery actually relates to the performance enhancement of established athletic skills. They also shared a concern with Richardson (1967) as to the basis on which tasks are divided into cognitive and motor components. After an extensive examination of the key elements and approaches to the symbolic learning theory, Murphy and Jowdy (1992) concluded that "Without a rigorous explanatory framework, the symbolic learning approach cannot serve as a useful heuristic for future researchers" (p. 237).

Although the contribution of this theory to the understanding of sport imagery ability assessment is limited, an association may exist between the cognitive blueprint proposal and the imaginal representation of coded movement information entailed within certain imagery ability assessment tasks. Such a simple relationship, however, does not constitute a sufficient basis for the inclusion of the symbolic learning theory as a primary interpretation of imagery functioning in the development of a measure of sport imagery ability.

Attentional-Arousal Set Theory

The attention-arousal set theory posits that there is an optimal arousal level for each athlete to achieve peak performance (Janssen & Sheik, 1994) and that imagery provides a method of closely approximating this optimal level of arousal or physiological activation (Schmidt, 1982). Imagery is also beneficial in focussing an athlete's attention on the requirements for superior performance and aiding in the screening of possible distractors (Janssen & Sheik, 1994). Vealey and Greenleaf (1998) have used the term "mental set" as a basic framework to explain the theory.

Empirical data to support the theory has been generated indirectly by examining the function of general arousal in mediating imagery effects, rather than as the result of the direct examination of the theory (Budney, Murphy & Woolfolk, 1994). Lee (1990) found that participants using task-relevant imagery (positive images of actual physical performance) produced significantly better scores on a sit up task than participants using imagery associated with the recall of task irrelevant positive moods. Lee concluded that the imagery effects on performance were not the result of arousal optimisation as indicated by positive mood state. Feltz and Riessinger (1990) concluded that "in vivo emotive imagery" was more effective than performance feedback in enhancing both self-efficacy and performance of a muscular endurance task. Although the theory has a certain intuitive appeal (Feltz & Landers, 1983), the major weaknesses of this theory are that it fails to explain how imagery optimises arousal and attention, and that it is yet to be validated through suitable research (Hecker & Kaczor, 1988; Vealey & Greenleaf, 1998).

Perry and Morris (1995) concluded that the role of the attention-arousal set theory in explaining the imagery process is unclear. Consequently, the contribution of the theory in establishing a framework for the construction of a self-report imagery ability measure would appear to be minimal. Imagery scripts written with the purpose of arousing a participant and encouraging them to attend to the specific requirements of their sporting involvement should still remain an important consideration in the development of a measure of sport imagery ability.

Bioinformational Theory

The bioinformational theory developed from Lang's (1977, 1979a) research examining imagery and the associated psychophysiology of phobias and anxiety disorders. Lang argued that an information-processing model could explain the operation of mental imagery. The model specified that images are sets of functionally-organised propositions stored within the long-term memory. The modification of propositions may generate changes in overt behaviour. The model considered two types of propositions: (a) stimulus propositions that describe specific characteristics of the imagery scene, and (b) response propositions that describe typical behavioural outcomes, that include cognitive, physiological, and emotional responses to the imagined situation. Lang proposed that any changes to learning, behaviour, or performance result from the linking of the two proposition types. Imagery represents a process that facilitates the strengthening of these links (Lang, 1979a).

Research evidence exists supporting the bioinformational theory (e.g., Hale, 1982; Hecker & Kaczor, 1988). Typical methodologies involved the demonstration of variations on a range of physiological responses dependent on the modification of imagery variables such as scene familiarity (Hecker & Kaczor, 1988), response orientation versus stimulus orientation (Lang, Kozak, Miller, Levin, & McLean, 1980), and imagery perspective (Hale, 1982).

A number of studies have attempted to demonstrate performance enhancement outcomes from research applications of the bioinformational theory. Ziegler (1987) could not find any significant difference in basketball free throw shooting between groups using active imagery (stimulus and response propositions) and passive (stimulus propositions). Kremer and Pressing (1998) found greater improvement in pistol shooting performance for the group using stimulus only propositions when compared to a group using stimulus and response propositions. This suggests an equivocal status for the influence of proposition type on performance. Although additional research to further test this theory is required, Hecker and Kaczor (1988) concluded "the strength of Lang's theory lies in its heuristic value since it provides a conceptual model that can guide research into imagery rehearsal" (p. 367).

In terms of imagery ability self-report assessment, review of the bioinformational theory highlights several key issues that warrant consideration within the development of any new measure. Firstly, the image scripts prepared should endeavour to include both stimulus and response style propositions (Hale, 1986; Hardy et al., 1996). This practice represents a positive attempt to construct a measure that provides the imager with an adequate content base from which to generate as complete an image as possible. Secondly, it is important that the scripts contain propositions representative of the sensorial and emotional variables the measure examines (e.g., fatigue, excitement). The thorough preparation of stimulus material may facilitate the generation of response evidence related to both the qualities of image processing, such as vividness and ease of generation, and the modal characteristics of the psychophysiological efferent outflow, such as visual and kinaesthetic sensations.

Triple Code Theory

The triple code model of imagery, as proposed by Ahsen (1984), shares an emphasis on the psychophysiological processes of imagery with Lang's (1977, 1979) bioinformational theory. Ahsen (1984) further developed the information-processing model by defining three essential components warranting consideration within the analysis of the imaginal process. The first part of the triple code model, also referred to as ISM, is the image itself (I), the second part is the somatic response (S) that represents the psychophysiological stimulation the image may generate, and, thirdly, the meaning (M) or significance of the image to the individual must be evaluated. Additionally, Ahsen (1997) recognised the importance of multi-sensory imagery. He noted that "performance, especially in sports, is never sensory-specific in an absolute way, as it involves other senses, such as muscles and other visceral feelings" (p. 13).

Murphy and Jowdy (1992) examined the nature of the triple code theory with respect to sporting performance and concluded that the "model recognizes the powerful reality of imagery for the individual and also reminds sports psychologists to pay attention to the meaning of the images they employ and their clients report" (p. 240). In addition, Murphy and Jowdy outlined three important aspects of Ahsen's (1984) model to which researchers should attend. These are the description of the imagery script and examination of the resultant imaginal experience; the measurement of various physiological systems in response to imagery; and the evaluation of the meaning the image has for the individual.

The triple code model has had limited empirical or applied evaluation in relation to sport imagery apart from Murphy's (1990) citation of his own clinical and academic work. Murphy was, however, adamant that the ISM represents a minimum theoretical standard researchers should adopt in relation to future imagery investigations in sport psychology. In considering the key elements of the ISM in association with the procedural suggestions outlined earlier by Murphy and Jowdy (1992), several issues of relevance to the development of a self-report imagery ability assessment instrument become apparent. Firstly, test developers should attempt to ensure that script content extends beyond the bio-informational theory and incorporates the image meaning element proposed within the ISM model. Secondly, any new measure requires appropriate script detail capable of stimulating a broad range of dimensional, sensory (quasi-physiological), and emotional imagery characteristics representative of the three components detailed in the ISM model (Murphy & Jowdy, 1992).

Psychological State Hypothesis

Several authors have put forward theories, models, or explanations that examine the effect of imagery on a range of associated psychological states (Budney et al., 1994; Gould & Damarjian, 1996; Grouios, 1992; Jannsen & Sheik, 1994; Perry & Morris, 1995; Weinberg & Gould, 1995). Gould and Damarjian (1996) outlined the general nature of this relationship and stated that: "imagery is also thought to influence athletic performance through its effect on other psychological states, such as self-efficacy or confidence and anxiety" (p. 34). Examples of the specific investigations of imagery in relation to particular psychological states include (a) improvement in motivation through the imagination of superior performance (Perry & Morris, 1995); (b) the acknowledgement of self-efficacy theory (Bandura, 1977) as a contributing factor in increased confidence, achieved via the use of imagery to vicariously model observed behaviour (Perry & Morris, 1995); and (c) the use of imagery-based programs to control and reduce anxiety as a component of performance enhancement (Gould & Udry, 1994).

The lack of conceptual specificity of the psychological state hypothesis limits its contribution toward the determination of those imagery ability components that could be incorporated within any measure. An understanding of the relationship between imagery abilities and other psychological states may still provide directions for future research and insight into the multi-dimensional nature of the cognitive activities occurring in the mind of the athlete. This would still require the development of an imagery measure that provides detailed knowledge of the specific characteristics that determine an individual's imagery ability.

Applied Model of Imagery Use in Sport

Although the Applied Model of Imagery Use in Sport (AMIUS, Martin et al., 1999) does not specifically detail the characteristics typically associated with imagery ability, the model does represent a useful overview of the operation of imagery in relation to athletic performance. Of importance to the current review is the incorporation of imagery ability as a key component within the framework of the AMIUS.

An important element in the AMIUS is Paivio's (1985) functional analysis of imagery in relation to behaviour mediation. Paivio suggested a 2 X 2 imagery model in which the dimension of cognitive and motivational processing contrasts the dimension of the achievement of general and specific behavioural goals. The dimensions are distinguishable based on image content. As an outcome of their extensive involvement in the field of sport and movement imagery, Hall and colleagues, have provided sport-oriented descriptions of these dimensional classifications (Hall, 1998, 2001; Hall, Mack, Paivio, & Hassenblaus, 1998; Martin et al., 1999). Martin et al. (1999) summarised the classes of imagery as: (a) cognitive general (CG) – imagery related to competitive strategies, (b) cognitive specific (CS) – imagery directed toward skill development or production; (c) motivational general arousal (MG-A) – imagery related to arousal, relaxation, and competitive anxiety; (d) motivational general mastery (MG-M) – imagery representative of effective coping and confidence in challenging situations; and motivational specific (MS) – imagery that represents specific goals and goal oriented behaviour.

Martin et al. (1999) stated that the basis for the model centred on the "type of imagery used by the athlete (i.e., the function or purpose that imagery is serving) as a determinant of cognitive, affective and behavioural outcomes" (p. 249). Consequently, the model comprises four components representative of this description. These include the type of imagery used (e.g., MG-A, CS), outcomes of imagery use (e.g., modifying cognitions, strategy rehearsal), the sport situation (e.g., training, competition), and imagery ability. Obviously, the fact that a conceptual analysis of imagery in relation to sport includes imagery ability as a significant mediating variable is valuable in the substantiation of a rationale for the development of a new measure. The model is yet to be examined empirically. However, evidence gathered from extensive research involving two imagery use measures, the Imagery Use Questionnaire (Hall, Rodgers, & Barr, 1990) and the Sport Imagery Questionnaire (Hall et al., 1998), has served as a useful foundation for the model's development. Later sections of this thesis include examinations of the specific details of these studies that relate to the assessment of imagery abilities.

Although the developers of the AMIUS have had access to existing imagery ability measures (e.g., MIQ, VMIQ), Martin et al. (1998) acknowledged the weaknesses of existing instruments as indicators of imagery capacities in relation to sport. They supported the broadening of the spectrum of modalities and dimensions assessed within imagery ability inventories. More directly, in relation to the AMIUS, Martin et al. provided guidance for a possible conceptual base for new measures and stated that "we encourage the development and validation of additional tests that measure the ability to image other types of sport-related experiences such as goal achievement (MS imagery) and game strategies (CG imagery)" (p. 257).

Each of the theoretical perspectives that have been examined here contribute varying degrees of pertinent information toward the development of a framework for the assessment of imagery ability. The psychoneuromuscular, symbolic learning, and attention-arousal set theories represent insights detailing specific facets of the imaginal experience rather than complete explanations constituting a conceptual base for the analysis of imagery abilities. These theories were also developed to explain motor imagery rather than sport imagery, so additional characteristics require consideration in the assessment of the latter construct. The bioinformational and triple code theories are more holistic in their description of the processes of imagery, and therefore provide greater scope for the development of a measure that adheres to a distinct theoretical perspective. Unfortunately, they were developed within general psychology rather than sport psychology, so their adaptation to evaluate sport-oriented imagery abilities, will necessitate a degree of conceptual reconfiguration to ascertain their value as explanations of the phenomenon. Finally, The AMIUS constitutes a conceptualisation of imagery use rather than the mechanisms associated with image generation. It does, however, represent a sport-oriented model that acknowledges the influence of an ability factor within the imagery behaviours of athletes, and provides practical guidance in relation to both stimulus content and the selection of ability characteristics warranting evaluation.

Several reviews of imagery theory in the sport domain detail a similar conclusion (e.g., Hall, 2001; Morris, 1997; Suinn, 1997). These authors suggested that an integrated interpretation of the current conceptualisations may lead to the clearest understanding of the operation of imagery. As an outcome of this review of theories and models it would appear that two important issues in the ongoing assessment of imagery ability are apparent. Firstly, new measures require the development and inclusion of high quality imagery scripts that are realistic, meaningful, and invoke the use of all the senses. Secondly, future instrument development practices should necessitate the examination of a broad range of imagery dimensions, modalities, and affective characteristics within any new assessment device.

Measurement of Imagery Ability

The measurement of imagery ability presents similar assessment problems to those experienced in the assessment of many other mental processes in psychology, primarily because of the difficulty of direct observation of the cognitive activity (Perry & Morris, 1995). Although it is possible to examine the variations in the performance of tasks influenced by imagery, assessments of this type are not equitable with the actual measurement of imagery abilities. Anderson (1981a) acknowledged an additional concern is that due to the broad range of conscious activity represented within the imagery definition, the possibility of finding an all-purpose assessment procedure is limited. It is due to these types of inherent difficulties that the measurement of imagery ability has suffered from a lack of appropriate and rigorous examination within both general and sport psychology (Perry & Morris, 1995). Previous research has adopted a variety of conceptual and methodological approaches, but only a limited number of studies have taken the necessary steps to present sufficient evidence of a sound theoretical base and acceptable psychometrics (Moran, 1993). It is imperative therefore, that the development of any new measure of imagery ability be undertaken with a clear understanding of assessable qualities of imagery, measurement techniques, and the characteristics of existing measures.

Components of Imagery Ability

Imagery ability questionnaires typically examine self-reported quality of imagery. As such, they are not, in the strictest sense, tests of ability. Hall and Martin (1997) and Hall (1998) supported the use of the term ability in the assessment context (as distinct from skill), on the basis that all individuals seem to have the capacity to generate and use images, "but not to the same degree" (Hall, 1998, p. 165). Research and applied work on imagery training indicates that imagery abilities can be improved, which is a characteristic of skills, not abilities. It has become conventional, however, to refer to the self-reported assessment of the qualities of imagery as 'imagery ability' (e.g., Ahsen, 1997; Hall, 1998; Hall & Martin, 1997), so I will use this term throughout this section of the present review. Morris (1997) defined imagery ability as "an individual's capability of forming vivid, controllable images and retaining them for sufficient time to effect the desired imagery rehearsal" (p. 37). Substantial support exists for the conceptual attention directed toward the three specific characteristics of imagery ability outlined in Morris's description. The consensus conclusion drawn by many researchers was that the construct represents more than a single measurable factor (Ernest, 1977; Hall et al., 1985; Munzert & Hackfort, 1999; Richardson, 1994; Richardson, J., 1988; Slee, 1988; Sheehan, Ashton, & White, 1983).

Throughout the imagery literature many terms are used to describe the characteristics that measures of imagery ability are assessing, such as traits, qualities, dimensions, aspects, components, competences, properties, parameters, and modalities (Ahsen, 1993; Anderson, 1981a; Denis, 1985; Hall, 1998; Perry & Morris, 1995; Munzert & Hackfort, 1999; Richardson, 1994; Tower, 1981). Many of the studies and reviews examining this area consistently discuss an assessment framework in which imagery ability is comprised of specific dimensional and sensory modality components.

The two dimensions most regularly discussed are those of vividness and controllability (Denis, 1985; Gould & Damarjian, 1996; Moran, 1993; Morris & Hampson, 1983; Murphy & Jowdy, 1992; Perry & Morris, 1995; Richardson, 1977, 1994; Sheehan et al., 1983; Tower, 1981; White et al., 1977). Moran (1993) described the first of these dimensions, vividness of an image, as "its clarity and 'sharpness' or sensory richness" (p. 158). Alternatively, Denis (1985) suggested that vividness "reflects the rate of activity of the mental processes underlying the experience of imagery" (p. 8S). Murphy and Jowdy (1992) referred to the self-report aspect of the dimension and how this reflects the reality of the image to the individual. Richardson (1994), in his elaborate analysis of vividness, outlined two important points. Firstly, the dimension does not measure accuracy of recall of an image, and secondly, he suggested that it represents the percept-like content (cognitive cues) and feelings (affective cues) generated within an image. Although such a broad variation in the descriptions of vividness implies that it is yet to be defined in a manner fully accepted within psychology, the feature of the dimension most consistently mentioned is that it assesses the reality of the imaginal experience, or as McLean and Richardson (1994) succinctly described it, the "life-likeness" of an image.

The term controllability describes the "ease and accuracy with which an image can be transformed or manipulated in one's mind" (Moran, 1993, p. 158). Denis (1985) referred to controllability from a cognitive processing perspective and stated that imagery is "under the control of processes which regulate their (images) current rate of activation and the possibility of their transformations" (p. 8S). Elaborating further, Denis suggested that control reflects the processing involved in refreshing an image and its maintenance over a certain period. Murphy (1994) also emphasised that control is representative of an individual's ability to influence image content.

Additional dimensions referred to in the literature include preference (Richardson, 1994), exactness of reference, duration (Denis, 1985), ease of generation (Hall et al., 1985; Tower, 1981), ability to change (Munzert & Hackfort, 1999), unvividness (Ahsen, 1985) and orientation or perspective (McLean & Richardson, 1994). Several of these are relevant to an understanding of the nature of imagery ability in the context of the physical and sport domains. Denis (1985) suggested that exactness of reference is important because:

> it is necessary that the figural content of the image accurately depicts what it is supposed to refer to, for instance, the dimensions of the objects, the distance from the subject to the objects, the direction of the movement, its magnitude, etc. (p. 9S)

Duration is represented by the amount of time an image is clearly maintained in the mind from its initial generation until it disappears or is substantially modified (Denis, 1985). The dimension of ease of generation represents the level of ease or difficulty in evocation of an image (Hall et al., 1985, Tower, 1981). The speed of formation of an image is a dimension that warrants investigation in determining the status of imagery skills. Currently, no research or analytic discussion of the imagery process proposes the assessment of this attribute. I contend, however, based on a perceived high level of logical validity, that speed of image generation represents a qualitative dimension that may provide valuable evidence of imagery ability. Several researchers have reported that examining the imagery perspective is important in understanding imagery ability (Hale, 1994; Mumford & Hall, 1985; Richardson & McLean, 1994). Unvividness or weak imagery was described by Ahsen (1985) as "not a sign of absence of imagery; rather, it is one of imagery's independent functional attributes" (p. 1). Ahsen claimed that the perceptual quality of all images is always imperfect to some degree, and that significant information is represented within the analysis of both complete and incomplete imagery detail. Perspective can be external (third person), as if watching oneself on video, or internal (first person), which involves experiencing the image as if in one's own body (Mahoney & Avener, 1977). As with vividness and control, some of these dimensions are already assessed in existing imagery ability measures, and several of those that are not, should be included in future tests if they provide information useful to the understanding of imagery.

Many authors have highlighted the need to involve all the senses when using imagery rather than just using the visual modality (Bird & Cripe, 1986; Janssen & Sheikh, 1994; Vealey & Greenleaf, 1998; Weinberg & Gould, 1995). Ahsen (1995) has closely examined the interaction of visuality among the other senses and stated that "imagery ability (like intelligence) is itself comprised of components and their functions; and to make it more difficult, other senses comingle with the visual cue" (p. 114). The assessment of imagery ability should, therefore, incorporate a range of sensory modalities, which may include visual, auditory, kinaesthetic, olfactory, tactile, and gustatory senses (Ahsen, 1995; Munzert & Hackfort, 1999; Perry & Morris, 1995; Richardson, 1994; Sheehan et al., 1983; White et al., 1977).

The two modalities to receive the most attention when examining imagery ability and motor performance have been the visual and kinaesthetic (McLean & Richardson, 1994). This may be due to the fact that the design of several of the existing imagery ability measures incorporates the assessment of only the visual and kinaesthetic modalities, or modifications that isolate these senses (Hall et al., 1985; Isaac, Marks, & Russell, 1986). Such a trend was indicative of the emphasis that researchers placed on the visual and kinaesthetic senses as the key characteristics of imagery in the motor domain. More recent discussions support the necessity to use multi-modal imagery (Gould & Damarjian, 1996; Vealey & Greenleaf, 1998) in the sporting context. This proposal should be reflected in the development of multi-modal measures of imagery ability.

Another individual characteristic that could be included as a component of imagery ability is the experience of emotion (Suinn, 1993). Affective states such as emotion are typically aligned with the senses aligned with the senses as an imaginal sub-component, rather than the dimensions (Vealey & Greenleaf, 1998; Weinberg & Gould, 1995). Vealey and Greenleaf (1998) suggested that in re-creating outstanding performance "athletes should feel the emotions associated with those experiences such as elation, satisfaction, pride, and self-esteem" (p. 239). Based on the emphasis that several authors have placed on the involvement of emotions within sport imagery, it is appropriate to include this characteristic as a variable within any future measure of imagery ability (e.g., Murphy & Jowdy, 1992; Perry & Morris, 1995; Suinn, 1993; Weinberg & Gould, 1999).

Ideally, the assessment of imagery ability requires a measure that examines the salient components used in producing images. Such a measure should include the dimensions of vividness, controllability, duration, ease, and speed of generation. Although evidence supporting the existence and independence of several of these dimensions is limited, the multi-dimensionality of the imagery phenomenon constitutes a well accepted proposition (e.g., Perry & Morris, 1995; Richardson, 1994). Therefore, an investigation that targets the full range of components representative of image generation could enhance the understanding of the relationship between, and uniqueness of, dimensional descriptors. Additionally, the accepted phenomenological viewpoint (e.g., Perry & Morris, 1995; Richardson, 1994; Suinn, 1993) supports the examination of specific sensory modalities such as vision, audition, touch, kinaethesis, olfaction, and gustation, and the emotional concomitants of imagery. Consequently, this necessitates a multi-modal approach to assessment to ensure the accurate representation of the sensory characteristics of sport imagery.

Classification of Imagery Ability Measures

Imagery ability is a characteristic typically assessed from performance on a specific set of mental ability tasks, or from answers to questionnaires that require behavioural or emotive imagery responses (Sheehan et al., 1983). None of the available measures of imagery ability have achieved wide acceptance as an instrument demonstrating content depth and cohesion, and psychometric adequacy. Anderson (1981a) suggested confusion in relation to the description of the constituents of imagery functioning. The complexity of the phenomenon has "spawned a number of procedures for assessing different dimension of imaginal processes" (p. 149). Several researchers proposed that, because of the varied nature of imagery skills, it is important to match the measure to the task under examination (Anderson, 1981a.; Katz, 1983; Paivio, 1985; Tower, 1981). Tower (1981) presented a summary of imagery measures used in general psychology that included the following categories (a) self-report (questionnaire, interview, phenomenological), (b) projective, (c) behavioural, and (d) physiological. The foundations underlying these assessment approaches emanate from the test designers' "implicit or explicit assumptions about the nature and relevant dimensions of the processes and phenomenal products involved" (Anderson, 1981a, p.149). The two types of imagery measure used most regularly in sport psychology are classified as either objective or subjective in nature (Hall, 1998; Hall et al., 1985; Moran, 1993). An additional category of imagery assessment described by Sheehan et al. (1983) is termed the experienced-based measurement of imagery. This represents the qualitative procedures that have been employed for examining imagery functioning.

Objective measures normally infer imagery ability from behavioural analysis of subjects' perceptual, cognitive, and spatial manipulation skills on specific tasks related to spatial visualisation abilities (Vandenberg & Kuse, 1978). Within the tests, individuals are required to mentally perform spatial manipulations of stimulus objects. Finally, they are required to select the object in its correct orientation from a given set of alternatives (Hall et al., 1985). Researchers have generally assumed that objective measures are attempting to examine the control dimension of imagery ability (Moran, 1993; Richardson, 1977). Morris and Hampson (1983) considered that it is still not clear what imagery abilities objective measures assess. Several authors have suggested that these tests could be representative of more general cognitive skills, such as memory, problem solving, or associative learning that do not require the use of imagery (Hall et al., 1985; Moran, 1993; Morris & Hampson, 1983). Objective measures of imagery ability typically assess imagery of the visual modality with no test of spatial abilities designed to examine the non-visual senses (Heil, 1984; Morris & Hampson, 1983).

Much more common in imagery ability testing, particularly in the motor domain, are questionnaires or self-report inventories. These tests are based on the assumption that the individual's subjective experience of the image: "is of primary importance rather than the match to any objective criterion and that this experience is at a conscious level" (Tower, 1981, p. 87). Respondents are usually required to report on specific characteristics, such as clarity of a descriptive image, for individual items that examine relatively common experiences such as 'hearing an ambulance siren'. Another presentation method involves individuals having to generate an image described within the test item and respond to a set of items relating specifically to the outlined image. For example, there might be four items relating to a country scene that involves the imagery of trees, a mountain, and a lake. There may be one or more image scenarios presented within the format of this kind of test. Response techniques have included 5-point or 7-point Likert type scales, 'yes/ no' or 'true/false' response scales, semantic differential scales, or the selection of one response from a set of alternatives provided. Specific dimensions of imagery previously examined include vividness, controllability, perspective (internal versus external), presence, and ease (Moran, 1993; Perry & Morris, 1995; Tower, 1981; Vealey & Walter, 1993). Although some subjective tests have considered only one sense modality, usually the visual, several have examined both the visual and kinaesthetic sensory modalities, with a small number of tests attempting to assess up to seven modalities (Hall et al., 1985; Sheehan, 1967a; Switras, 1978).

Previous reviews of imagery ability assessment detail several criticisms of subjective measures (Anderson, 1981a; Katz, 1983; Moran, 1993; Richardson, 1994). Morris and Hampson (1983) pointed out that there is no absolute standard in differentiating between individuals' responses to imagery items, such as rating the vividness of an image. It is difficult to know just how different a rating of perfectly clear and vivid is from a rating of moderately clear and vivid. Secondly, it has not been determined whether imagery questionnaires are greatly affected by unwanted error variance created by the faking of responses or the influence of a social desirability factor (Richardson, 1994).

The final method of imagery assessment reviewed concerns the examination of aspects of participants' consciousness that are a direct reflection of their experiences (Sheehan et al., 1983). Ericsson and Simon (1993) described two forms of verbal reports that appropriately reflect characteristics of cognitive processes such as imagery. Firstly, concurrent verbalisation (CV) is a procedure involving "talk aloud" or "think aloud" reports where the participants verbalise directly information currently entering attention. The second type, retrospective verbalisation (RV), is a report provided by the participant after a temporal separation from the initial occurrence of the cognitive process. Anderson (1981a) noted that all verbal reports are retrospective to some degree as participants are describing what they were cognitively processing prior to the verbalisation.

Anderson (1981a, 1981b) presented detailed reviews of a qualitative procedure of imagery assessment involving the content analysis of verbal reports that describe imaginal activities. An analysis system detailed by Anderson was developed in consideration of two theoretical perspectives of imagery processing: firstly, the propositional interpretation of imaginal processing that represents key elements of the theories proposed by Pylyshyn (1973) and Lang (1977) and secondly, Neisser's (1976) conceptualisation of imagery as it relates to the nature of cognition and perception.

The propositional interpretation of imagery focuses on the manner in which knowledge is stored and represented (Anderson, 1981a). Information is thought to be stored in an imaginal quasi-sensory or verbal form, or in a common format, that has a propositional structure. Propositions representing imagery experiences constitute descriptive units that include information associated with meanings, relations, properties, and concepts (Anderson, 1981a). In terms of imagery assessment, Anderson (1981b) proposed, "images of different quality would be associated with propositional networks that differ in the amount of descriptive detail of information they contain" (p. 94). An index of image quality, where quality indicates the similarity between an image and its actual counterpart, can be derived from the analysis the amount of detail individuals' report within their imaginal experiences (Anderson, 1981 a).

Neisser's (1976) view of imagery emanates from the proposal that cognitive feedback factors associated with perception comprise schemata that operate to anticipate a general form of the stimulus to be perceived. Imagery in this model constitutes the activation of this schema in the absence of an actual perception of the schemata (Anderson, 1981b). Neisser (1976) postulated that the imagery experience was "just the inner aspect of a readiness to perceive the imagined object, and differences in the nature and quality of people's images reflect differences in the kind of information they are prepared to pick up" (p. 131). The basis for an imagery assessment approach implied through Neisser's model is that an individual's imaginal constructions may be qualitatively differentiated relative to the kind of information reported within them (Anderson, 1981a, 1981b).

Anderson's (1981a, 1981b) interpretation of these two imagery conceptualisations provided key elements for an underlying framework for the analysis of image descriptions. More specifically, Anderson stated, "the amount and kind of information that is processed may be important dimensions of imaginal activity. One way of assessing these dimensions is by indexing the amount and kind of descriptive detail contained in narrative reports of imaginal activity" (1981a, p. 164).

Sheehan et al. (1983) have suggested that measures of this type that tap the real experiences of the individual "may be more valid for measuring those aspects of cognition that characterize current everyday thinking" (1983, p. 195). Sheehan et al. outlined several advantages of these procedures, the first being that narrative or verbalisation methods are sensitive in the manner in which they address the idiosyncratic aspects of participants' experience and fully involve them in the measurement process. Secondly, the methodology attempts to examine recent memories, which, as Sheehan et al. point out, is in contrast with questionnaire measures "where items are relevant to memory of events that rarely have taken place in the immediate past" (p.195). The disadvantages of verbalisation procedures centre on the assumptions made concerning the participants. Firstly, participants are thought to be articulate about the experiences they are asked to describe and, secondly, participants may require assistance to retrieve the generated images, which may in some circumstances bias the participants' responses (Sheehan et al., 1983). Although this type of procedure has been infrequently discussed in the sport psychology literature, the methodologies described by Anderson (1981a), Ericsson and Simon (1993), and Sheehan et al. could provide interesting and useful adjuncts to self-report measures in examining mental imagery in the motor domain.

In determining which type of measure is most suitable for the assessment of imagery ability, two important points warrant acknowledgement. Firstly, Katz (1983) has shown support for the use of subjective assessment because of his belief that subjective measures are more directly associated with the construct of imagery than objective tests. Secondly, self-report material is considered to be a more appropriate representation of the experience or phenomenon of imagery. Katz (1983) also suggested that the response detail from self-report measures provides a clearer indication of ability than objective measures. Pylyshyn (1979) argued that spatial manipulations may be completed using skills not associated with imagery functioning. Preference of assessment methodology in the motor domain has certainly been for the use of subjective tests (Hall, 1998). Consequently, a development focus in the preparation of new measures of sport imagery ability should be the incorporation of a subjective self-report design.

Tests of Imagery Ability Used in Sport Psychology

Interest in the area of imagery abilities has prompted the development of a variety of assessment devices. Researchers have directed substantial effort toward the conceptualisation, design, and psychometric evaluation of an interesting collection of measurement approaches. Reviews of the existing imagery tests, presented in both the general and sport psychology literature, serve as a valuable base for the examination of measures used previously in sport psychology (Anderson, 1981a; Hall, 1998; Moran, 1993; Ostrow, 1996; Perry & Morris, 1995; Richardson, 1994; White et al., 1977). The format, assessed imagery characteristics, and examples of the basic psychometric properties of these instruments are summarised in Table 2.1A and 2.1B and discussed in greater detail in the following section.

Table 2.1A

Review of Existing Imagery Measures. Part A.

Scale	Modalities	Dimensions	Question Style	No. Items & Format
Questionnaire upon Mental Imagery (QMI) Betts (1909)	Visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, organic	Vividness	Generate common image per item	150-Likert
Shortened Questionnaire upon Mental Imagery (SQMI) Sheehan (1967)	Visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, organic	Vividness	Generate common image per item	35- Likert
Survey of Mental Imagery (SMI) Switras (1978)	Visual, auditory, olfactory, gustatory, tactile, somathetic, and kinaesthetic	Vividness and controllability		86
Vividness of Visual Imagery Questionnaire (VVIQ) Marks (1973)	Visual	Vividness	Generate images about four set scenes	16- Likert
Vividness of Movement Imagery Questionnaire (VMIQ) Isaac, Marks & Russell (1986)	Visual and kinaesthetic	Vividness	Generate basic movement image per item	24-Likert
Vividness of Movement Imagery Questionnaire-II (VMIQ-II) Isaac (1995)	Visual and kinaesthetic	Vividness	Generate basic movement image per item	18-Likert and 2-tick the box

Scale	Modalities	Dimensions	Question Style	No. Items & Format
Movement Imagery Questionnaire (MIQ) Hall & Pongrac (1983)	Visual and kinaesthetic	Vividness and ease of imagining	Generate a movement image after rehearsal	18-Likert
Movement Imagery Questionnaire-Revised (MIQ-R) Hall & Martin (1997)	Visual and kinaesthetic	Vividness and ease of imagining	Generate a movement image after rehearsal	8-Likert
Gordon Test Of Visual Imagery Control (GTVIC) Gordon (1949); Richardson (1969)	Visual	Controllability	Generate and manipulate set images	12-Yes, no, or unsure
Individual Differences Questionnaire (IDQ) Paivio, 1971	Visual	Vividness and preference	Respond to items relating to use of imagery	86-True or False
Group Mental Rotations Test (GMRT) Vandenberg & Kuse (1978)	Visual	Controllability	Manipulation of a criterion figure	20-Choice of pictorial alternatives
Sport Imagery Questionnaire(SIQ) Vealey & Walter (1993)	Visual, auditory, kinaesthetic, and emotional	Vividness, controllability, and perspective	Generate images to four sport scenes	20- Likert and 4 yes or no

The Betts (1909) Questionnaire Upon Mental Imagery (QMI) is a scale of 150 items that investigates imagery in seven major sensory modalities: Visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic. Forty items pertain to the visual modality and 20 items to each of the other senses, except the organic modality, which has 10 items. Individuals attempt to generate images suggested by the items and rate the vividness of their imagery on the Betts 7-point rating scale, which ranges from 7 (*no image present at all*) to 1 (*perfectly clear and vivid*). Betts did not provide a rationale for the distribution of items across modalities, and no reliability information appears to be available. In reviewing this measure, Moran (1993) stated that it is, "the prototypical test of imagery vividness. Most of the other scales in this field adopt its Likert-style rating format (and sometimes borrow its items)" (p.161).

Sheehan (1967a) developed a shortened form of the Questionnaire on Mental Imagery (SQMI). The revised test derived 35 items (five items per modality) from the original measure and a correlation with the long version was reported as, $r = .9$ (Sheehan, 1967a). Reliability has been consistently established, with typical findings reported, such as an internal consistency of $r = .95$ (Juhass, 1972) and test-retest reliability of, $r = .78$, over a seven month interval (Sheehan, 1967b). Several researchers have implied the existence of evidence supporting the test's convergent validity, because the SQMI correlates moderately with other measures of imagery ability (Kihlstrom, Glisky, Peterson, Harvey, & Rose, 1991), including the Vividness of Visual Imagery Questionnaire ($r = .43$, Lorenz & Neisser, 1985) and the Gordon Imagery Control Scale ($r = .56$, Lorenz & Neisser, 1985). Sheehan (1967a) reported the determination of a homogenous factor structure (imagery vividness). The SQMI has proven to be both reliable and popular within imagery research yet remains restricted by its evaluation of only the dimension of vividness.

Table 2.1B

Review of Existing Imagery Measures. Part B.

Scale	Reliability	Validity	Usage	Comments
QMI	Subscale correlations from 0.4 to 0.78	Expected single general factor	General Psychology before SQMI developed	Protypical test of imagery vividness
SQMI	Internal consistency-0.95; Test-retest-0.78	Homogenous factorial structure	General and sport psychology-extensive	Restricted by assessment of only vividness dimension
SMI	Internal consistency-0.68 - 0.95 Parallel form-0.91	Factor analysis-Seven factor structure	General and sport psychology-minimal	Good basic design but very minimal research usage
VVIQ	Internal consistency-0.83 - 0.95 Test-retest- 0.62 to 0.87	Construct, predictive, and convergent. Single dimension factor structure	General and sport psychology-extensive	Widely used limited but single dimension and modality format
VMIQ	Internal consistency-0.96 Test-retest-0.76	Convergent	Sport psychology-continued	More appropriate for sport area but limited rationale for design
VMIQ-II	None reported	None reported	Sport psychology-continued	Development of original with emphasis on the kinaesthetic modality
MIQ	Internal consistency-0.87 Test-retest-0.83	Predictive. Two dimension factor structure.	Sport psychology-continued	More related to motor learning than sport imagery

Scale	Reliability	Validity	Usage	Comments
MIQ-R	None reported	Convergent as represented by $r = .7$ (MIQ)	Sport psychology-continued	Simplified version of the original related to motor skills
IDQ	Internal consistency-.80 imagery and .83 verbal	Factor structure supports subscales	General psychology - limited	Compares modes of cognitive processing in one measure
GTVIC	Split-half-0.76 and Test-retest-0.84	Convergent as represented by $r = .42$ (QMI) and $r = .67$ (VVIQ)	General and sport psychology-extensive	Widely used but restricted by assessing control in one modality
GMRT	Test-retest-0.7 to 0.83; Kuder-Richardson-0.88	Convergent as represented by positive correlation with DAT-Spatial	General and sport psychology-minimal	More a test of spatial visualisation than imagery
SIQ	None reported	None reported	Sport psychology-research minimal, widely used in practice	Basic design of test is very good but no work has been undertaken psychometrically

The most current version of the SQMI is the randomised short Betts QMI developed by White, Ashton, and Law (1978). Modifications to the previous SQMI centred upon two important areas. Firstly, items previously presented in a grouped modality format of five items were individualised and presented independently. Secondly, White et al. (1978) randomised the format of individual items in an effort to reduce any response set bias generated from the grouping of similar modality items. Only limited evidence of the reliability of this adaptation of the SQMI is currently available (Ashton & White, 1980;

White et al., 1978). Inferences of improved validity resulted from the analysis of a comparison between the original and randomised SQMI to highlight any gender differences. Ashton and White (1980) found that the substantial sex differences reported for the earlier version were reduced for the randomised version. They suggested that this test represents a measure of imagery vividness less contaminated by response biases.

The Survey of Mental Imagery (SMI; Switras, 1978) is a paper-and-pencil self-report measure containing 86 items. The test examines the ability to produce mental images in seven sensory modalities (visual, auditory, olfactory, gustatory, tactile, somasthetic, and kinaesthetic), and assesses the dimensions of controllability, vividness, and presence (existence of images). The parallel form reliability provided correlations of, $r = .91$, for the controllability subtest and, $r = .92$, for the vividness subtest. Internal consistency has been represented by alpha coefficients for specific modality subscales ranging from, $r = .68$ to $r = .95$, across both forms. Switras has suggested that the measure has convergent and discriminant validity, based on the analysis of the correlations between dimensions and modalities assessed within the measure. The following relationship patterns were reported: (a) different sensory modality and controllability-vividness discrimination between the various subtests; (b) same sensory modality and same dimension convergence among the various subtests; and (c) correlation between control-vividness on the same test form was less than the correlations between the similar factors on the different test forms. Since its original development, very few studies have utilised the SMI (e.g., Hull & Render, 1984; Jopson, Henschen, & Schultz, 1989). This situation is difficult to explain as the test demonstrated both conceptual potential in its design, by analysing several major dimensions across all sense modalities, and an adequate reliability and validity. The large number of items, and resultant extended completion time, could be key factors in the limited employment of the measure.

The Vividness of Visual Imagery Questionnaire (VVIQ) is a 16-item self-report inventory developed by Marks (1973) as an extension of the visual sub-scale of Betts' questionnaire. Individuals are required to rate the vividness of their visual images generated on a scale from 1 (*perfectly clear and vivid as normal vision*) to 5 (*no image at all, you only 'know' you are thinking of the object*) on four different scenes, first with their eyes open and then with their eyes closed. The scenes examine the following topics: characteristics of a friend or relative, the weather, a local shop, and the country. Respondents can score 16 to 80 points; the lower the score, the better the self-rated imagery. Several studies of the internal consistency of the VVIQ were examined by McKelvie (1995), who reported a mean alpha coefficient of, $r = .89$. More recently, Eton, Gilner, and Munz (1998) reported internal consistencies of, $r = .91$, and, $r = .95$, for the two subscales. Test-retest reliability has also been reported as ranging from, $r = .62$ (Eton et al., 1998), to, $r = .86$ (Parrot & Strongman, 1985), both over two-week intervals. Evidence of criterion validity is typically generated through comparison of the VVIQ scores with a range of tasks, including self-reported imaging, cognitive-perceptual processing, and memory (McKelvie, 1995). After analysing available criterion data, McKelvie reported a validity coefficient of, $r = .27$, and concluded that generally the evidence supports the VVIQ as a valid measure. Factor analysis has yielded a unitary factor pattern (Dowling, 1973). Although widely used, reliance on the assessment of solely the vividness dimension in the visual modality to infer imagery ability restricts the applicability of the VVIQ within sport psychology. The on-going questions relating to the measure's stability over time and construct validity are also of concern (Chara & Hamm, 1989; Eton et al., 1998).

The Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986) contains 24 items that measure the visual imagery of movement and the imagery of kinaesthetic sensations associated with movement. Items examine participants' ability to image specified basic body movements and movements requiring precision and control in upright, unbalanced, and aerial situations. Participants are asked to rate the vividness of imagery for each item both with respect to watching someone else and as if watching themselves. Participants respond to each item on a 5-point ordinal scale, which ranges from 1 (*perfectly clear and as vivid as normal vision*) to 5 (*no image at all, you only 'know' that you are thinking of the skill*). The VMIQ has a basic format that makes it easy to administer to large groups. Eton et al. (1998) reported that alpha coefficients ranged from $r = .96$ ('other' subscale) to $r = .97$ (total scale). A test-retest coefficient of, $r = .76$, has been reported over a three-week period (Isaac et al., 1986) and of, $r = .62$, over a two-week period (Eton et al., 1998). High to moderate correlations with the VVIQ ($r = .60$, Eton et al., 1998; $r = .81$, Isaac et al., 1986) and Movement Imagery Questionnaire ($r = .58$, Hall & Martin, 1997) form the basis of minimal evidence of the measure's validity data. Several studies exist that examined the validity of the VMIQ based on individual differences in imagery abilities. Both the Eton et al. (1998) and Isaac and Marks (1994) studies determined that scores on the VMIQ can distinguish between athlete groups of varying participation levels and non-athletes. In contrast, Williams and Isaac (1991) found that the VMIQ could not differentiate between groups based on motor skill level. A later section of this literature review includes a more detailed analysis of this research. A recent revision, the VMIQ Mark II, has only 18 items, and the addition of a third rating score related to the kinaesthetic sensation or "feeling it yourself". Two *tick the box* items relating to the respondent's eye status (open or closed) during imagery and handedness (left, right, or both) are also included within the newer version of the measure. The emphasis on the direct reporting of kinaesthetic imagery in the revised version may have been the result of a reported unitary (visual) factor structure for the original measure (Campos & Perez, 1990).

The single dimensional component of this measure is directly related to its adaptation from the VVIQ. Although it is limited in the number of modalities assessed (visual and kinaesthetic), the VMIQ represents a more relevant approach for the assessment of movement imagery ability in the context of sport psychology, than multi-modal general imagery techniques (Eton et al., 1998; Isaac et al., 1986).

The Movement Imagery Questionnaire (MIQ; Hall et al., 1985) contains 18 items, nine for the visual subscale and nine for the kinaesthetic subscale. Individuals are initially asked to perform one of a variety of arm movements, leg movements, and movements involving the entire body as the first step in the completion of each item. Next, the respondent preforms the movement required for that item. The respondent then assumes the starting position of the movement and is asked to image the movement either visually or kinaesthetically (no movement is actually performed) and then rate how easy or difficult it is to use visual or kinaesthetic imagery to imagine the movement task. Individuals respond to each item using a 7-point rating scale, ranging from1 (*very easy to picture or feel*) to 7 (*very difficult to picture or feel*). Total score extends from 9 for the high imagery limit to 63 for the low imagery limit, for each subscale. Reliability has been reported as internal consistency coefficients of, $r = .87$ (visual), and, $r = .91$ (kinaesthetic), in addition to a test-retest reliability of .83 (one-week interval). A relatively high correlation of, $r = .58$, was found between the visual and kinaesthetic subscales, suggesting only a limited level of independence of the modalities. Hall et al. (1985) suggested that the correlation indicated "that visual and kinaesthetic imagery of movement are related, but separate measures" (p. 115). Exploratory factor analysis revealed a bifactorial structure (visual and kinaesthetic) (Atienza, Balaguer, & Garcia-Merita, 1994). Evidence in support of the measure's predictive validity was achieved through comparison of MIQ scores with participants' movement pattern learning ability (Goss, Hall, Buckolz, & Fishburne, 1986;

Hall, Buckolz, & Fishburne, 1989). The general design of the test is sound but administration is more difficult than a basic paper and pencil measure. Test items appear more suitable in assessing imagery ability related to motor learning rather than general sporting performance

More recently, Hall and Martin (1997) modified the MIQ and developed the MIQ-Revised (MIQ-R). The primary goal of the revision was to reduce the administration time and eliminate those items that some participants would refuse to physically perform (Hall, 1998). Modifications included the reduction of the number of items, from nine to four, for each subscale, the reversal of the rating values so that higher scores relate to higher imagery ability, and the rewording of certain items to improve clarity (e.g., "hard" and "see" replaced "difficult" and "picture"). As yet, the specific psychometric properties of the MIQ-R have not been fully determined. Moritz, Hall, Martin, and Vadocz (1996) reported a correlation between the visual and kinaesthetic subscales of, $r = .44$, a value that inicates improved modal uniqueness compared to that found for the subscales of the original version. Hall and Martin (1997) suggested that the MIQ-R is an adequate revision of the MIQ because of the significant correlation ($r = .77$) between corresponding visual and kinaesthetic subscales for each measure.

Following an investigation of the relationship between the VMIQ, MIQ, and MIQ-R, Hall and Martin (1997) outlined a framework for the most effective applied and research usage of these three measures of movement imagery ability. The VMIQ is best suited to large groups where space is limited and restricts the performance of physical movements. The MIQ-R is an instrument, administered easily to either individuals or small groups, which examines both the visual and kinaesthetic modalities. The MIQ is most appropriate for use with young fit individuals, and when there is no time restriction attached to testing. Hall (1998) also suggested that the use of a combination of these measures may "provide a more complete assessment of imagery abilities" (p. 167).

The Gordon Test of Visual Imagery Control (GTVIC; Gordon, 1949; Richardson, 1969) is a self-report test designed to assess, not how vivid the person's images are, but how well the person can manipulate and control them. The test originally involved oral instructions, which preceded 11 questions relating to a suggested image, for example, a car, with questions addressing colour and physical position. Participants answered either *yes* or *no*, depending upon their ability to manipulate evoked visual images. Richardson (1969) modified this format by adding a twelfth item and including a tripartite scoring scheme - *yes*, *no*, and *unsure*. Richardson also suggested the use of written rather than oral instructions. Reliability data has been reported as both an internal consistency estimates of $r = .77$ to $r = .84$ (Hiscock, 1978) and a split-half value of, $r = .76$ (McKelvie & Gingras, 1974). Stability over time has been represented by test-retest coefficients of $r = .84$, over a three-week interval (McKelvie & Gingras, 1974), and, $r = .60$ to .64, over a 12-month period (White & Ashton, 1976). The GTVIC has not proven to be unidimensional and is generally represented by three or four factors of imagery control in factor analytic studies (Ashton & White, 1974; Morrison & White, 1984; White & Ashton, 1977). The test has been widely used and is reliable, but is restricted in the assessment of general imagery ability by its original design, focusing on controllability.

The Individual Differences Questionnaire (IDQ; Paivio, 1971) is an 86-item true-false measure designed to assess visual imaginal and verbal thinking habits and skills. The instrument examines the manner in which participants report on their ways of thinking, studying, and problem solving. An example of an imagery item is, "I can easily picture moving objects in my mind." The measure was developed on the framework of the dual coding theory of imagery (Paivio, 1971) and, thus, includes not only visual imagery items but also items examining verbal habits and abilities, such as "I prefer to read instructions about how to do something, than have someone show me." The questionnaire results in separate scores for the imagery and verbal processes subscales. The wording of a number of items varies to include both positive and negative statements, in order to reduce the effect of agreement or acquiescence (Hiscock, 1978). Reliability information is limited to the presentation of internal consistency, with Hiscock (1978) reporting alpha coefficients of, $r = .80$, for the imagery scale and, $r = .83$, for the verbal scale. An examination of the factor structure suggests two possible models. Firstly, a two-factor solution that corresponds closely to the original scales and secondly, a six-factor solution that represents a more refined interpretation of the nature the test (Paivio & Harshman, 1983). The minimal research use of the questionnaire and limited data available regarding its psychometric properties make it difficult to accurately interpret its suitably as an imagery ability assessment device within the sport psychology context. The IDQ was included in this review on the basis of the divergent relationship of the two scales ($r = .09$, Hiscock, 1978). This finding highlights distinct differences in the nature of visual imagery and verbal processes. Similar patterns of relationships are examined within a later data analysis section of this thesis.

The Group Mental Rotations Test (GMRT; Vandenberg & Kuse, 1978) contains 20 items in five sets of four items. Each item consists of a criterion figure, two correct alternatives, and two incorrect ones. Correct alternatives are always identical to the criterion in structure, but shown in a rotated position. For half the items in the test, the distracters are rotated mirror-images of the criterion, while distractors in the other 10 items are rotated images of one or two of the other criteria. The reliability of the test has been reported as test-retest coefficients of, $r = .83$, and, $r = .7$, over periods of one-year and a Kuder-Richardson value of, $r = .88$. Convergent validity was supported through positive correlations with measures of spatial ability, and predictive validity is related to the significant correlation of the GMRT with performance in World Cup Canoe-Slalom Racing (Moran, 1993). Although reviewed by Moran (1993) as a test of mental imagery, the developers of the instrument have described it as a test of spatial visualisation (Vandenberg & Kuse, 1978), and for this reason its usefulness as a specific measure of the control dimension would be difficult to support.

The Sport Imagery Questionnaire (SIQ) is a self-report measure developed by Martens (1982) and more recently modified by Vealey (1986a), Vealey and Walter (1993), and Vealey and Greenleaf (1998). The test involves descriptions of four common sport oriented scenes: (a) practicing alone, (b) practicing with others, (c) recalling a peak performance, and (d) playing in a contest. For each scene, time is allowed for image generation and then vividness of visual, auditory, kinaesthetic, and mood imagery are rated on a 5-point scale. The modified 28-item test examines imagery relevant to sport situations across (a) the three sensory modalities and mood characteristic from the original; (b) the dimensions of vividness and controllability, and (c) the visual imagery associated with the internal and external perspectives. Participants are required to rate items related to modality and dimension on a 5-point scale with 1 representing *no image present* or *no control of image* and 5 representing an *extremely clear and vivid image* or *complete control of image.* In addition, the items relating to internal and external imagery perspective are also rated on a 5-point scale on which respondents evaluate how well they able to see the image from inside or outside the body. At this point in time no reliability or validity data is available. Although the test has been widely used in applied sport psychology, the lack of psychometric properties makes the few research conclusions based on the test questionable (Kenitzer & Briddell, 1991; Thomas & Fogarty, 1997). The multi-modal, multi-dimensional design is sound and the four scenes are well described, but the test lacks any reference to generation and duration of image. The measure is useful in the applied setting because it provides information concerning a range of relevant aspects of imagery ability, however, the perspective items are not typically considered as indicators of the same class of imagery attribute. It is unfortunate that the original developer and subsequent revisers of the SIQ have failed to appropriately determine the qualities and efficacy of the measure in a scientific manner.

Although many of these tests described in this section are currently used in both research and applied situations, no single measure can be identified as ideal for use in imagery ability assessment in the field of sport psychology. Several design problems of the measures reviewed have been identified to provide an insight into those areas that should be addressed in the development of any new measure. Firstly, a lack of conformity across measures in the selection of modalities and dimensions that should be evaluated indicates a degree of ambiguity in the definition of imagery ability. Secondly, variation in question styles, item numbers, and response formats highlight a need for test designers to continue to analyse existing measures in determining the question and response framework for any new measure. It is these components that generally determine the time required to complete the measure and its ease of administration. Thirdly, reliability data appears adequate, but validity data for a number of the measures is yet to be fully generated. This lack of validity information is in conflict with the regularity with which a number of these measures are used in research. Both the issues of reliability and validity will be examined more fully in the next section of the literature review. In conclusion, it is difficult to find a major factor that contributes to the rationale and longevity of the use of these imagery ability measures. Certain tests appear sound in design but have been used minimally in research and practice, whereas, other tests that lack basic psychometric properties represent the preferred devices for use in the applied setting or investigative situation.

Psychometric Issues Related to Imagery Ability Tests

Within the field of sport psychology, the problems related to imagery ability assessment are similar to those experienced in all areas of psychology when examining social-psychological variables. Gauvin and Russell (1993) stated that:

> Despite the considerable effort that has been directed towards test and scale development and recent attempts to provide instrumentation guidelines, many researchers are still grappling with the often difficult task of achieving reliable and valid measurement in sport and exercise settings (p. 891).

This situation appears to exist due to a lack of continuous re-evaluation of test instruments (Gauvin & Russell, 1993) and because, quite often, the statistical methods used to show evidence of reliability and validity are poor (Schutz & Gessoroli, 1993). The primary outcome of these measurement-based problems is the limited development of useful measures to evaluate imagery-related phenomena. Such minimal progress also inhibits the substantiation and expansion of current theoretical perspectives of imagery functioning (Mahoney & Epstein, 1981; Murphy & Jowdy, 1992).

Several of the important psychometric issues that exist in relation to imagery ability assessment are the substantiation of reliability and the presentation of suitable evidence to support construct validity of existing measures and for instruments currently under development. This section of the thesis examines the procedural characteristics and reporting of these essential measurement characteristics, in relation to tests of imagery ability.

Reliability

Generally, the tests outlined earlier have provided appropriate initial reliability data. For the more established measures, the consistent replication of relevant reliability data constituted a vital component of ongoing psychometric evaluations (e.g., McKelvie, 1994;

Richardson, 1994). Evidence of reliability has normally been presented as one or more of test-retest, parallel or alternative forms, split-half, Kuder-Richardson-20, or Cronbach's alpha coefficients. In the majority of reported cases, the data appears satisfactory, by equalling or exceeding a minimum criterion level of, $r = .7$, as suggested by experts in psychometrics, such as Kerlinger (1986) and Nunnally (1978). McKelvie (1994) suggested that the evaluation of the evidence of reliability in relation to test-retest coefficients for imagery measures may necessitate a less stringent application of this value, depending on interval period and the type of measure. Recently, Schutz (1998) noted that the use of the parallel forms methodology has been limited in psychology research because of the difficulty in constructing suitable matching measures. The outcome of this problem is the reliance on the test-retest and internal consistency methods in determining the reliability of measures. Sheehan et al. (1983) concluded after their review of imagery assessment that: "Studies on the reliability of the imagery ability measures, however, continue to reveal that self-report inventories are reliable and stable in the scores they yield within subjects and on the same subjects who are retested" (p. 204).

Richardson (1994) formulated a summary table of the reliability statistics, derived from his examination of a large set of psychometric evaluations, of the general imagery measures regularly used in psychology, such as the QMI, VVIQ, and GTVIC. Evidence presented included the range and mean for both internal consistency and stability over time for studies that have examined these reliability attributes of the above three measures. Alpha coefficients for the QMI ranged from, $r = .90$ to .99, with a mean of, $r = .93$. For the VVIQ the range was from, $r = .83$ to .94, with a mean of, $r = .89$, and for the GTVIC the range was from, $r = .68$ to .95, with a mean of, $r = .78$. Test-retest reliability for the QMI ranged from $r = .54$ to .91, with a mean of $r = .72$. For the VVIQ the range was from, $r =$ .73 to .86, with a mean of, $r = .78$, and for the GTVIC the range was from, $r = .60$ to .86, with a mean of, $r = .75$. Imagery is similar to many other psychological phenomena, so as the test-retest interval lengthens the tendency is for reliabilities to drop (McKelvie, 1994; White et al., 1977). Specific modality test-retest data for the QMI indicates a greater level of variability and inconsistency over time, $r = .29$ (kinaesthetic) to .82 (tactile), than for the entire test (White et al., 1977). Overall, the data certainly suggests acceptable reliability and supports the frequent use of these measures for the assessment of vividness and control (Richardson, 1994). The inconsistency of individual modality scores for the QMI may present a problem in making specific comments related to sensory imagery. White et al., (1977), in addressing the stability of imagery measures over time, have stated that:

> a reduction in a subject's ability to remember his/her previous response works to substantially influence a subject's current evaluation of his/her evoked image. It appears as if subjects do no respond only to the image evoked by the test items. (p. 151)

Finally, inferences made based on the reliability of these long-standing measures of imagery ability should take into account the fact that the majority of research samples have been college students (White et al., 1977).

The reliability of measures examining imagery ability in the area of movement, such as the MIQ and VMIQ, appears to be acceptable. Unfortunately, reliability data remains unavailable for the only measure pertaining to sport imagery ability, the SIQ. Both the movement-based questionnaires (MIQ and VMIQ) have undergone evaluations of their internal consistency and stability over time beyond their initial development (Atienza et al. 1994; Eton et al., 1998). Recent findings suggest that, although the internal consistency of these measures is very high, the limited investigation of the test-retest reliability of the MIQ, and a recent moderate 2-week test-retest correlation for the VMIQ ($r = .64$, Eton et al., 1998), indicate that these two instruments may not be highly stable over time. Eton et al. (1998) addressed this problem and concluded that, as with general imagery measures, this type of finding "may reflect the dynamic quality of the imagery process rather than an inherent weakness of the tests" (p. 134).

Item analysis is a statistical procedure used to improve our knowledge of why a particular measure displays a specific level of reliability (Murphy & Davidshofer, 1994). The primary value of item analysis centres on maximising the measurement characteristics of a test by identifying and eliminating items that do not adequately assess the variable under investigation (Murphy & Davidshofer, 1994). Tenenbaum and Fogarty (1998) have described the two most common scale item analysis procedures used in developing measures in sport psychology. Firstly, the corrected item-total correlation provides information as to the relationship between a single item and the total scale score. Low correlations suggest that the item may not be assessing the same characteristic as the other items and should be modified or deleted. Secondly, the alpha if item deleted statistic gives an indication of the contribution of a given item to the overall internal consistency of the scale. An item with an item deleted value greater than the total alpha weakens the internal consistency and should be modified or deleted. These particular statistics therefore are vital, in both the initial development and psychometric review phases of psychological scales, such as imagery ability measures.

Unfortunately, attempts to gather information relating to the item analyses of existing imagery ability measures proved difficult. Only one measure of those reviewed earlier discussed how this procedure was undertaken in the development of the test or questionnaire. The developers of the MIQ, Hall et al. (1985), provided a useful description of the item analysis procedures incorporated in the initial phase of test construction, which resulted in a reduction in the number of items from 28 to 18. It is important that future measures of imagery ability are scrutinised at the individual item level, and the results suitably described and reported.

An additional psychometric property closely related to item analysis is the examination of item variability or skewness. Previous research has shown that imagery ability measures have tended to be skewed toward the upper end of the response scale (Hiscock, 1978; Kihlstrom et al., 1991; Sheehan, 1967a). Kihlstrom et al. (1991) surmised that the majority of questionnaire respondents are "claiming to experience at least moderately vivid images, and vanishingly few subjects reporting no imagery at all" (p. 134). Sheehan (1967a) reported a similar finding during his initial investigations of the SQMI and concluded that relatively few individuals lack the capacity to generate the images contained within imagery ability measures. More specifically, findings have highlighted the substantial negative skew for individual items with respect to dimension (e.g., vividness and control), and a contrasting directional distribution in the analysis of individual modality. For example, the visual and auditory senses were reported as being more easily imagined than gustatory or olfactory (Hiscock, 1978; Kihlstrom et al., 1991).

Examination of the results of studies of measures that examine imagery ability in the motor domain reveal similar response patterns to those described above (Eton et al., 1998; Hall & Martin, 1997; Isaac & Marks; 1994). Item scores for both the VMIQ and the MIQ are typically shown to be negatively skewed. Hall and Martin (1997) reported a mean score for the visual subscale items of the MIQ of 2.07 equating to an approximate scale response of 'easy to see'. Eton et al. (1998) found that on a 5-point scale, varsity athletes had a mean item score for the VMIQ of 2.04 (clear and reasonably vivid). Non-athletes registered a mean item score of 2.39, a score that falls between the response scale anchors of clear and reasonably vivid and moderately clear and vivid. These findings, in conjunction with those discussed for measures of general imagery ability, suggest that test developers should consider carefully the manner in which items are devised, to ensure the most appropriate distribution of item scores.

Analysis of the reliability of any new measure of imagery ability constitutes a fundamental component in the development of the instruments. The procedures relating to item analysis, the gathering of reliability data, and the review of the distribution of item scores, should follow the accepted psychometric methodologies. It will only be possible to draw appropriate conclusions on the evidence derived from the use of imagery ability measures, when researchers can demonstrate the consistent reliability of a device.

Validity

The complexities surrounding the issue of inferring the validity of a test are inter-related with the primary difficulties of all psychological measurement. These problems are, firstly, assessing that a test measures what it purports to measure, and secondly, deciding on whether the data derived from the measure are useful in making decisions concerning the construct of interest (Murphy & Davidshofer, 1994). A simple definition of validity that highlights the relationship of measurement and meaning has been provided by Kaplan and Saccuzzo (1997) who stated that "validity can be defined as the agreement between a test score or measure and the quality it is believed to measure" (p. 131).

Several authors of books relating to psychological assessment have referred to a text entitled "Standards for Educational and Psychological Testing", published by a joint committee of the American Education Research Association, the American Psychological Association, and the National Council on Measurement in Education (1985), in their examination of validation strategies and procedures (Anastasi & Urbina, 1997; Kaplan & Saccuzzo, 1997; Murphy & Davidshofer, 1994). The findings of this committee in relation to a definition of validity were summarised by Kaplan and Saccuzzo (1997) in describing validity as inferential evidence of test scores made up of three types of evidence which were (a) content-related, (b) criterion-related, and (c) construct-related.

All of the authors referred to in the previous paragraph made particular reference to the specific nature of construct validity. They drew a similar conclusion, inferring that construct validation represents a procedure that includes all other types of validation activities. Each piece of evidence gathered in the development and analysis of a measure contributes to the establishment of construct validity. Most recently, Marsh (1998), has described a construct validation approach, with respect to measurement in sport and exercise psychology, based on the concept that theory, measurement, empirical research, and practice interact in such a manner that ignoring one component will affect the accuracy of evidence derived from another. Marsh (1998) defined the ideal validation process as one:

> in which theory and practice are used to develop a measure, empirical research is used to test the theory and the measure, both the theory and the measure are revised in relation to research, new research is conducted to test these refinements, and theory and research are used to inform practice. (p. xvi)

Although it would seem that a key goal of measure development, refinement, and practical application centres around construct validation, the nature of both the procedures and evidence relating to content and criterion validity must also be addressed. In addition, Kaplan and Saccuzzo (1997) suggested that the issue of face validity must also be examined, because of its frequent reference within the testing literature. Face validity also referred to as logical validity (Thomas & Nelson, 1996) is inferred when the instrument appears to examine the construct it claims to measure when reviewed by technically-untrained observers (Anastasi & Urbina, 1997). Evidence is typically based on the interpretation that a test looks the way it should and can function as an aid in motivating participants to complete a measure they perceive as relevant (Kaplan & Saccuzzo, 1997). Although no specific procedure exists to establish face validity, it is important to examine the measure to determine that the individual items have a relationship with the underlying function of the measure (Kaplan & Saccuzzo, 1997).

Content validity is established when a test appropriately represents the conceptual domain of the attribute it is designed to measure (Kaplan & Saccuzzo, 1997; Murphy & Davidshofer, 1994). This type of validity is dependent not just on the content of the test but on the processes involved in completing the measure (Guion, 1977). Although it is not described as content validity, Marsh (1998) outlined a procedure termed logical analysis that most appropriately details the important characteristics warranting consideration in establishing validity during the initial stages of test development. Marsh (1998) stated that "Logical analysis examines the logical consistency of the construct definition, the construction of items based on this definition, the acceptability of the measure's instructions, item format, scoring procedures etc." (p.xvi). This procedure also outlined the importance of addressing developmental, maturational, cultural, and ethical concerns in this early stage of test construction.

As with face validity, no statistical evidence is required to decide that a measure has content validity (Thomas & Nelson, 1996). The assessment of content validity usually requires logical judgements, made by experts familiar with the attribute of interest, in relation to adequacy of the measure as an instrument examining a certain content domain (Murphy & Davidshofer, 1994). If evidence for content validity is to be quantified, the information collected from expert opinion provides a framework. Kerlinger (1986) considered the issues associated with the gathering of this evidence and concluded that:

> judges should judge the content of the items..........the judges must be furnished with specific directions for making judgements, as well as with specification of what they are judging. Then, some method for pooling independent judgements can be used. (p. 418)

Minimal reported evidence appears available in relation to the content validity of imagery ability measures. Evidence in this instance, was represented by references to use of expert opinion in determining the final content and structure of a measure. Paivio (1971), in developing the IDQ, outlined how graduate students familiar with imagery theory were used to examine a set of items suggested by him, generate other similar items, and decide collectively on the final item pool on the grounds of comprehensibility, content relevance, and situational variety. More recently, Vella-Broderick and MaCrae (1997) presented a detailed description of the use of expert opinion in the content validation of the Mental Imagery and Sensation Scale (MISS). They utilised two methods for obtaining feedback on the initial draft of the MISS, focus groups and mail-out surveys. Focus groups ranged from 2 to 22 participants and included sport psychology students, academics, and practitioners. These groups examined issues relating to the theoretical conceptualisation of mental imagery and the processes of scale development. The mail-out survey involved 51 participants, with practical experience in mental imagery, completing the MISS and commenting on its design. Vella-Broderick and MaCrae (1997) concluded that this process contributed to the content validity of the MISS and is an essential phase in the development of a practical and psychometrically acceptable measure of imagery ability. It is envisaged that other test constructors will attempt to ensure that similar procedures are incorporated into the development of alternative instruments examining the construct of mental imagery.

Criterion-related validity is evaluated by comparing a test, scale, or measure with another variable or criterion considered to provide evidence of the attribute of interest (Kerlinger, 1986). The main reason for assessing criterion validity is to determine if the measure is a suitable indicator, that may function as a 'stand in' for the criterion variable, that is, the criterion is measured at the same time as the measure being validated (Kaplan & Saccuzzo, 1997). The two types of criterion validity are concurrent and predictive.

Concurrent validity assesses the current relationship between a measure and the criterion (Kaplan & Saccuzzo, 1997). Predictive validity is determined by comparing performance on a measure with performance on a criteria variable undertaken or examined at a later date (Whitley, 1996). Evidence related to the evaluation of the criterion validity of imagery ability measures is discussed in detail within a subsequent section of this literature review. The reason for combining of the examination of research is that the evidence related specifically to the criterion validity of existing measures is limited, and to a certain degree mimics the type of evidence examined in the context of construct validation.

As detailed earlier, establishing the construct validity of psychological measures involves assembling evidence that adequately defines the meaning of the test or instrument (Kaplan & Saccuzzo, 1997). The accumulation of this evidence necessitates the application of a range of statistical and experimental methodologies. Murphy and Davidshofer (1994) outlined three procedures, beyond those considered in relation to reliability and content validity, which appear most appropriate in considering the construct validation of imagery ability measures. The first method is to show the relationship between the test of interest and other tests or behavioural measures. Marsh (1998) described an important feature of this process and stated "two measures of the same construct should be substantially correlated with each other (evidence for convergent validity) and less correlated with measures of different constructs (evidence for divergent validity)" (p. xvii). Typically, procedures involve the comparison of measurement approaches, such as self-report questionnaires and opinion surveys, or the correlation of scale scores derived from subjective and objective tests of the construct. The results of different techniques of data collection, such as quantitative and qualitative procedures, also warrant comparison (Marsh, 1998). Secondly, factor analysis provides an important insight into the construct characteristics represented within the responses to a given measure. Murphy and

Davidshofer (1994) outlined that this procedure involves the analysis of the test scores, determining a relationship between the derived or predicted factors and the items or subscales of an assessment device. The goal of this procedure is to show that the resultant or *a priori* factors provide an accurate representation of the construct of interest. The final methodology used in establishing an instrument's construct validity constitutes the experimental manipulation of the selected construct and interpreting responses to the measure in relation to the manipulation (Murphy & Davidshofer, 1994). For example, if previous research and theory suggests that a certain intervention will result in specific changes in participants' responses or behaviours, the extent to which the measure can substantiate the predicted changes, provides evidence for the instrument's construct validity. The development of any psychological test, including measures of imagery ability, must follow a pattern of investigation that works towards gathering evidence to support the construct validity of the measure.

Evidence Related to the Construct Validation of Imagery Ability Measures

A substantial body of research exists that has provided evidence relevant to the construct validity of existing measures of imagery ability. This section of the literature review deals with studies that have examined the relationship between imagery ability measures (e.g., subjective and objective), the relationship between imagery ability measures and other psychological and psychophysiological variables relevant to the current thesis, the factor structure of imagery ability measures, and experimental manipulations designed to assess specific psychometric characteristics of imagery ability measures. Research examined in relation to the last group of studies will deal with material outside of the motor and sport domains, as these types of experimental investigations are covered in subsequent sections of the literature review. The key goal of this section is to highlight the psychometric characteristics, qualities, and weaknesses of current measures as evidence supporting the development of sport-based questionnaire of imagery ability.

Relationship Between Imagery Ability Measures

The examination of inter-test correlations between imagery measures is primarily undertaken as a procedure to gather convergent and discriminant evidence as a contributing component of the construct validation process. Analysing and reviewing the relationships between the tests, as complete measures, or their specific subscales typically generate this data. Several reviewers have provided critical analysis of a substantial body of the existing research that has compared imagery ability measures (Ernest, 1977; Richardson, 1994; Sheehan et al., 1983; White et al., 1977). These authors presented summaries of the evidence relating to the assessment of imagery ability, with respect to the uniqueness of both the dimensions and modalities examined, and the nature of imagery as measured by self-report and objective style tests.

General Subjective Measures

The most recent of these reviews, undertaken by Richardson (1994), summarised 25 studies in which two or more of seven imagery measures, that assessed one or more of the dimensions of vividness, controllability, or preference, were correlated. The relationships of interest to the current thesis are those involving the SQMI, GTVIC, and VVIQ. Mixed gender samples ranged in participant number from 18 to 208, and the reported correlations between the measures varied from, $r = -.06$ to $r = .81$. The mean correlation between the SQMI and VVIQ was, $r = .48$, between the SQMI and GTVIC was, $r = .36$, and between the GTVIC and the VVIQ was, $r = .37$. These findings indicate that measures of vividness have shown larger correlations than the moderate relationships reported between the measures of vividness and control. Evidence such as this suggests that support, although limited, exists for the independence of the two dimensions. Other researchers have also drawn this type of conclusion (Ernest, 1977; White et al., 1977). Following his review of measures of mental imagery used with athletes, Moran (1993) questioned the purity of these constructs on the basis of similar inter-correlation values, and stated that "the imagery dimensions of vividness and controllability are neither conceptually nor empirically distinguishable" (p. 161).

Generally, the sample sizes examined in the studies reviewed by Richardson (1994) were of less than 100 participants. In a larger scale study, Kihlstrom et al. (1991) compared the scores on the SQMI, VVIQ, and GTVIC. The first part of the study involved 2,029 university psychology students completing both the SQMI and the GTVIC. Results indicated the correlations between the individual subscales of the SQMI and the GTVIC ranged from, $r = .25$, for the visual and kinaesthetic subscales to, $r = .18$, for the olfactory subscale. The investigators did not report the details of the relationship between the total SQMI score and the GTVIC. Phase two of the study involved 730 university psychology students, who completed the VVIQ and the GTVIC. A correlation of $r = .41$ was found between the measures. Kihlstrom et al. highlighted the variation in the nature of the relationship between the measures of vividness of visual imagery and control by comparing the correlation of, $r = .25$, for the visual subscale of the SQMI and the GTVIC of the first sample with the correlation of, $r = .41$, for the VVIQ and the GTVIC. They noted that the VVIQ is an extended version of the visual subscale of the SQMI and suggested that the difference in the correlations are not the result of variations in cohort effects, reliability, or limited range but may be attributable to the features of the VVIQ that involve manipulations or transformations similar to those examined by the GTVIC. In addition, Kihlstrom et al. expressed concern in relation to the skewness of the measures, as indicated by the high levels of vividness and control abilities reported by most participants, restricting the distribution of scores and limiting the size of the observed correlations. The evidence derived from this investigation arguably questions the psychometric quality of these measures of vividness and control, and therefore, the true uniqueness of the dimensions they assess.

Objective Measures

Resolving the confusion in the interpretation of the relationship between subjective self-report measures and objective tests of imagery ability has been an important component of several correlational studies and research reviews (Di Vesta, Ingersoll, & Sunshine, 1971; Ernest, 1977; Hiscock, 1978; Lorenz & Neisser; 1985; Richardson; 1977). As detailed earlier, objective measures often include sub-tests of spatial relations or visualisation, derived from measures, such as the Differential Aptitude Test (DAT; Bennett, Seashore, & Wesman, 1966) and the Minnesota Paper Form Board Test (MPFB; Likert & Quasha, 1970). The information generated through this type of research provides a broader base in understanding the assessment of the imagery construct. Specific multiple test studies established to analyse these relationships must ensure that the findings are appropriately examined as outlined by Sheehan et al. (1983), who stated "The data need to define for us not only the relationship among the various measures, but how the measures converge (or diverge) with respect to the underlying process that is being assumed" (p. 193).

The general findings from the administration of a battery of imagery measures is that subjective and objective measures correlate significantly amongst themselves (Hiscock, 1978; Lorenz & Neisser, 1985; Richardson, 1977), but the two test types tend to be weakly intercorrelated (Katz, 1983; Morris & Hampson, 1983). Interestingly, Sheenan at al. (1983) suggested that objective measures provide an adjunct data set to supplement responses from subjective measures. Richardson (1977) found, for a sample of 60 psychology students, that the SQMI and GTVIC did not correlate significantly with the

MPFB, with values reported of, $r = -.15$ and $.11$, respectively. Hiscock (1978) reported correlational data for a mixed gender sample of 79 psychology undergraduates that showed once again that the SQMI (visual) and GTVIC are not strongly associated with the MPFB, $r = -.09$ and $-.06$. As part of a related study, Hiscock (1978) found that the imagery subscale of the IDQ and the space relations form of the DAT were not significantly correlated, $r = .05$, for a sample of 81 male university students. Finally, Lorenz and Neisser (1985) analysed the degree of association between the space relations form of the DAT and the SQMI and GTVIC. For a sample of 58 university participants, the respective correlations of, $r = -.16$ and $.04$, were found.

The evidence presented in the previous paragraph contributes toward the substantiation of the argument that subjective and objective tests of imagery ability are unrelated (Hall, 1998; Moran, 1993). Each type of instrument is either measuring a different construct or assessing orthogonal aspects of imagery ability (Katz, 1983; Morris & Hampson, 1983). Various researchers have suggested possibilities as to the basis of this ambiguous relationship. Firstly, Katz (1983) described neurological evidence that indicates that the measures operationalise different parts of the brain. Secondly, Morris and Hampson (1983) and Moran (1993) presented similar frameworks that purport that self-report measures are related to generation or representation abilities whereas objective tests assess transformation or processing skills. As yet, no definitive conclusion can be drawn as to the true nature of the difference between subjective and objective measures, therefore the relationship warrants on-going investigation in future assessments of imagery abilities.

Movement-Based Measures

Recently, tests designed to assess movement-based imagery abilities have undergone similar styles of convergent and discriminant evaluations as the more general imagery ability instruments (Eton et al., 1998; Isaac & Marks, 1994). Although certain similarities have been acknowledged between movement imagery and imaging in a sporting context, as yet the developers of measures with a specific sport-based orientation have not presented validity evidence related to the associations between their measures, and other imagery- and non-imagery based variables.

Several studies have been documented that report correlational data for the VMIQ and other measures of imagery ability (e.g., Campos & Perez, 1988; Isaac et al., 1986). As an important feature of the initial development study of the VMIQ, using a sample of 170 university physical education students and 50 high school students, was the reported a large correlation of $r = .81$ with the VVIQ as evidence of convergent validity (Isaac et al., 1986). Perry and Morris (1995) suggested that this high level of shared variance could be due in part to a similarity in format and response methodology.

Subsequent studies have further investigated the relationship between the VMIQ and the VVIQ. Isaac and Marks (1994) found that for a sample of 547 participants ranging in age from 7 to 78 years, the correlation between the VMIQ and VVIQ was substantially lower ($r = .35$) than the value reported by Isaac et al. (1986). The most recent examination of both the VMIQ and VVIQ involved a group of 125 university students of varying degrees of athletic ability. Eton et al. (1998) found a correlation of, $r = .60$, between the two vividness measures. These relationship variations suggest that variables such as age and athletic ability may influence the response patterns found for each measure. Additionally, sample size differences could also affect the value of the measure relationships.

Campos and Perez (1988) examined the association of the VMIQ with imagery measures other than the VVIQ. The questionnaires that were used were the IDQ and the Mental Imagery Questionnaire (MEIQ; Farthing, Venturino, & Brown, 1983). The latter is a 20-item two-part test that examines the dimensions of vividness, ease, and absorption for scenes related to visual experiences and personal behaviour. The relationships of key interest to the current study were between the VMIQ and (a) the imagery subscale of the IDQ, $r = -.34$, and (b) the vividness dimension, $r = -.51$, and (c) the ease dimension, $r = .43$, for the visual scenes of the MEIQ. These data, in conjunction with the VVIQ evidence, contributes to the general perception that the VMIQ seems to be assessing a different attribute of imagery, movement imagery, than the more general type of measure (Campos & Perez, 1988; Isaac et al., 1986). The degree of variation in the correlations between the VMIQ and the VVIQ, and the fact that the original inter-test correlation of, $r = .81$, is higher than the test-retest correlation of, $r = .76$ (Isaac et al., 1986), certainly highlight contradictory evidence in relation to the validity of the measure as a pure indicator of movement imagery ability (Perry & Morris, 1995; Richardson, 1994).

The second measure of movement imagery ability described earlier, the MIQ, also suffers from the problems of inadequate or insufficient inter-test correlational evidence (Moran, 1993). Data describing the relationship between the MIQ and other measures of imagery ability was not included in the original development report (Hall et al., 1985), and only recently generated as a component of the revision of the questionnaire (Hall & Martin, 1997). Inter-correlation material was not presented within two multiple test examinations of athletes' imagery abilities that included the MIQ as one of the measures (Jopson et al., 1989; Young-Overby, 1990). This type of data, if made available, would significantly contribute toward a clearer understanding of the function of the MIQ as an imagery measure appropriate for use in the assessment of movement or sport-related imaging ((Murphy & Jowdy, 1992).

Correlational data presented by Hall et al. (1985) for a sample of 80 university physical education students showed that the visual and kinaesthetic subscales, $r = .58$, assessed related but separate aspects of movement imagery. More recently, Hall and Martin

(1997) examined the relationship between the MIQ, VVIQ, and VMIQ for a sample of 44 physical education students. The correlations between the measures were, *r* = 58 and *r* = .54, respectively. Separate correlations for the VMIQ and the visual and kinaesthetic subscales of the MIQ of, *r* = .65 and *r* = .49, were reported. Hall and Martin stated that "the kinaesthetic subscale of the MIQ is tapping a component of imagery that the VMIQ does not capture" (p. 146). Also of interest was the large correlation of, *r* = .78, found between the VMIQ and the VVIQ, similar to that presented by Isaac et al. (1986), which suggests that the VMIQ is substantially more oriented to the examination of visual rather than kinaesthetic imagery. Unfortunately, the authors did not present correlations between the VVIQ and either the MIQ or its subscales, or the correlation between the MIQ subscales. The inconsistency in the presentation of correlations detailing the relationship of the MIQ with other general subjective or objective measures of imagery ability is a problem that needs to be addressed in considering the validity status of this well designed and highly reliable instrument.

Relationship Between Imagery Ability Measures and Other Psychological Variables

Researchers have directed substantial effort toward the examination of the relationship between imagery ability and performance on certain psychological criteria. The types of psychological characteristics that have served as a variable base include learning, problem solving, memory, perception, intelligence, and personality (Ernest, 1977; Morris & Hampson, 1983). It has been suggested that finding which psychological characteristics share variance with imaging abilities will, firstly, aid in the understanding of how images are retrieved, constructed, cued, or transformed (Morris & Hampson, 1983) and, secondly, specify the role imagery ability plays in the performance of tasks considered to require imagery as an element of their function (Katz, 1983). Due to the extensive amount of material representing the investigation of these types of relationships (See Ernest, 1977, for review), I will review only general imagery ability studies that have examined similar psychological variables to those used in the present thesis. In the case of movement imagery, previous research has only incorporated a limited number of psychological variables. Consequently, the set of studies reviewed relate to a broader base of variables than those examined within the current evaluation of imagery abilities and psychological operations.

Cognitive Abilities

The general patterns in the relationship between self-reported imagery abilities and cognitive abilities have indicated little or no association between imagery and cognitive variables. Tedford and Penk (1977) found scores on the SQMI and Shiply-Hartford scale (a measure of intelligence), for a mixed gender sample of 100 undergraduates, to correlate only minimally. As a component of a study that examined the creative skills of 30 high-IQ upper primary-school children, Shaw (1985) reported a correlation of, $r = -.03$, between the composite imagery score (vividness and control) of the VVIQ and the GTVIC and scores on the Otis-Lennon intelligence (IQ) test. These results reinforced the general proposition that no definitive pattern of association exists between self-reported imaging ability and general intelligence (Richardson, 1994).

Researchers assessing verbal abilities in relation to mental imagery have typically applied a discriminatory emphasis (e.g., Hiscock, 1978; Rossi & Fingeret, 1977). Theoretical approaches to the examination of imagery and memory such as Paivio's (1971) dual code hypothesis have proposed interconnectedness between the operations of imagery and verbal processes (Hall, 1980). Several reviewers of sport imagery assessment in discussing the Individual Differences Questionnaire (IDQ; Paivio, 1971), the measure developed on the foundations of the dual code theory, concluded that the verbal scale of the measure was irrelevant for use in research in this field (Perry & Morris, 1995; Moran, 1993). Perry and Morris (1995) did suggest that sport imagery training techniques using a verbal orientation might benefit from incorporation of the information derived from the IDQ verbal processes score. The majority of research in this area would lend support to the prediction that a negligible relationship exists between sport-oriented imagery ability and verbal processing (e.g., Campos & Perez, 1988; McKelvie & Rohrberg, 1978).

Many general imagery studies have focussed attention on the examination of more specific aspects of cognition, such as verbal reasoning, abstract reasoning, numerical skills, incidental recall, and spatial ability (e.g., McKelvie & Rohrberg, 1978; Hiscock, 1978). Of primary interest within the present thesis are those studies linked in some manner with the relationship of verbal cognitive abilities and self-reported imagery. Morris and Gale (1974) found small, significant correlations, for a sample of 32 university students, between an incidental word-recall task and the SQMI, $r = -.33$, and the GTVIC, $r = .31$. As part of a study described earlier, Richardson (1977) reported very small correlations between a 33-item vocabulary test and both the SQMI and GTVIC. McKelvie and Rohrberg (1978) reported no significant differences in verbal reasoning between 15 high and 15 low scorers on the VVIQ. Hiscock (1978) found that the Quick Word Test (Borgatta & Corsini, 1960) did not correlate significantly with either the visual subscale, $r = -.09$, or auditory subscale, $r = -.12$, of the SQMI, the GTVIC, $r = -.05$, or the imagery subscale of the IDQ, $r = -.14$. Hiscock did find however, only a small association between the verbal subscale of the IDQ and the quick word test, $r = .30$, and that the verbal and imagery subscales of the IDQ were unrelated, $r = .03$. The general conclusion drawn from the above results is that self-reported imagery ability involves a different set of cognitive abilities than those relating to verbal reasoning or ability.

Several researchers have investigated the relationship between objective measures of imagery ability and verbal processing abilities. Hiscock (1978) found only a small correlation between the MPFB and the Quick Word Test, $r = 18$, with a sample of 79 psychology undergraduates. Additional findings from a related study reported by Hiscock showed that for males only ($N = 81$) the DAT correlates significantly with the Quick Word Test, $r = .29$. The small value of the correlation indicates the relationship is not strong and possibly affected by the male only sample. As part of a study examining imagery ability and the recognition of verbal and nonverbal stimuli, Ernest (1979) concluded that the verbal processing abilities of 24 psychology students, who scored high on the DAT and MPFB, were no different from the 24 students who scored low on these measures. These types of results suggest that scores on objective measures of imagery ability do not associate, in any consistent manner, with scores on tasks related to verbal reasoning.

Memory

Although I used no direct measure of memory in the present research, I will briefly review the relationship between imaging abilities and memory for the purpose of highlighting any influence memory may play in the performance of the imagery tasks undertaken within this study. Richardson (1994) is quite direct in his analysis of the interaction between the dimension of vividness and memory and stated that " Whatever it is we measure with our vividness questionnaires, it is not something that necessarily predicts high or low accuracy of recall" (p. 7). One plausible interpretation of the association between imagery and memory is that images may facilitate or prompt the recall of memories by activating relevant cognitive or affective mnemonic cues (Richardson, 1994). It is important to understand that no image is necessary to encode something to memory and that accurate retrieval from memory is quite possible without the representation of any images associated with a certain memory (Richardson, 1994). Whereas Richardson (1994) purported that imagery and memory operate as different cognitive processes, several authors have devoted significant portions of their texts to the examination of whatever relationship does exist (e.g., Finke, 1989, Morris & Hampson, 1983; Yuille, 1983). Unfortunately, these discussions present a broad range of perspectives that have yet been unable to converge toward a unified framework. A concluding remark presented by Begg (1983) following research examining this area captures well the difficulties of interpreting and supporting hypotheses that evaluate the relationship of the processes of imagery and memory. Begg (1983) stated that:

> Although we cannot doubt that imagery does something important in the memory system, this fact alone does not tell us the memorial consequences of what was done. Imagery is perhaps the most powerful process for binding items together - a truly remarkable glue, as it were. But binding is only binding (p. 113).

Researchers examining the association of imagery-memory have presented varied findings that both support and refute the notion that imagery ability and memory (as demonstrated through various recall activities) are related. As an important component in the development of the VVIQ, Marks (1973) examined the role that imagery has in memory. Marks (1973) found that the group of psychology students (n = 18) that scored highest on the VVIQ, recalled significantly more of information contained in photographs, than the lowest scoring group (n = 18). In a later correlational study, Morris and Gale (1974) reported that, for a sample of 32 mixed gender undergraduates, both the SQMI and GTVIC correlated significantly with an incidental word-recall task, r = -.33 and .31 respectively. Although these two studies presented data that suggests a relationship exists between imagery ability and memory, small sample sizes, small to moderate correlations between measures, and only minimal differences between groups, are factors that restrict the conclusions that may be drawn on the strength of the association.

The results of later investigations using larger sample sizes demonstrated only minimal variation in the observed relationship between imagery ability and memory.

Hiscock (1978) found only small correlations between a measure of visual memory ability and the visual subscale of the SQMI, $r = .01$, the auditory subscale of the SQMI, $r = -.14$, the GTVIC, $r = .06$, and the imagery subscale of the IDQ, $r = .04$, for a sample of 79 psychology undergraduates. The recall task required participants to remember and describe specific details of common local area objects. In a more elaborate examination of event recall, Lorenz and Neisser (1985) asked 38 female and 20 male university students to complete six event memory description tasks, such as recollections of the first moon landing and the Reagan shooting, their earliest childhood memory, and memories of schooling. The investigators calculated scores for each of the memory activities and compared them with the SQMI and GTVIC scores. Correlational data indicated no significant relationships between the event-recall measures and the tests of imagery ability. Correlations varied from, $r = -.03$ (Reagan vs SQMI), to, $r = .25$ (New Year vs GTVIC). One of the important hypotheses of a study of the relationship between imagination and memory undertaken by Tracy, Tracy, and Ramsdell (1985), was that participants who reported higher levels of imagery vividness would display a higher level of object and modality recall. The memory scores were derived from how accurately the 99 business and commerce majors recalled objects and sense modalities that were depicted within tape-recorded statements relating to the beach, they heard earlier. The correlation between the self-report imagery scale, a modified version of the SQMI, and the recall task, $r = .04$, was very small and not significant. Hall et al. (1989) conducted an investigation of the relationship between movement imagery ability and memory for movements. They found that groups of university students, assessed as either high ($n = 12$) or low ($n = 9$) ability imagers on the basis of MIQ scores, performed no differently in the recall of simple movement patterns. Overall, the results presented within this group of studies provide substantial support for the relative independence of self- reported imagery ability as a cognitive skill and thus, imagery should be considered separately from memorial abilities.

Ernest (1977) comprehensively reviewed research relating to the association of objective measures of imagery ability and various tasks representing memory performance. The key conclusion she presented was that a small to moderate relationship exists between spatial manipulation skills and recall. The interaction between the variables was more apparent for non-verbal memory stimuli, such as forms, colours, and pictures, than for verbal material. In a later study, Ernest (1979) found significant differences between high ($n = 24$) and low ($n = 24$) imagery ability groups, as determined by participants combined scores on the DAT and the MPFB, for the recall of pictures (line drawings), but not for words (concrete and abstract). Lorenz and Neisser (1985) reported only small correlations, of no consistent direction, $r = -.22$ to .26, between scores on the DAT and the range of memory tasks such as recollections of the first moon landing and their childhood. The evidence of a relationship between objective tests of imagery ability and memory tasks is slightly more supported than for self-report measures, however, this may be due to the link that spatial abilities and recall and recognition tasks share with intellect, rather than with imagery ability. Objective style evaluations of spatial reasoning regularly form subtests of the major measures of intellectectual functioning (e.g., MAB; WISC; WISR), thus, it would appear that they share a strong link with this cognitive construct.

Although the findings relating imagery and memory are inconclusive, common sense suggests that images constitute an important component of the memorial process. For an individual to generate an image of an object that is not present, or of an event that is not currently happening, information of some form must be retrieved from memory (Morris & Hampson, 1983). Morris and Hampson presented an interesting summation of the interaction of imagery and memory within the context of cognitive processing. They stated that "Imagery can also be considered a phenomenon which stands at the intersection of memory and perception, where it can be used to aid conscious thinking and problem solving" (p. 4). Nevertheless, it is clear from the predominantly low correlations that an accurate reflection of an individuals' imagery ability cannot be gleaned from their scores on various tests of memeory and intellectual fuctioning alone. The direct measurement of imagery ability is essential to accurately depict an individual's capacity to create and manipulate images.

Social Desirability

Several investigators have discussed the issues associated with the relationship of self-reported imagery ability and the psychological variable of social desirability (Durndell & Wetherick, 1975; Ernest, 1977; White et al., 1977). The primary concern is that social desirability may affect individuals' ratings within self-report imagery tests, with participants reporting high vividness or controllability regardless of the actual nature of their imaging abilities (Di Vesta et al., 1971; Richardson, 1994).

The most common procedure for examining the interaction of imagery ability and social desirability has been the correlation of scores on self-report imagery measures and scores on a tests of the need for approval, such as the Marlowe and Crowne Social Desirability Scale (M-CSDS) (Crowne & Marlowe, 1960). DiVesta et al. (1971) concluded that responses to both the SQMI and GTVIC were affected by social desirability, because all three measures loaded on the same factor when analysed with a number of other objective imagery measures and several cognitive ability tests. Durndell and Wetherick (1975) presented the actual correlations from the DiVesta et al. investigation which were SQMI and M-CSDS, $r = .29$, and GTVIC and M-CSDS, $r = .20$, indicating that the relationship between the variables is not as strong as originally suggested. As a key feature of their own research, Durndell and Wetherick (1975) reported generally low correlations between the SQMI, the GTVIC, the visual subscale of the SQMI, and the M-CSDS for three mixed gender samples ($N = 36$ to 185, $r = -.05$ to .46). The only correlation above, $r = .20$, was between the M-CSDS and the SQMI, $r = .46$, and was based on a sample of only 53 participants. The general conclusion of this research was to accept that little relationship exists between reported imagery scores and social desirability. Several other reviews of existing research (Ernest, 1977; Richardson, 1994) examined the findings of studies using the SQMI, GTVIC, and M-CSDS that involved a variety of sample sizes. These reviewers drew the similar conclusion that, although a pattern exists in which males are more influenced by social desirability than females (only for the SQMI), the general trend is that self-report imagery ability measures are relatively free of social desirability contamination. Richardson (1994) considered that sample composition is a key factor in the range of correlations reported within the reviewed research and suggested that the unique nature of any given sample with respect to what they consider to be socially desirable abilities could be reflected in the set of existing relationships. For example, the elite athlete group that perceives imagery ability as a desirable trait may be prone to responding in a socially desirable manner in an effort to demonstrate a high degree of competence. Irrespective of the relatively small and inconsistent relationship between self-report imagery ability and social desirability, the interaction must be considered in the development of any new measure.

Other Psychological Attributes

Very few investigations have examined the association between non-imagery psychological variables and self-reported movement or sport imagery ability. In fact, data relating to only one measure, the MIQ-R, appears to be available on which to base judgements concerning the interaction of movement imagery and other important psychological attributes. Scores from two well known sport psychology measures, the State

Sport Confidence Inventory (SSCI; Vealey, 1986b) and the Competitive State Anxiety Inventory - 2 (CSAI-2; Martens, Burton, Vealey, Bump, & Smith, 1990), have been compared with scores from both subscales of the MIQ. Moritz et al. (1996) reported for a sample of 57 elite rollerskaters, small significant correlations between the SSCI and the kinaesthetic, $r = .34$, and visual subscales, $r = .35$, of the MIQ-R. Moritiz et al. noted that the high sport confident athletes reported higher movement imagery scores and inferred a potential mediating effect of these abilities on sport confidence. As a second component of the same study, Vadocz, Hall, and Moritz (1997), investigated the interaction of competitive anxiety (CSAI-2) and imagery ability. It was found, for the same sample, that visual imagery ability was significantly correlated with both cognitive anxiety, $r = -.29$, and somatic anxiety, $r = .27$, but kinaesthetic imagery ability was correlated with the anxiety variables at a near zero level. Vadocz et al. proposed that visual imagery ability may operate in assisting the athlete to control the visual content of images in a manner that regulates anxiety levels. Although this is a possibility with respect to cognitive anxiety, where the negative correlation indicated that stronger visual imagery of movement was related to lower state anxiety, the positive correlation of somatic anxiety and visual imagery ability, and the very small correlations found for kinaesthetic imagery ability suggest that the association of anxiety variables and imaging abilities is unclear. Generally, the minimal size of the relationships examined between either psychological variable and subscales of the MIQ-R, and the limited discussion of these interactions provided by the authors, support the arguments that movement imagery ability is relatively independent of other assessable psychological characteristics related to sport. Additionally, the assessment of imaging abilities more directly representaive of sport could provide clearer evidence of the association of this characteristic with other types of psychological behaviours.

A primary goal in the development of measures of imagery ability should be to present divergent evidence that supports the validity of the test. The research examined in the current section generally demonstrates the independence of the tests of imagery ability from a variety of other psychological variables. In addition to highlighting the uniqueness of a score from a given imagery measure, researchers must endeavour to provide information related to the possible links of particular cognitive processes and the ability to generate images. More specifically, investigations within sport psychology, require the avaliability of psychometrically sound, sport-oriented measures of imagery ability to facilitate the generation of accurate evidence demonstrating the nature of the relationships between various cognitive operations.

Factor Structure

A critical procedure in the generation of psychometric evidence for the validation of any new measure is the examination of its factor structure. Many of the existing imagery ability questionnaires have been factor analysed with the primary goal of defining a factor structure supportive of the researcher's proposed theoretical framework of imagery ability. Researchers examining those measures that assess only one or two modalities or dimensions, such as the VVIQ, VMIQ, and MIQ, have been able to report factor analysis results that clearly support their original design (Atienza et al., 1994; Campos & Perez, 1990). Unfortunately, researchers analysing measures that attempt to assess a larger number of dimensions and/or modalities have been unable to consistently support a multi-dimensional or multi-modal factor structure (Lane, 1977; Switras, 1978; White, Ashton, & Law, 1974). In addition, investigators examining the factor structure of imagery measures given as part of a multiple test battery have reported results that highlight both a single general imagery ability factor and an associated multiple modality or dimensional factor structure (Hiscock, 1978; Kihlstrom et al., 1991; Richardson, 1994).

The primary focus of several factorial studies was the examination of the construct structure of well-established, single-dimension, single-modality imagery ability measures. Factor analyses demonstrated that all items of the VVIQ load on a single vividness factor (Dowling, 1973; Marks, 1973), and that the similarly designed items of the VMIQ also represent a simple unitary structure (Campos & Perez, 1990). Isaac et al. (1986) reported the correlation between the two measures as, $r = .81$. These results indicated that very little distinguishes the items that represent either movement or visual imagery within these measures. Analysis of the factor structure of the GTVIC has resulted in four distinct factors being clearly interpretable (White & Ashton, 1977). In their original analysis of the GTVIC, using a large sample of 1,562 psychology students, Ashton and White (1974) reported finding three factors, but considered their interpretation, in relation to loadings of test items, to be impossible. Two methodological inadequacies, a conservative factor extraction procedure and the use of orthogonal rotation, were considered as the reasons for a lack of clarity in the factor structure in this analysis of the GTVIC. White and Ashton (1977) reanalysed the original data in conjunction with a new sample of 532 students, using oblique rotation and factor extraction that produced four factors. The four resultant factors were labelled movement, misfortune, colour, and stationary image. Recommendations made by the authors centred around further examining the uniqueness of these four factors and increasing the number of items representing each factor construct.

Imagery ability measures constructed to assess multiple modalities have been factor analysed with mixed results. Depending on which factor analysis procedures were used to examine the SQMI, White et al. (1974) reported that, for the original larger sample involved in the Ashton and White (1974) GTVIC study, a general imagery factor was revealed by using principal components extraction before rotation. Following orthogonal and oblique rotations, seven specific sensory factors were found, and after a second-order analysis of the oblique factor pattern, a general imagery factor was revealed once again. A second bi-polar factor also resulted from the latter analysis that accounted for nine percent of the variance and had positive loadings on the two mechanical senses of touch and kinaesthesis, and negative loadings for the chemically sensitive modalities of smell and taste. In a later study, White, Ashton, and Law (1978) modified the format of the SQMI with the restriction that no items of the same modality follow each other. An oblique factor analysis undertaken on this data produced a five-factor structure with items related to the specific senses loading in the following arrangement: smell and taste on factor 1; kinaesthesis on factor 2; vision on factor 3; organic on factor 4; and hearing and touch on factor 5. The authors were of the opinion that randomising the SQMI may produce a more accurate representation of factor structure than the earlier version of the SQMI. Finally, following a principal components analysis with orthogonal rotation on SQMI data from 2,083 psychology students, Kihlstrom et al. (1991) reported that the seven senses examined in the SQMI were found to exist as distinct factors.

Several studies have examined the factor structure of measures, other than the SQMI, that assess imagery ability in multiple modalities. Switras (1978) used the principal components method and orthogonal rotation to analyse the SMI scores of a sample of 350 psychology students. Results supported a multi-modal factor structure, but also indicated that vividness and control items typically loaded on the same factor with respect to sensory modality. The factors revealed were: visual imagery, olfactory imagery, somesthetic imagery, kinaesthetic-tactile controllability, gustatory imagery, kinaesthetic-tactile vividness, and auditory imagery. Lane (1977) examined an untitled multi-modal measure of imagery control and found that principal components analysis of subscale scores yielded a single-factor structure for a sample of 320 university students. A second principal components analysis of individual items produced an 11 factor structure more representative of test content and format than of any given sense modality. Interestingly, in describing the general abilities suggested by the factors derived in this analysis, such as imaging movement, manipulating specific images, and imagining absurd or unusual situations, Lane outlined factors similar in nature to those reported in analyses of other tests of imagery control (e.g., Morrison & White, 1984; White & Ashton, 1977). Atienza et al. (1994) examined the factor structure of the MIQ using the maximum-likelihood method with oblique rotation. Results supported a visual and kinaesthetic two-factorial structure. The authors concluded that these findings supported the usefulness of the MIQ as a measure of the vividness of movement imagery, yet individual items require participants to report on the ease or difficulty of their imaging and not its clarity.

Results of studies examining the factor analyses of batteries of imagery ability measures have tended to show results that indicate very little consistency in the distinction between imagery dimension and modality. Four studies, in which a range of sample sizes from 58 to 232 participants were used, outlined the results of principal component analyses (using orthogonal rotation) of test batteries that included the SQMI and GTVIC (in addition to other cognitive abilities measures) as specific items (Di Vesta et al., 1971; Hiscock, 1978; Lorenz & Neisser, 1985; Richardson; 1977). In each case, the SQMI and GTVIC were found to load on the same factor, whereas no modality factors were reported in any of these studies. Such evidence would support the argument that vividness and control of imagery are difficult to distinguish as relatively independent factors, although it must be noted that the sample sizes were small relative to some studies (e.g., Kihlstrom et al., 1991; White et al., 1974). One study that highlights results distinguishing between vividness and control, as measured by the SQMI and GTVIC, is that of Kihlstrom et al. (1991), who used principal components analysis on the SQMI and GTVIC with orthogonal rotation. This analysis yielded 11 factors, the first seven relating to the senses of the SQMI, with the remaining four factors being related to the GTVIC in a manner similar to factorial representation reported by White and Ashton (1977). It may be the case that when a suitably large sample size is used, and assessment is limited to a small number of imagery measures, the factorial structure revealed highlights greater independence between dimensions and modalities.

Richardson (1994) constructed a correlation matrix between seven imagery self-report questionnaires, based on the data collected in 24 smaller studies involving the intercorrelation of imagery test scores. The resultant 7 x 7 matrix was analysed using both principal components analysis and principal axis extraction with orthogonal and oblique rotations. Richardson found that both the VVIQ and SQMI loaded highly on the first of three factors revealed using principal components analysis. He labelled this factor as vividness. Under all analysis methods, the VVIQ, SQMI, and GTVIC loaded on the third factor reported, subsequently defined as a controllability factor. Again, this evidence would make it difficult to support the existence of two conceptually distinct imagery dimensions of vividness and control on the basis of the evaluation of the factor structure of existing imagery measures (Richardson, 1994).

The typical factor structure analyses undertaken in relation to imagery ability measures have relied on exploratory methods. Studies pertaining to the use of more rigorous statistical techniques, such as structural equation modelling, specifically confirmatory factor analysis, appear infrequently in the imagery research literature. Few published investigations have discussed the factor structure of an imagery ability measure on the basis of an *a priori* interpretation of the instrument's dimensional or modal content. Babin and Burns (1998) detailed the confirmatory factor analysis of an untitled 14-item scale designed for the measurement of communication-evoked mental imagery. The term communication-evoked mental imagery is derived from consumer and marketing studies, where imagery is associated with the degree and character of "mental imagery triggered by particular advertising stimulus" (Babin & Burns, 1998, p. 262).They proposed, following the principal components analysis and subsequent reduction of a larger item pool, the a priori existence of three dimensions including vividness (8 items), quantity (3 items), and elaboration (3 items). Specific details of the three-factor model testing procedure reported for a sample of 251 students, included the following fit index values: comparative fit index of 0.91, a root-mean-squared error of approximation of 0.09, and a non-normed fit index of 0.91. Internal consistency estimates for vividness, quantity, and elaboration were, $r = .94$, .87, and .79, respectively. This factor structure and reliability data support an imagery ability conceptualisation that provides a psychometrically adequate basis for the on-going investigation of this cognitive process. Minor modification of the measure could enable its use in a wide variety of contexts within which it is proposed that these dimension types (e.g., vividness, elaboration) operate. The test developers noted that the scale would benefit from additional revision, specifically suggesting that factors based on only three items remain at risk of limited reliability and instability in model testing. In the overall context of analysing the factor structure of imagery abilities, the research of Babin and Burns provides an excellent representation of the best practice procedures warranting adoption in the development and revision of tests in this area.

To summarise, the conceptualisation underlying measures of imagery ability has varied considerably, there being unimodal, unidimensional tests, such as the VVIQ, VMIQ, and GTVIC, and multimodal, unidimensional questionnaires such as the VMIQ-II, SQMI, and MIQ. As yet, no psychometrically-validated, multimodal, multidimensional measure has exhibited any significant usage much beyond its developmental research (e.g., Lane, 1977; Switras, 1978). In addition, there is some confusion surrounding the factor structure of imagery ability measures, particularly those that purport to be multimodal or multidimensional. Future investigations of factor structure would benefit from the application of current measure development procedures proposed and applied within both general (e.g., Reise, Waller, & Comrey, 2000) and sport psychology (e.g., Conroy, Motl, & Hall, 2000). Finally, there is no measure of imagery ability specific to sport, or movement that demonstrates a factor structure that supports the existence of a multi-modal, multi-dimensional conceptualisation of the characteristics associated with imagery processing.

Imagery Ability Assessment and Motor Performance

The recent development of measures associated with imagery abilities in the motor domain has lead to an increase in the number of studies that have investigated individual differences in imaging and the performance of motor tasks. Earlier research made substantial contributions to the knowledge base within this area, although in certain instances the applicability of findings within the movement domain are restricted by the use of imagery ability assessment devices developed for use in general psychology. It has also been noted in examinations of the outcome of imagery interventions as an enhancement strategy in the performance of motor tasks, the effect may be limited by the failure to assess individual imaging abilities as a mediating variable (Feltz & Landers, 1983; Hinshaw, 1991). An underlying basis for investigations in this area relates to the premise that the cognitive processing of motor tasks is an activity that involves imagery strategies, and that the examination of performers' ability to image represents an important variable to consider (Hall, 1985; Hall et al., 1992; Hall, Schmidt, Durand, & Buckolz, 1994). Imagery ability may contribute to differences in motor performance outcomes through either an innate variation in imagery ability affecting motor performance (Hall et al., 1989) or because differences in imagery ability may affect the learning of motor tasks (Richardson, 1994).

This section examines the literature detailing the nature of the relationship between the performance of individuals on a number of the measures of imagery ability described earlier in the review (or tests similar in design), and their performance on some form of motor task. Studies were grouped in this section according to the device used for assessment. The measures represent the categories of (a) general imagery ability relating to vividness, control, and spatial ability, as assessed by instruments used regularly in psychology, (b) imagery ability assessed by tests developed specifically for the study, and (c) questionnaires that measure movement imagery abilities. In addition, I selected the studies reviewed here on the basis that the participants were chosen from groups that did not emphasise athletic ability as a prerequisite for involvement in the research. I made this distinction for two reasons. Firstly, although motor imagery constitutes a foundation characteristic of sport imagery, it represents a form of imagery in regular use by the general population and may be best examined within the context of the physical rather than the sporting domain. Secondly, separating motor- and sport-oriented imagery studies allows for the subsequent intricate review of imagery characteristics unique to both areas that in relation to the present thesis could provide guidance in the development of a measure designed for use specifically in the sporting domain.

Motor Performance Research Involving General Imagery Ability Measures

Start and Richardson (1964) conducted one of the important early studies from the first category outlined earlier. Their sample consisted of 52 male college students aged between 18 and 21 years. Participants completed a modified QMI, the GTVIC, and three judges subsequently scored their performance of a simple gymnastic skill learned through mental practice. The investigators reported small non-significant correlations between the QMI total, $r = -.09$, visual subscale, $r = -.23$, and kinaesthetic subscale, $r = -.06$, and criterion skill scores. Results of a chi square analysis of the high and low criterion skill scores and high and low GTVIC scores was also non-significant. The evidence indicated that neither vividness nor control of imagery adequately predicted motor task performance of a skill that had been rehearsed mentally. Start and Richardson did report, however, that the results indicated that control was possibly a better dimension to analyse with respect to motor performance, because judges evaluated the criterion performances of participants with vivid uncontrolled images as lower in movement skill level.

Several studies in which individuals were involved in the learning or mental practice of a specific motor task, using various imagery rehearsal strategies, have also attempted to highlight the influence of individual differences in imagery ability. White, Ashton, and Lewis (1979) grouped 24 high school and university students, who ranged in age from 13 to 27 years, on the basis of the mental and physical practice strategies used to learn the action/reaction start used in competitive swimming. Imagery ability as assessed by the SQMI and the GTVIC appeared to be unrelated to performance improvement scores. The kinaesthetic subscale scores of the SQMI were, however, found to correlate significantly, $r = -.57$, with improvement scores for the 12 participants that used mental practice. The researchers interpreted this latter finding as representative of the importance of kinaesthetic imagery within the framework of mental rehearsal. In a study in which various mental rehearsal strategies were implemented to enhance physical practice in learning the basic backstroke swimming skill, Yamamoto and Inomata (1982) found, for a sample of 36 undergraduates, that two groups using imagery based rehearsal strategies did improve both distance and speed of swimming. This improvement in performance over three test sessions was not significantly greater than for a physical practice only control group. Each test session involved the assessment of imagery ability on a modified version of the QMI and by a shorter, swimming specific imagery version of this measure. Although Yamamoto and Inomata found no direct interaction between imagery ability and improved performance, correlations between the two imagery measures for each test session for each group highlighted an interesting pattern of association. The correlations increased over the training period for the imagery groups, $r = .52$ to $.65$, and, $r = .30$ to $.87$, but not for the control group,$r = .49$ to $.25$. The results tentatively support the conclusion that mental rehearsal increases imagery vividness, specifically the ability to vividly image actual motor task performance. Evidence generated from these two studies provides limited support for the appropriateness of assessing imagery abilities in conjunction with motor performance evaluations within imagery rehearsal studies. In addition, the findings highlight the need for increased attention to both the specificity of the areas of imaging assessed, such as the kinaesthetic modality, and the level of task relevance used to facilitate images within the design criteria of imagery ability measures.

Studies in which the SQMI was used to classify participants into high and low groups have generally been unable to show that differences in imagery ability can discriminate between performances on motor tasks considered to involve the use of imagery. Walsh, Russell, and Imanaka (1980) found that groups of four participants rated high in imagery ability were unable to recall either the end-point or movement distance of a simple horizontal linear movement task with greater accuracy than similar groups with low scores on the SQMI. The investigators replicated this result in a second study in which they gave participants specific instructions to use imagery to perform the motor movement recall activity (Walsh et al., 1980). Hale (1982) used a similar grouping procedure as a component of a study investigating psychophysiological responses to imagining a biceps curl. Participants were classified as high if they scored 10 or less on the visual subscale of the SQMI or low if they scored 16 or more. The first group ($n = 11$) had no significantly greater ocular response than the second group ($n = 11$). Scores on the kinaesthetic subscale of 10 or less and 17 or more, were also used to group participants. High imagers ($n = 13$) recorded similar levels of biceps electrical innervation, during the imaging of a biceps curl, to low imagers ($n = 15$). Conclusions drawn for these studies focused on the ineffectiveness of individual differences in imagery ability to predict performance on the motor-related tasks. Although Hale (1982) made appropriate use of the modality specific nature of the SQMI subscales within his study, the general nature of the items within this questionnaire may be a contributing factor in the failure to detect differences in either memory or psychophysiological responses related to motor-based imagery activities.

Housner and Hoffman (1981) and Housner (1984) have reported on similar investigations that examined the role of imagery abilities in the recall of motor stimuli. The research incorporated both objective and self-report measures as classification devices for grouping participants with respect to their imaging skills. In the first study, Housner and Hoffman (1981) used a measure of space relations, the Differential Aptitude Test, to select 12 high and 12 low scorers from a sample of 70 male undergraduates. They examined motor behaviour involving the recall of movement end locations and distances within four different retention conditions. The initial analysis of the data failed to highlight any significant differences between the high and low groups. Subsequent comparison of those participants in the high group who reported using imagery coding strategies with those in the low group who used no such strategy indicated significantly less recall error for the highs in the immediate and imaginal rehearsal conditions. Housner and Hoffman suggested that "visual imagery ability may be an important factor in the retention of location information, but of little functional significance in the recall of distance" (p. 207). The use of a test of spatial relations as an accurate indicator of visual imagery ability constitutes a factor that could limit the imagery group differences in relation to the motor performances reported. Gubelmann (1993) also found little relationship between scores on a spatial ability measure, the 3D tube-figure test (Stumpf & Fay, 1983) and performance on an agility task. The research involved two large samples of mixed gender juveniles ($N = 228$

and $N = 296$) undertaking a mental rehearsal treatment program and completing pre- and post-test performances of a standardised steeple-chase run. Small negative correlations between spatial ability scores and pre-and post-test difference scores, $r = -.13$, for both samples, support the earlier suggestion that imagery ability in relation to motor skills may not be adequately examined by this type of objective measure.

In a subsequent study, Housner (1984) made use of a more accepted measure of visual imagery ability, the VVIQ. Ten male and 19 female undergraduate physical education students were randomly assigned to two experimental groups that were each divided into high and low ability classifications on the basis of a median split dichotomisation of VVIQ scores. The motor task required participants to view and reproduce filmed examples of a variety of particular body movements of varying levels of complexity and orientation. Two judges independently scored the videotaped reproductions of participants. Results revealed a significant main effect for imagery ability and free recall scores, in which high scorers recalled the movements with less error than lows. Additionally, Housner reported a non-significant main effect for the serial recall of the movement patterns. These findings provide only minimal supplementary evidence as to the role visual imagery may play in the performance of motor activities. Of interest from a measurement perspective is the suggestion by the Housner that the true nature of the effects of imagery abilities in these types of motor memory activities may have been hidden, because the differences between the two imagery groups "were not large enough to produce the anticipated effects" (Housner, 1984, p. 156). The mean score for highs on the 5-point scale of the VVIQ was 1.91 and for lows 2.79. Housner concluded that it is important to ensure that the extreme high and low scorers on this type of measure are utilised in future investigations, however, this may be difficult due to the high level of skew observed in the results of many measures.

Motor Performance Research Involving Study Specific Imagery Measures

The examination of imagery abilities and motor task performance has often involved the use of measures designed specifically for a particular study or the use of measures of unknown psychometric quality. Epstein (1980) described a positive association (no correlations provided) between dart-throwing ability and auditory, tactile, and olfactory imagery for 42 male undergraduates. Females ($n = 33$) demonstrated a similar association only for auditory imagery. The imagery-style questionnaire assessed the variables of clarity, difficulty, ability to concentrate, auditory, olfactory, tactile, and kinaesthetic sensations in response to the following four images: peeling an orange, riding an elevator, dialling a phone, and throwing a dart. The unusual pattern of results in conjunction with the general nature of the images that participants were asked to generate would most probably have impacted quite negatively on the findings. As a post-test component of a study to investigate the efficacy of mental imagery in performing a motor task, Ryan and Simons (1982) asked participants to rate the strength of their images. A sample of 80 male traffic police were categorised, on the basis of a pre-test imagery use questionnaire, into six groups: physical practice, no practice, imagers asked to use imagery, imagers asked not to use imagery, non-imagers asked to use imagery, and non-imagers asked not to use imagery. Results indicated that participants from the four experimental groups who reported strong visual imagery showed significantly greater improvement on a stabilometer balancing activity than those reporting weaker images, and those with strong kinaesthetic imagery performed better than those with weak kinaesthetic imagery. Although this latter set of results provided a basic indication of the association between imagery ability and motor performance, a more sophisticated or detailed questionnaire including a broader set of modalities and dimensions may have been useful in defining specific characteristics of the individual differences in the imaging abilities relative to motor skills images.

An interesting approach to both the assessment of imagery ability and the examination of how the methodology related to the performance of a simple motor task was detailed by Alvoeiro and Sewell (1993). The questionnaire involved the rating of words, selected on the basis of their strong sensorial image qualities. A final list of 36 high imagery visual, auditory, kinaesthetic, and mixed modality words was presented to participants, who were then asked to circle the sense (visual, auditory, or kinaesthetic) they considered best represented the image generated by the word. The experimental motor task involved participants, who wore displacement goggles, practising pointing at the centre of a dartboard. This activity was followed by an assessment period in which the 16 participants were asked to use either visual or kinaesthetic imagery to assist in the performance of the pointing task 10 times with their eyes closed. A control group (n = 16) performed the activity without using imagery related to the motor task. Results of a correlational analysis of the experimental group data revealed that high visual imagery scores were significantly associated with less movement deviation when using visual imagery, $r = -.50$, and with greater movement deviation when using kinaesthetic imagery, $r = .68$. Participants who scored high with respect to kinaesthetic imagery displayed less movement deviance when using kinaesthetic imagery, $r = -.51$, and greater movement variation when using visual imagery, $r = .75$. The investigators reported no consistent differences for the control group. These results highlight the appropriateness of including modality-specific test items as a procedure for identifying differences in the sensory emphasis individuals may display with respect to their images. In addition, the measure provided a simple framework to aid in the selection of the image characteristics that the person should attend to during imagery training regimens. Such research has merit as an attempt to ensure the imagery assessment device is relevant to the task being examined, a methodological problem noted as affecting previous studies (Katz, 1983).

Motor Performance Research Involving Movement Imagery Ability Measures

The precision with which the relationship between imagery ability and motor performance is examined has been enhanced by the development of measures that focus on the assessment of imagery related to movement. As described previously, the VMIQ is a measure that was created to highlight the nature of the visual and kinaesthetic imagery associated with physical movement and provide support for distinguishing movement imagery from the imagery examined within general questionnaires. Several studies have incorporated the device to assist in the investigation of the association between individual differences in movement imagery and competence in performing various motor skills (e.g., Isaac & Marks, 1994; O'Bryan-Doheny, 1993; Williams & Isaac, 1991).

Williams and Isaac (1991) divided a sample of 53 mixed gender teenage school children into high and low motor skill groups on the basis of the Bruininks - Osenetsky test of motor proficiency. Very small non-significant differences were found between the groups on both the Vividness of Visual Imagery Questionnaire (VVIQ) and the Vividness of Movement Imagery Questionnaire (VMIQ). Following bivariate analysis, two correlations of note were reported for the high skill group only. The relationships discussed were the VMIQ and the visuomotor component of the Bruininks test, r = .46, and the VVIQ and performance on a mirror tracing task, $r = -.42$. Although these correlations appear to provide useful information, it should be noted that they are either reported incorrectly or they are representative of a high imagery ability to low motor skill relationship, as both the imagery measures are reverse scored. Williams and Isaac proposed several reasons for these findings. Firstly, the young age ($M = 14.4$ years) of the participants may be a limiting factor in the level of stored movement information and, secondly, the questionable validity of the dependent measure due to its limited association with the other motor proficiency measures suggests that this finding is not reliable (Williams & Isaac, 1991). A possible explanation not presented by the authors relates to the classification of the two groups. It could be argued that they do not represent the extremes of motor skill performance but merely a median split.

O'Bryan-Doheny (1993) presented additional research that utilised the VMIQ to examine the imagery effects of mental practice on the performance of a psychomotor skill. The specific skill investigated was giving an intra-muscular injection. Ninety-five nursing students, of which 87 were female and only eight were male, were randomly assigned to the following groups: an instruction-only control, guided imagery, relaxation, and guided imagery plus relaxation. A member of the nursing faculty assessed performance of the skill following the treatment period by using a standardised rating procedure. High imagers were differentiated from low imagers on the basis of the median score on the VMIQ. The results revealed a marginally significant difference between the two levels of imagers in performing the motor task, irrespective of treatment group, based on the chi-square statistic. The median split of VMIQ scores as a grouping technique may have limited the true distinction between high and low ability participants, as a number of scores within the low ability group represented imagery that was rated moderately clear and vivid. These findings provide support for the premise that individuals with high movement-related imaging ability perform basic motor activities more accurately than low imagery ability individuals. Additionally, the VMIQ appears to be a suitable device for examining the imagery related to this type of skill. Generally, the VMIQ represents a positive development in the methodological approach to the measurement of movement or motor-related imagery abilities. The research support for the test as it is used with respect to motor performance is limited, however, new investigations would contribute significantly to a more complete understanding of the applied and research qualities of the VMIQ.

Much motor imagery research has involved the use of the MIQ as an assessment device to quantify imagery abilities in relation to motor performance. Many of the existing investigations using the MIQ involved collaboration with the developer of the questionnaire, Craig Hall. Goss et al. (1986) asked 219 individuals, involved in either a summer sport program or enrolled in general university programs, to complete the MIQ. From this sample, the investigators classified participants into three groups based on their MIQ scores, as high visual/high kinaesthetic (HH) ($n = 22$), low visual/low kinaesthetic (LL) ($n = 19$), and high visual/low kinaesthetic (HL) ($n = 11$). A final group size of 10 participants was employed for each classification. No participants scores matched the criterion of low visual/high kinaesthetic imagery. The learning, retention, and reacquisition of four simple movement patterns performed on a pantograph constituted the basis for the motor performance variable. The researchers asked participants to use kinaesthetic imagery to aid in the performance of the task. Analysis of the acquisition phase, using the Tukey test, indicated a significant difference between the groups. The HH group required the smallest number of trials to learn the patterns, followed by the HL and LL groups respectively. Although the trend of required trials for the reacquisition phase was similar to the acquisition phase, the differences were not significant. Results from the retention phase, in which the researchers recorded the number of participants from each group who correctly performed at least one of the movements was found to be significant using a chi-square analysis. Goss et al. found no significant differences between the groups based on the total distance error (TDE) scores for any of the experimental phases and attributed this finding to the similarity in both initial scores and the overall retention rate of the groups. As part of a post-test questionnaire, participants high in imagery ability reported they had less difficulty in kinaesthetically imaging the patterns than the low ability group. The general conclusion was that variations in imagery ability may affect the learning, and to a lesser extent the retention, of movement patterns.

In a similar follow-up study, Hall, et al. (1992) used the MIQ to classify participants as high or low with respect to imagery ability. From an original sample of 103 university student volunteers, the classification of participants resulted in a group of 12 high visual/high kinaesthetic imagers, and a second group of nine low visual/low kinaesthetic imagers. The researchers provided participants with two trials, for each of 12 movement patterns performed on a pantograph, during the learning phase. The use of both visual and kinaesthetic imagery was encouraged as an aid in the acquisition of the patterns. Following a distraction activity, the researchers asked participants to recall as many of the movement patterns as possible. One week latter, delayed recall and recognition was tested. Results revealed no significant differences between the groups in either immediate or delayed recall. Interestingly, the pattern of TDE scores within these groups differed from the previous study, in that Hall et al. reported a significant difference effect between the groups, using split-plot. These results support the broader research findings (Hiscock, 1978; Tracy et al., 1985) that imagery ability has minimal involvement in the process of memory and prompted the authors to suggest that: "high imagers can be expected to have little advantage over low imagers on standard movement recall and recognition tests" (p. 89). Motor task performance (e.g., movement accuracy) does appear to be influenced by variations in the ability to image (Hall et al., 1989; Hall et al., 1992).

Both the sound design and psychometric qualities of the MIQ may have prompted the use of the measure in a number of other imagery-related motor skill investigations. Corlett, Anton, Kozub, and Tardif (1989) found no significant group differences between low, medium, and high imagers, as classified on the visual subscale of the MIQ, in performance of a "blind" target-directed, walking task. The descriptive trends for the dependent motor task variables indicated that high and medium level imagers performed more accurately than low imagers. It was suggested by Corlett et al. that the skewed nature of the MIQ scores, task simplicity, and relevance of the assessment task to the imagery measure requirements may have influenced the results. Closer examination of the methodology highlights two additional problems unaddressed by the researchers. Firstly, although Corlett et al. indicated that visual imagery was the variable of interest, they selected the MIQ as the imagery assessment device, a dual modality measure, and utilised only the scores from the visual subscale. An alternative single-modality measure (VMIQ or VVIQ) may have proven a better option to accurately assess visual imagery ability. Secondly, no instructions were given to the participants to use imagery in the performance of the task, which may have limited the advantage a high imager had over a low imager on this type of activity.

Investigations of the physiological responses of muscle groups during imagined motor performance have also utilised the MIQ to quantify imagery ability. Jowdy and Harris (1990) compared the biceps EMG responses during imagination of a juggling action, of experienced (n = 14) and novice (n = 15) jugglers. It was reported that there were no significant differences in EMG activity, when the sample was classified high or low on the basis of their MIQ scores. The only significant correlation reported, r = .78, was found when kinaesthetic score was compared to muscular activity during imagery. Unusually, this correlation suggests that participants low in kinaesthetic imagery generated greater muscular responses during imagery. Descriptive data for the MIQ scores also showed that the low skill group had higher imagery abilities than the high skilled group. As Jowdy and Harris suggested, the fact that imagery ability was not controlled for within the study may well have influenced the results. Bakker, Boschker, and Chung (1996) tested the hypothesis that participants whose EMG patterns during an imagined dumbbell curl that most closely replicated the actual movement pattern, would have higher MIQ scores than participants whose patterns were less similar to the movement. A mixed gender sample of 39 participants, 10 of whom were experienced body builders, volunteered for the study. Results of an ANOVA for the EMG activity index and the kinaesthetic subscale score of the MIQ indicated no significant differences between the high score and low score groups based on the MIQ variable. No result for this type of analysis for the visual subscale scores was presented. Collins and Hale (1997) examined this research in detail and concluded that it was flawed by several conceptual, methodological, and analytical problems, in particular the lack of emphasis on specific physiological responses within the pre-image instructions. Generally, the results of these studies using the MIQ, as with earlier studies (e.g., Hale, 1982), highlight that demonstrating a significant association between self-reported imagery ability and the physiological responses generated through imagery, is either very difficult to achieve, or affected by problems relating to study design and implementation.

Although the evidence generated from motor performance studies that have used the MIQ has presented a number of non-significant findings, the general trend of results suggests it is suitable for this type of research. The regular selection of the measure as an applied tool within investigations of a broad spectrum of motor skill tasks, suggests that researchers within sport psychology consider the MIQ is capable of highlighting any relationship between movement imagery ability and performance of motor skills.

The assessment of imaging abilities as a mediating variable in the performance of specific motor activities has been substantially researched. Support for the existence of an association between these variables, as the previous review of research details, is inconclusive. The results of several investigations (e.g., Goss et al., 1986; Hall et al., 1989) provide encouraging indicators that continued research is warranted. A number of key factors relating to methodological imperfections have become apparent as an outcome of this review, that other researchers have previously noted (Collins & Hale, 1997;

Gubelmann, 1993; Wollman, 1986). These are the use of an appropriate measure to assess both quality and quantity of imagery ability, the importance of using suitable imagery instructions, the assurance that the motor activity being examined requires imagery within its performance, and a level of task difficulty that is appropriate to differentiate between participants. Future studies in this area should endeavour to deal with these factors to maximise the possibilities of accurately detecting the effects of individual differences in imagery ability in the area of motor performance.

Imagery Ability Assessment and Sports Performance

Authors of recent discussions of imagery in sport have acknowledged the importance of imagery ability as a mediating variable in understanding the efficacy of imagery for enhancing athletic performance (e.g., Cox, 1998; Gould & Darmajian, 1996; Hall, 2001; Perry & Morris, 1995; Rushall & Lippman, 1998; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). Unfortunately, there is limited detailed research confirming a specific basis for the association between imagery ability and achievement in sport. In addition, no parallel exists between the development of specific measures designed to examine movement-related imagery and the construction of tests emphasising sport-oriented imagery. Much of the existing research in this area that examined individual differences in imagery ability in relation to sports skills has relied on measures assessing general or movement-related imagery (e.g., Eton et al., 1998; Mahoney & Epstein, 1981; Rodgers, Hall, & Buckolz, 1991). This section of the review examines the available research in which measures of imagery ability were used to generate data relating to the study of imagery and sports performance.

Previous studies have examined issues such as the comparison of successful and non-successful performers, the comparison of elite and non-elite performers, effectiveness of imagery training programs for athletes, and individual differences of athletes from different sports. In an effort to maintain a consistent approach within this review where assessment is the key focus, I will discuss existing research in relation to the particular measure selected to assess imagery ability (e.g., MIQ, SIQ, VMIQ), rather than in relation to sporting characteristics (e.g., individual versus team) or specific sports (e.g., basketball, skiing). Additionally, research using measures of a more general nature, such as the SQMI, is reviewed first, followed by research using measures developed specifically for a certain study or comprising only small sections related to imagery ability. The examination of studies assessing movement or sport-related imagery ability concludes this section of the review.

Sports Performance Research Involving General Measures of Imagery Ability

The research examining sporting performance or participation, in which general measures of subjective or objective imagery ability have been used, is very limited. Graydon (1980) administered the space relations form of the DAT to three groups of 13 female squash players. The groups were classified as international level, low ability, and non-players. The results of an ANOVA revealed no significant differences between DAT scores for the groups. It was argued by Graydon that the game of squash is so complex that "the contribution of a single factor such as spatial ability is likely to be minimal" (1980, p. 970). No discussion of spatial ability as a measure of imagery ability was undertaken. Moran (1991, as cited in Moran, 1993), reported that scores on the Mental Rotations Test (MRT, Vandenberg & Kuse, 1978), a measure of spatial visualisation, were positively correlated, $r = .44$, with successful results in World Cup canoe-slalom events. Although this result suggests that an association existed between sporting performance and spatial ability, the lack of other published research using objective measures and the evidence from the Graydon study, raise some doubt whether tests of this type are particularly useful in analysing the nature of the association between imagery and performance abilities typical of a broad range of individual and team sports.

Only one imagery study involving athletes, in which the SQMI was used, was identified during the course of the present review. Hecker and Kaczor (1988) asked 19 members of a varsity NCAA Division I-AA women's softball team to complete the SQMI. This investigation primarily focussed on the measurement of variations in heart rate, while participants imaged four different scenes, two of which related to athletic activity, one was a non-sport anxiety-provoking scene, and the fourth a neutral scene. Hecker and Kaczor reported no significant correlations between SQMI scores and heart rate variation scores for each scene. Interestingly, the SQMI scores of this small sample ($M = 70.16$, $SD = 18.24$) were indicative of higher imagery ability when compared to relevant large sample norms ($M = 87.33$, $SD = 24.57$), detailed by Miller et al. (1986). A additional rating scale of imagery vividness, using a 9-point Likert type format ranging from 0 (*no image*) to 8 (*lifelike image*), was developed by Hecker and Kaczor and used by participants to rate vividness for each of the four scenes. The vividness ratings of the athletic scenes (action and anxiety) were significantly higher than the vividness scores associated with the neutral scene. Hecker and Kaczor found no significant correlations between SQMI scores and these vividness ratings. This set of results highlights several points of interest. Firstly, it seems that sporting groups, such as this one, may out perform non-athlete samples on measures of imagery ability, such as the SQMI. Secondly, the effectiveness of the SQMI as an indicator of sport-related imagery abilities is questionable because it showed little association with the imagery vividness ratings of sport-oriented scenes. Finally, the relevance to the respondent of the scene or item used to stimulate generation of the image (sport versus non-sport) could mediate imagery vividness scores as assessed by the simple scale used in this study. The research of Hecker and Kaczor has proven useful in both indicating certain characteristics of general measures of imagery ability in relation to athletic samples and in highlighting the importance of measures of imagery ability containing items appropriate to the population of interest.

Some of the earlier research in the sports performance area relied on introspective reports and simple one- or two-item questionnaires as the procedure for evaluating the imagery ability levels of participants. Clark (1960) asked 72 high school students, who were involved in a mental practice training program for a one-handed basketball free throw shot, to introspectively report on the images they experienced during the experimental condition. The conclusion drawn following analysis of the interview material was that participants "reported a growth of the ability to visualize and imagine the shooting technique to some degree" (p. 568). In a later study, Shick (1970) investigated visual vividness ratings of imagined volleyball skills following a mental rehearsal treatment program. A group of 36 non-professional volleyball players, in responding to a 5-point Likert-style item ranging from 1 (*no image*) to 5 (*every detail clear*), rated their images of both serve and volley skills as either clear or mostly clear. In addition, participants generally responded 'yes' to an item that asked if they were able to 'feel the action', while imaging both the serve and volley skills. These types of findings suggest that the efficacy of various mental rehearsal strategies may be better understood if imaging abilities are examined as an adjunct to physical performance assessments. Although these relatively simple measures revealed basic trends in relation to sport imagery, multifaceted assessment devices targeting a broader range of imagery processing variables could facilitate the acquisition of detailed information in relation the imagery abilities of athletes.

As a component in the examination of the psychological characteristics of elite athletes, several groups of investigators have included items assessing imagery ability. Unfortunately, the number of items pertaining to this variable has tended to be very small (e.g., two or three), and generally dealt with only vividness and control of visual or kinaesthetic imagery. Mahoney and Avener (1977) presented one of the initial studies of this type. The research involved 13 male gymnasts, preparing to compete in the final trials for the U. S. Olympic team. Of the 53 questionnaire items that examined a variety of psychological characteristics and the use of cognitive strategies, only two items referred specifically to imagery ability. These particular items used an 11-point Likert-type response scale and examined image clarity and the difficulty of controlling imagery. Results indicated only a limited association between the imagery ability item scores and grouping as either a team qualifier or non-qualifier. The control item, $r = -.34$, was more strongly associated with the grouping variable than the vividness item, $r = .17$. In a subsequent study involving nine elite male racquetball players, Meyers, Cooke, Cullen, and Liles (1979) used the inventory developed by Mahoney and Avener (1977). Dependent performance evaluation variables included: (a) coaches' rankings, from 1 (*most skilled*) to 9 (*least skilled*), of both practice during the previous week and participation in competition at the end of that week; (b) divisional ranking from first down to third division; (c) round eliminated at the Tennessee State Championships; and (d) points differential between points scored and points given up at these championships. Small to large correlations, in the expected direction, were reported for association between the vividness item and each of the performance variables, $r = -.70$ to $.44$, except the coaches' ranking following competition, $r = -.06$. The pattern of the relationships between the control item and the performance measures was difficult to interpret. Moderate correlations, in the direction that indicated better performance was associated with less imagery control, were reported for the coaches' first ranking and the divisional ranking, $r = -.41$ and $-.51$, respectively. A very small correlation was found between the control item score and the coaches' second ranking, $r = .03$. Moderate correlations were found between the control item scores and the two championship performance variables, round eliminated, $r = -.34$, and point differential,

$r = -.50$. These results highlighted the type of associations, between objective sport performance indices and imagery control scores, representative of the expected outcome of participants high in imagery control ability performing better in athletic competition than those with low imagery control ability. Finally, Rotella, Gansneder, Ojala, and Billing (1980) investigated the psychological characteristics of 47 mixed-gender, elite, junior skiers, using the Mahoney and Avener measure. Participants were ranked according to performances over the last competitive ski season for slalom and giant slalom events. Rotella et al. reported no significant correlations between athletic ranking and scores on either of the imagery ability items.

The findings from these three studies provide basic evidence of the nature of the relationship of athletic performance and the vividness and control of imagery. Several characteristics of the research methodologies adopted within these investigations may have contributed to the inconsistency of the resultant data. Specifically, procedural problems included the small sample sizes used for these types of correlational studies, the focus on differentiating between athletes from samples that are relatively homogenous with respect to sporting skill levels, and the limited number of items within the questionnaire related to imagery ability. Future research could benefit substantially from attention to these types of problems, particularly the inclusion of elite and non-elite athlete groups and the use of measures developed specifically to examine sport-related imagery ability.

A second group of studies that focussed on the evaluation of the psychological characteristics of elite athletes also included the examination of imagery ability within the assessment devices developed. Highlen and Bennett (1979) used an adaptation of the Mahoney and Avener (1977) inventory, modified for specific use with wrestlers. The sample comprised 24 qualifiers and 15 non-qualifiers, who participated in the trials for representation on three Canadian National wrestling teams. Prior to the commencement of the competition, the athletes completed the psychological characteristics questionnaire. Only five of the 143 items related to the general area of imagery, as one of 12 factors relating to the behaviour and cognitive processing athletes typically employ in their mental preparation for elite level wrestling competition. Although not specifically detailed within the article, review of the measure revealed that several of the items did relate to the vividness and control of imagery. Highlen and Bennett found the imagery factor to be one of the variables that did not significantly discriminate between qualifiers and non-qualifiers. They also concluded that one of the most important contrasts between their findings and those of the Mahoney and Avener (1977) research involving elite gymnasts, was that the wrestling sample reported only a moderate involvement of imagery within their mental preparation. Highlen and Bennett suggested that variations in the results of these studies might be attributable to differences in the way that athletes use imagery within open and closed athletic skills.

Gould, Weiss, and Weinberg (1981) used a modified version of the Highlen and Bennett (1979) inventory, comprising 107 items, with a sample of 49 volunteer wrestlers involved in a large interstate college wrestling championships. As with the earlier study, the five items relating to imagery use, control, and clarity as a subscale did not differentiate between 19 placegetters and the 30 non-placegetters. In addition, Gould et al. used a comparison of the wrestlers' performances over the preceding 12 months to categorise participants into two groups. These were (a) those that had won more matches than the sample average and (b) those that had won fewer matches than the average. This grouping procedure did not differentiate the wrestlers in relation to their imagery subscale scores. In discussing these findings in relation to other similar studies based on the Mahoney and Avener (1977) inventory, Gould et al. (1981) concluded that these results "add support to the contention that the utility of imagery techniques in enhancing imagery may be sport specific" (p. 80). Gould et al. (1981) and Highlen and Bennett (1979) could have enhanced the imagery specific information derived from the comparisons undertaken in their research by presenting the data relating to specific items dealing with vividness and control of imagery.

A follow-up study undertaken by Highlen and Bennett (1983) compared the psychological characteristics of elite level open- and closed -skill athletes. The investigators modified two versions of their earlier questionnaire for use with wrestlers and divers respectively. A sample of 44 divers competing at the Canadian National Championships, eight identified as qualifiers and 36 non-qualifiers, completed the 110-item questionnaire. Results relating to the comparison of the two groups with respect to the five imagery scale items, revealed significant differences for the control item, but not for the vividness item. Highlen and Bennett conducted an additional comparison of 39 wrestlers competing for national team representation, of which 15 were classified a qualifiers and 24 as non-qualifiers, using the modified questionnaire. They found no significant differences between the two groups relating to the imagery items. Finally, the investigators completed a number of direct comparisons between the data from the diving sample, representing a closed-skill sport, and the wrestling sample representing an open-skill sport. The hypothesis Highlen and Bennett were testing was that the elite divers would utilise more visual strategies than the elite wrestlers. The results of the between group *t* tests for the imagery subscale scores and for individual imagery test items revealed no significant differences. On the basis of the overall findings of the study, Highlen and Bennett concluded, that imagery self-report data was similar for the two athlete samples and that it only differentiated qualifiers and non-qualifiers for the diving sample. This data, in conjunction with the findings of the related studies, tentatively indicated the existence of individual differences in imagery ability between athlete samples. Measures designed specifically to examine a more comprehensive range of the characteristics associated with sport imagery ability could prove more sensitive in the identification of any differences between athletes in their generation of images than those questionnaires that simply incorporate imagery variables as a component of broader psychological skills evaluation. Subsequently, the development of any new measure capable of generating precise and detailed imagery information would necessitate the adoption of procedures, such as the description of rationales for the inclusion of items, increasing the number of items, and the rigorous psychometric evaluation of the device.

Further studies investigating the psychological skills of elite athletes continued to use general measures that included items associated with imagery abilities. Mahoney, Gabriel, and Perkins (1987) acknowledged certain psychometric limitations associated with the questionnaire developed by Mahoney and Avener (1977), and also a number of methodological problems, related to the sampling procedures used in several of the studies described earlier. Initially, Mahoney et al. redesigned the Mahoney and Avener (1977) measure through rewording items and modifying the item response format to include a true/false distinction. Mahoney et al. administered the 51-item Psychological Skills Inventory for Sports (PSIS) to three mixed gender athlete groups classified as elite (n = 126), pre-elite (n = 141) and non-elite (n = 446). It seems questionable that the non-elite classification was appropriate, as the group comprised athletes from major university athletic teams, rather than recreational athletes. Mahoney et al. justified this grouping framework by suggesting that highlighting the psychological skills that may differentiate athletes participating at the highest levels was a key design element of the measure. A fourth group of 18 sport psychologists responded to the measure from the perspective of an elite level athlete. Mahoney et al. presented results for a number of different analyses relating to the three items representative of imagery abilities. Items examining the vividness of visual and kinaesthetic imagery and imagery control only differentiated between the elite and non-elite athletes with respect to kinaesthetic imagery. The fact that both items referring to visual imagery and control were negatively worded might have affected the response patterns. Interestingly, both items relating to visual and kinaesthetic imagery differentiated the elite group from the sport psychologists. The sport psychologists answered these items, along with the control item, and responded that elite athletes have more vivid and controlled imagery than the athletes actually reported that they experience. Results of discriminant and regression analyses revealed that the kinaesthetic imagery item was one of the strongest of the 10 items that differentiated the elite and non-elite groups. The small number of items, the true/false response structure, and the use of a homogeneous sample limited the evidence from this study relevant to the imaging abilities of athletes. The inclusion of the sport psychologists' responses did provide information not previously considered in this area. Chartrand, Jowdy, and; Danish (1992) have also questioned the validity of the PSIS. These types of findings provide additional support for the continued investigation of the role of imagery abilities independently of measures that serve as general indicators of the psychological characteristics of superior athletic performers.

Sports Performance Research Involving Qualitative Assessment Of Imagery

Orlick and Partington (1988) used both interview material and questionnaire data in assessing the mental readiness of 235 Canadian Olympic athletes. Their study revealed a number of important relationships between imagery ability and elite level sports performance. In reviewing the interview transcripts reproduced in their report, I was able to identify elements related to the imagery dimensions of vividness, ease, and control, the visual, kinaesthetic, auditory, and tactile modalities, and the imagined emotional experience. The authors summarised key features of the nature of the imagery training of the 75 interviewed athletes which included the development of quality imagery skills and practice routines, the importance of both visual and kinaesthetic sensory involvement, and that good imagery control was only achieved through regular rehearsal. Results of the comparison of the performances of the athletes at the 1984 summer and winter Olympics with responses to the specific questionnaire items examining imagery, revealed that higher achieving male athletes experience more vivid kinaesthetic imagery, $r = .26$. In addition when the response ratings for control and use of kinaesthetic imagery were combined for the males athletes, the correlation increased to, $r = .41$. The investigators did not report any significant correlations for female athletes between quality and quantity of imagery and their Olympic performance rankings. Quantity of their "success imagery" (p. 126), however, did correlate significantly with their reported mental readiness to perform at the Olympics, $r = .58$. This relationship highlights the importance of the emotional component of sport-based imagery that would typically be involved in images associated with Olympic achievements. The key findings of this research provide useful indications of the types of variables warranting consideration within the design of measures assessing sport imagery ability.

Although not directly related to the differentiation of athletes on the basis of their level of sports performance, recent qualitative research examining the imagery processes of elite athletes provides important evidence regarding modalities and dimensions (Munroe, Giacobbi, Hall, & Weinberg, 2000; Moran & MacIntyre, 1998; White & Hardy, 1998). White and Hardy (1998) examined imagery use of elite slalom canoeists ($n = 3$) and artistic gymnasts ($n = 3$). They did not directly generate evidence regarding modal or dimensional content. A review of the study, however, highlighted reference to interview material describing visual, kinaesthetic, aural, and emotional imagery characteristics in relation to athletic participation. Munroe et al. (2000) also used interview procedures to investigate the imagery use of 14 elite athletes, representing seven different sports. The findings of this study of relevance to the present thesis relate to the modal content of the participants imagery descriptions. Munroe et al. reported that identified interview content referring to kinaesthetic imagery occurred most frequently, slightly more than visual imagery, and substantially more than both auditory and olfactory imagery. Finally, Moran and MacIntyre (1998) presented data derived from interviews with 12 elite level world cup canoe-slalomists detailing the specific modal quantities of the athletes sensory-oriented imagery references. The findings indicated that 100% of the group referred to the visual sense, 75% to the kinaesthetic sense, 67% to the auditory sense, 16% to the tactile sense, and 8% to the olfactory sense. Overall, this collection of studies highlights the capacity of qualitative methods to provide valuable evidence of modal indicators of the imagery processes of elite athletes. Unfortunately, it appears that this methodology is less capable of providing consistent indications of the dimensional characteristics of sport imagery. Additionally, comparisons between athletes performing at various competitive levels, based on imagery transcript material, could provide valuable information toward understanding individual differences in imagery abilities.

Sports Performance Research Involving Measures of Imagery Use

The Imagery Use Questionnaire (IUQ; Hall, Rodgers, & Barr, 1990) and its sport specific modified variants have proven to be useful in generating evidence of the imagery abilities of a variety of athlete groups, in addition to information regarding imagery use. In its original form, the measure comprised 37 items, including 12 items relating to aspects of imagery ability, such as vividness, control, ease, visual sensations, tactile sensations, kinaesthetic sensations, and emotional experiences. Hall et al. (1990) administered the IUQ to a mixed-gender sample of 381 athletes from six sports. The athletes competed at four levels ranging from recreational to international. Only one item differentiated significantly between the competitive classifications. This item examined the ease of generating a visual image of an entire physical skill. Several trends were evident from the descriptive statistics that suggested athletes participating at higher competitive levels rate their imagery vividness and imagery control higher than recreational athletes. Closed skill athletes rated their kinaesthetic imagery higher than open skill athletes. Overall, the majority of participants rated kinaesthetic imagery as relatively easy to use, similar to their ratings of visual imagery ability. These trends suggest that the investigation of imagery ability in sport is a procedure that can generate valuable evidence to assist in understanding the manner in which athletes, at all levels of sporting ability, utilise imagery as a psychological skill.

Researchers have successfully used sport specific versions of the IUQ to investigate the relationship between imagery characteristics and athletic ability. Barr and Hall (1992) assessed the use of imagery of a sample of 348 rowers performing at the high school, college, and national levels. The rowing version of the IUQ contained 12 items examining similar aspects of imagery ability detailed in the original measure. Seven of these items refer to the modal qualities of imagery, with one item pertaining to vividness of visual imagery and six items related to specific characteristics of the kinaesthetic imagery of rowing (e.g., "To what extent do you feel the blade through the water?"). Discriminant function analysis of the test items that best differentiated the elite and novice rowers, revealed that four of eight most discriminating items assessed the kinaesthetic modality. Elite and novice rowers also differed in the content of their visual imagery. These results suggest that any new measure of sport imagery ability should emphasise the assessment of the kinaesthetic sensations, as well as the visual sensations, associated with sporting performance.

Salmon, Hall, and Haslam (1994) developed a soccer oriented version of the IUQ. This adaptation of the IUQ contains items worded in such a manner that they appear to relate more to imagery ability than imagery use (e.g., "When you are imagining to what extent do you see yourself tackling the ball?"). The emotional experience of imagery and auditory sensations are also emphasised within several of the questionnaire's 34 items. This measure also assesses the dimensions and modalities examined in earlier versions of the IUQ. A mixed gender sample of 362 local to national level soccer players completed the measure. Results presented are more concerned with the nature of imagery use rather than the evaluation of imagery ability. Salmon et al. did find that although the involvement of auditory sensations within images was small, this variable did differentiate national and provincial level athletes from local level athletes. Emotional feelings of sporting images tended to be higher for provincial players than local players. The extent of involvement of kinaesthetic and visual sensations within the players' images did not differentiate between participation levels.

The IUQ and its various adaptations are capable of providing a general indication of the imaging ability of athletes. The measures, however, are not systematic or comprehensive in the manner in which they evaluate imagery ability. Each of the studies using versions of the IUQ provided evidence that could be of significant benefit in the development of a measure of sport imagery ability. Information pertaining to the imagery dimensions and modalities used by athletes represent the key elements of sport imagery use that could be successfully incorporated within a multi-modal, multi-dimensional measure dedicated specifically to the evaluation of imagery ability.

The Sport Imagery Questionnaire (SIQ; Hall, Mack, Paivio, & Hausenblas, 1998), a recent major revision of the IUQ, was designed to assess cognitive and motivational functions of imagery use. Examination of the individual item content indicates that aspects such as emotion and imagery control have been emphasised within the wording of certain items. Unfortunately, specific information pertaining to comparisons of elite and non-elite athlete groups on the basis of inferred dimensional or modality information contained within the SIQ is currently unavailable. It is noted that Hall et al. used regression analyses to determine which function of imagery use predicted performance at three levels of competition (high school, varsity, national) for a sample of 217 male and female athletes. Their results indicated that the cognitive functions of imagery, representative of imagery control, were more likely to predict the performance of athletes at lower levels of competition. In contrast, the motivational functions of imagery, representative of the emotional experience of imagery, predicted the performance of athletes performing at higher competitive levels. Future applied use of this new measure could generate information to ascertain its capabilities to assess the attributes of the imagery abilities of athletes performing at various skill levels, in conjunction with the measure's primary goal of evaluating imagery use. As with the other measures of imagery use discussed, the SIQ was not designed to measure imagery ability and for this reason can only provide basic information related to the ability of athletes to generate, manipulate, and maintain multi-modal sport-oriented images.

Sports Performance Research Involving Measures of Movement Imagery

Researchers have used movement imagery measures to assess individual differences in the imagery abilities of athletes in an effort to understand the role of imagery within sporting performance. The Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986) is one measure used successfully for this purpose in several studies. Isaac (1992) presented details of a study designed to determine the efficacy of a mental practice program on the learning of a complex trampolining skill. Participants were classified as novice or experienced on the basis of the time period over which they had received formal coaching. One group of 35 experienced athletes that had been coached for more than one year and a second group of 35 novice physical education students that had received no formal coaching, completed both the VMIQ and the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973). Isaac organised participants into pairs (novice/experienced) and then distributed pairs into an experimental group and no imagery control group. Following an 18-week training period for the experimental group and no contact for the control group, high imagers improved significantly more than low imagers, and the experimental group improved significantly more than the control group. Unfortunately, Isaac did not report details of the scores for the VMIQ and VVIQ. Isaac concluded that the findings supported the earlier proposition of Marks (1977) that irrespective of trampolining skill level the variable of importance in this type of mental rehearsal study is imagery ability. Participants who scored higher on the imagery ability measures and received the imagery training treatment showed the greatest improvement in performance of the skill. The results of this study do highlight the usefulness of imagery ability measures in supporting propositions regarding the effectiveness of imagery as a procedure in learning sports skills. The lack of specific details regarding visual or movement imagery scores inhibits the conclusions drawn as to which of the imagery variables has the greater influence in learning this type of skill. Future studies must ensure that information is detailed regarding the specific dimensional or modal qualities of imagery ability. This practice will serve to enhance the understanding of both the psychometric qualities of the measure and the manner in which imagery ability characteristics are influenced by imagery training programs.

Individual differences in the mental imagery experience of athlete samples have been examined through the use of the VMIQ. Isaac and Marks (1994) completed two studies that examined response differences on both the VMIQ and VVIQ for athletic and non-athletic samples. In the first study, the investigators compared the scores on the two imagery measures for 75 physical education students with the scores of 167 students from the degree programs of English, physics, and surveying. The findings supported the hypothesis that physical education students would report more vivid movement imagery than students from other subject areas. Comparison of the VVIQ scores of the two groups revealed no significant differences. These results suggest that the assumed superior movement abilities of physical education students are associated with superior imaging abilities related to the generation of movement images, rather than visual images.

Athletes from 16 different sporting disciplines and non-athletes matched for age and gender completed the VMIQ and VVIQ in the second study undertaken by Isaac and Marks (1994). The sample comprised equal-sized groups of 312 participants. Results of *t* tests on the scores for each of the sports groups and the control group indicated that 11 of the 16 sports groups scored significantly higher on the VMIQ. Only 9 of the 16 sporting groups had significantly higher VVIQ scores than the control group. Athletes from the five sports with the smallest numbers of participants, track and field, diving, swimming, kayaking, and shooting, were the only participants whose scores on both measures did not differ significantly. The data partially supported the hypothesis that the imagery abilities of sportsmen and women would be superior to age- and gender- matched members of the general population. Overall, these studies highlighted that variations in the movement and visual imagery abilities of athlete groups from different sporting disciplines are determinable. The development and usage of measures that assess multiple imagery characteristics could provide a broader insight into the types of abilities that differentiate athletes on the basis of skill level and sports preference.

Eton et al. (1998) recently reported a study comparing athlete and non-athlete samples using the same imagery ability measures (VMIQ and VVIQ). Participants were categorised based on hours of participation in physical activity per week into varsity (n = 51), recreational (n = 48), and non-athlete (n = 26) categories. One-way ANOVAs revealed significant differences between the non-athlete category and the varsity and recreational categories on both the VMIQ total score and the VMIQ 'self' score. These analyses also revealed no significant differences between the groups on the VMIQ 'other' score and the VVIQ score. The findings supported the propositions by Eton et al. that athletes of higher sporting ability would report more vivid movement imagery than their non-athlete peers and that the two groups would be similar in relation to visual imagery ability. The studies of Isaac and Marks (1994) and Eton et al. (1998) highlight the importance of using appropriate measures of imagery ability to attempt to discriminate between individuals at different levels of athletic performance. The VMIQ, although limited to the measurement of the vividness of visual movement images, is an instrument with greater application within the sport domain than other general measures of imagery ability. As a measure of sport imagery ability, it is unable to consistently differentiate between athletes of varying levels of ability, or distinguish between athletes from different sporting disciplines in an explainable pattern (e.g., open versus closed skills). Instruments with a more specific sport orientation would be better suited to identifying individual differences in imagery ability within athlete samples, whereas the VMIQ might be better suited to the assessment of samples that include athletes and non-athlete groups.

Researchers have also used the Movement Imagery Questionnaire (MIQ) to evaluate the imagery abilities of different athlete groups. As a component of the measure's initial development study, Hall et al. (1985) found several differences in relation to visual imagery for a sample of 80 physical education students. The participants completed an information sheet that included details of sport interests and a subjective rating of performance ability. As detailed in the earlier review of the MIQ in this chapter, a low score is indicative of high imagery ability, and a high score indicates low imagery ability. Although Hall et al. suggested that an association existed between sport ability level and visual imagery for movement, the evidence to support this conclusion is questionable. They presented only two small correlations between visual imagery and the variables of swimming ability, $r = -.2$, and track/cross-country ability, $r = .19$. These correlations indicate contrasting associations for the two sports, and in the case of track/cross country, the unexpected relationship where higher level of visual imagery ability corresponds to a lower sport ability rating. The article did not include descriptive data or outline information regarding the relationship of kinaesthetic imagery ability and sport ability level. Despite the acknowledgement that this study represented development research, the lack of data presented relating to individual items or subscale scores for the athlete groupings, limits the usefullness of any conclusions that were drawn. Hall et al. (1985) referred to a study by Mumford and Hall (1985) as a contributing element in the validation of the MIQ. In the Mumford referred to and Hall study 59 figure skaters, performing at the novice ($n = 19$), junior ($n = 24$), and senior levels ($n = 16$), completed the MIQ. Results of an ANOVA indicated that the senior group was significantly higher in kinaesthetic imagery ability than novice and junior skaters, whereas the groups did not differ significantly on visual imagery subscale scores. The senior skaters also improved significantly more on a modified senior level figure skating task than the novice performers, but not the junior skaters. Mumford and Hall provided two possible explanations for the senior skaters' higher levels of imagery ability: Firstly, practice may enhance kinaesthetic imagery and secondly, kinaesthetic imagery may be an important component in excelling at figure skating. Evidence from this study does indicate a capacity for the MIQ to identify variations in the imaging abilities of athletes relative to sport ability. The finding that senior skaters were the most able to generate kinaesthetic images and demonstrated a greater improvement in the sport skill than the novices, suggests that the association between imagery ability and sport performance is detectable using appropriate imagery tests and relevant performance tasks (Hall et al., 1985).

Several other researchers have used the MIQ as an imagery ability assessment device in relation to sporting performance. Jopson et al. (1989) recruited 44 National Junior gymnasts ($M = 12.59$ years) and 28 Class II level gymnasts ($M = 11.07$ years). The gymnasts completed the MIQ and the visual and kinaesthetic subsets of Switras' (1978) Survey of Mental Imagery (SMI). Analyses of variance and covariance indicated that there were several significant differences between the two groups. Although the actual use of MIQ responses was not clear, the imagery evaluation methodology proposed by Jopson et al. was that the MIQ kinaesthetic and visual imagery subscale scores were used in combination with the SMI modality related scores to contribute to composite scores representing the visual and kinaesthetic orientation of imagery. Jopson et al. also used the SMI vividness and control scores for the visual and kinaesthetic modalities to evaluate the athletes' imagery abilities. The results of ANOVAs revealed that the junior elites showed significantly greater levels of vividness and control of imagery and stronger kinaesthetic and visual orientation of imagery than junior non-elites. In subsequent analyses controlling for age and years of competition, only the kinaesthetic orientation imagery ability variable exhibited significant group differences. Jopson et al. concluded that the results of the investigation support the proposition that junior elite level gymnasts' imagery abilities are superior in comparison to their younger less accomplished peers. The pattern of the differences confirms the importance of investigating kinaesthetic imagery as a component within measures used with athlete groups. The tentative findings reported by Jopson et al.in relation to the vividness and control of imagery may reflect on the debatable use of the SMI, a rarely used general imagery instrument, to examine these variables within an athlete sample.

As part of a broad-based investigation of the imagery abilities of novice ($n = 20$)

and experienced ($n = 20$) dancers, Young-Overby (1990) used three quite different imagery ability tests. Both of the participant groups completed the MIQ, the Individual Differences Questionnaire (IDQ; Paivio, 1971), and the Stumpfs Cube Test (SCT; Stumpf & Fay, 1983). Hottellings 't' revealed that scores for the experienced dancers differed significantly from the novice dancers' scores on two of the imagery ability variables, namely the IDQ-Verbal and the SCT. Young-Overby reported no significant differences between the groups' scores for the MIQ and IDQ-Visual. The pattern of subscale scores of the MIQ indicated that experienced dancers found it easier to generate both visual and kinaesthetic images. Review of the experimental method suggests that the test administration procedures may have contributed to the lack of significant group differences related to the MIQ. Participants completed all tests in one session and the MIQ was the last measure administered. The physical requirements and large number of items of the MIQ, in conjunction with possible test fatigue toward the end of a one-hour testing session, may have resulted in participants losing concentration and could have affected their imaging capacities. Recent revisions to the MIQ have attempted to address these types of procedural problems (Hall & Martin, 1997). Young-Overby (1991) presented two conclusions of relevance to the assessment of imagery ability of dancers using the IDQ and the SCT. These were, first, that more experienced performers have greater spatial manipulation skills and, second, that dance experience relates to superior verbal processing of cognitive images and a tendency to process verbal and visual images similarly. In a study reviewed earlier in relation to motor performance, Jowdy and Harris (1990) found that more experienced jugglers scored significantly lower on the MIQ kinaesthetic imagery subscale. This atypical finding indicated that higher ability in relation to feeling movements was associated with lower skill levels in jugglers. In considering this set of findings, the MIQ kinaesthetic and visual subscales have not consistently discriminated between individuals involved in physical performance activities not generally classified as sports based on their level of experience.

Several studies have assessed imagery ability in relation to sporting performance in conjunction with the assessment of imagery use. Researchers typically examined the two imagery classifications (ability and use) in association with other sport-oriented psychological characteristics. Some studies have examined imagery ability or use as the mediating variables determining the efficacy of mental practice treatments. Rodgers et al. (1991) investigated the effects of imagery training on imagery ability, imagery use, and sporting performance of figure skaters. Participants were 40 young figure skaters ($M = 13.7$ years) of varying skill levels. The experimental groups formed were the imagery rehearsal ($n = 14$) and verbal description ($n = 15$) groups, in conjunction with an age-matched, no-treatment, control group ($n = 11$). The treatment groups received 16 weeks of psychological skills training appropriate for use with figure skaters, emphasising either the use of imaginal strategies (particularly involvement of the kinaesthetic sense) or verbal description of performance strategies. The researchers used the MIQ and IUQ to assess imagery ability and imagery use before and after treatment. The four measures of figure skating performance used included the number of free skate tests attempted and passed, percentage of routine elements completed, a performance score, and a program score. Rodgers et al. reported several interesting findings. The imagery training group demonstrated significant improvement in MIQ visual imagery score, and group differences were marginally short of significance for MIQ kinaesthetic imagery subscale scores. No similar improvements were seen in the verbal and control groups. Skaters who received the imagery intervention also improved elements of their IUQ scores.

Findings from the Rodgers et al. (1991) study related to imagery ability were that these participants were significantly more able to see themselves performing jumping components, to kinaesthetically imagine specific muscles and successful performance, and to control imagined body movements and external perspective images. Although Rodgers et al. found no significant differences between the three groups in figure skating performance, improvements were larger for the two treatment groups. Improvements in visual imagery ability correlated significantly with percentage of elements completed, r = .43, and performance score, r = .43. Correlations approached significance for these two performance variables and kinaesthetic imagery ability, r = .30 in both cases. Rodgers et al. presented a number of well-construed conclusions in relation to the effect of imagery interventions and subsequent changes in imagery ability and figure skating performance. Firstly, the pattern of the figure skating performance improvements in relation to visual imagery ability improvements suggested that skaters with higher visual imagery ability are better overall performers and performed routines with greater consistency. Secondly, improvements in imagery ability were seen to be the result of imagery training treatment, rather than physical practice, because no improvements in MIQ scores were seen in the verbal and control groups. Finally, the smaller changes in kinaesthetic imagery ability may have been due to the MIQ's general movement orientation, rather than a specific representation of figure skating movements. In contrast, the IUQ (developed for figure skaters) did highlight differences in the generation of kinaesthetic images related to participants' skating performance. Rodgers et al. indicated that, as this young group was not elite, their limited performance experience might reflect a lack of development of their kinaesthetic imagery ability. In general, this study successfully examined the association of certain characteristics of imagery ability and imagery use, and ascertained their relevance as psychological indicators for determining the effectiveness of imagery training in sport.

Two studies discussed earlier (Moritz et al., 1996; Vadocz et al., 1997) examined the relationship of imagery ability, imagery use, and sporting performance, as an outcome of their research focusing on alternative aspects of imagery functioning in sport. Both studies involved the same sample of 57 junior elite roller skaters and shared a number of procedural elements. The studies incorporated the MIQ-Revised, in conjunction with the later version of the IUQ, the SIQ. Results of interest to the present thesis relate to the association of MIQ-R and SIQ scores and the relationship of imagery ability and performance at the Junior North American Roller Skating Championships. Findings indicated small significant correlations between the MIQ-R kinaesthetic subscale scores and the SIQ cognitive specific subscale, $r = .30$, and motivational general-arousal, $r = .37$, and between MIQ-R visual subscale scores and SIQ motivational general-mastery, $r = .27$. A discriminant function analysis successfully discriminated between medallists and non-medallists on the basis of kinaesthetic imagery ability. It was concluded that the results suggest that "athletes higher in imagery ability are more likely to use imagery, and using imagery subsequently strengthens imagery ability" (Vadcoz et al., 1997, p. 251). It was also noted that image content, as represented within SIQ items, may impact on the ability of the individual to generate images and explain variations in the correlations between the MIQ-R subscales and the SIQ subscales. Kinaesthetic imagery was again shown to be an important variable in discriminating between levels of athletic performance and it was recommended that it should be routinely considered within studies attempting to determine the psychological characteristics that differentiate elite athletes.

Sports Performance Research Involving Measures of Sport Imagery

Very few studies are available that have incorporated measures of sport imagery to examine imagery ability characteristics in relation to involvement in sport. The primary reason for this lack of research is that only one measure, which is unvalidated, is currently available. The SIQ (Martens, 1982) was described earlier in this thesis and I found two studies in which it has been used as an assessment device to evaluate the imagery abilities of athletes. Kenitzer and Briddell (1991) investigated the effect of a program of mental imagery strategies on the swimming performance and imagery abilities of 16 female collegiate level athletes. They found that significant differences existed between the participants' pretest and posttest imagery subscale scores for the visual, auditory, kinaesthetic, and mood variables of the SIQ. In addition, they reported that athletes with SIQ scores above 60 at post-test also achieved their personal best performance during an end of season major regional swimming championship. Thomas and Fogarty (1997) analysed individual differences in imagery ability, using the SIQ, as one attribute of the examination of the effects of imagery and self-talk training on the psychological skills and golfing performances of 32 male and female middle-aged amateur golfers. The comparison of pretest and posttest SIQ scores for the visual, auditory, kinaesthetic, mood, controllability, and perspective subscales, following a 2 month training period, highlight significant improvements in all variables except perspective. Participants golf performances also improved as a result of the treatment technique. Both these sets of findings demonstrate a basic capability of the SIQ to evaluate changes in the imagery abilities of those involved in sport as an outcome of involvement in imagery training. The results also support the need to assess multiple imagery abilities, but the comparison of results highlights that little consistency exists in relation to which modal or dimensional characteristics to measure, even when the same questionnaire is selected as the evaluation device. The inclusion of an item relating to perspective use, using a different response format, also reinforces the distinction that should be made between perspective use (when not evaluated as ability to use a given perspective) and imagery abilities. Specifically, in relation to the SIQ, its lack of psychometric evaluation, limited inclusion of modal and dimensional variables, and its mixed response format remain as concerns that limit the support the measure warrants for its continued use as a measure of sport imagery ability.

The evidence presented within this section of the literature review has certainly highlighted the existence of an association between imagery ability and sports performance. Several researchers demonstrated individual differences in imagery ability as an outcome of comparisons of elite and non-elite athletes, successful and less successful competitors, between athletes of different sporting backgrounds, and as an outcome form involvement in sport imagery training. As imagery measurement techniques have become oriented toward the assessment of the ability to generate images related to movement, or on the rare occasion sport, the resultant data is of greater use in explaining the involvement of imagery abilities within athletic achievements.

The developers of the VMIQ, MIQ, MIQ-R, IUQ, SIQ (Hall et al., 1998), and SIQ (Martens, 1982) have laid important groundwork, through the construction and usage of their measures, to facilitate the understanding of imagery abilities as they concern athletic populations. Unfortunately, the information derived from these measures focuses on movement imagery and imagery use, or results from the use of a questionnaire that has not yet undergone appropriate psychometric analysis. It would seem logical, firstly, to follow the trends pursued in other areas of sport psychology assessment (e.g., anxiety, confidence) and develop psychometrically sound sport specific measures to evaluate the attribute of interest. Secondly, measures of imagery use do not effectively evaluate ability characteristics and should not be used for this purpose. Despite the evidence derived from existing imagery measures demonstrating differences in the imagery abilities of athletes, important information may have gone undetected because of the lack of sport specificity, the incorporation of only a limited number of ability characteristics within these questionnaires, or insufficient psychometric support. Consequently, the assessment of sport imagery ability would be best served by the development of a questionnaire that focuses on content emphasising sport rather than movement-related images, evaluates multiple attributes of imagery ability rather than use, and is exposed to rigorous program of evaluation.

Summary

Following the examination of existing research, I contend that imagery ability is a variable that in relation to physical activity and sports participation has yet to be fully explained. Ten years ago, Jowdy and Murphy (1992) stated that imagery ability is a critical variable that may regulate athletic performance that:

> has not received the amount of serious attention from researchers that would be expected. The combined results of the research described suggest that individual differences in imagery ability must certainly be considered by researchers who are investigating the performance effects of imagery based strategies. (p. 228)

Over the intervening period, a large number of authors and researchers have continued to examine the broader area of imagery in sport (e.g., Driskell et al., 1994; Hall, 2001; Vealey & Greenleaf, 1998), however, limited efforts have been directed toward the advancement of the understanding and evaluation of imagery ability. Development of a measure of sport-oriented imagery ability could serve as a process to expand the existing knowledge base and stimulate a wide variety of investigations that are possible in this field. The commencement of this task has necessitated the review of a large collection of existing literature from both general and sport psychology that examine the key elements of the imagery process and their relationship to athletic performance. Analysis and evaluation of this information has provided an important foundation on which to construct a measure that incorporates the key propositions and conclusions of experts within this area of psychology.

Initially, this review of literature provided an outline of the diversity of perspectives in relation to the description of imagery. Subsequently, I have utilised the current analysis to provide an amalgam definition constructed on the basis of the most pertinent elements of existing definitions relevant to the conceptualisation of sport imagery. No single theory or model yet provides a wholly-supported framework that adequately describes the physiological and cognitive components and processes of imagery function. At best, it could be proposed that specific elements of a number of the existing propositions can provide useful fundamentals for the enhanced understanding of the operation of imagery, particularly in relation to physical performance. The development or improvement of theory that explains the imagery process and resolves the role of imagery abilities remains an important task yet to be effectively completed. Incorporating the findings generated from studies analysing the imagery abilities of athletes, using a sport specific validated measure, represents a useful strategy to commence the analysis of existing theory, and the creation of new conceptualisations to describe the function of imagery ability within the context of sport imagery.

Researchers from many areas of psychology and the human movement sciences have used a large number of imagery ability measures that vary markedly in style. From the sport psychology perspective, a range of issues are apparent, concerning the availability and adequacy of the assessment devices used in existing research. Currently, no fully validated sport-oriented measure of imagery ability is available. This has resulted in investigators, who are interested in evaluating athletes' imagery abilities, relying on general imagery scales or movement imagery questionnaires. None of these instruments was specifically designed for this purpose, and thus, may fail to produce data that satisfactorily represents the construct of interest. Several researchers attempted to overcome this problem by constructing measures specifically for their study. Unfortunately, these instruments were often used as indicators of imagery ability irrespective of the fact they were unvalidated.

A second area of concern relates to the characteristics examined in the reviewed set of imagery ability measures. Little consensus exists as to which variables warrant evaluation. It appears that the information gathered from the administration of one style of measure, purported to be assessing imagery ability, can vary substantially from another, due to its focus on different modal or dimensional attributes. This makes the comparison of data between measures, or between studies, a questionable procedure, if the instruments do not examine similar dimensions (e.g., vividness), senses (e.g., visual), or experiences (e.g., emotion). It would seem that it is critical that a multi-attribute approach be implemented to determine the characteristics that may be of greatest relevance in the assessment of sport imagery ability.

The substantial variability in the reported findings from studies measuring imagery abilities, particularly in reference to reliability and validity data, indicates that considerable development work is required to establish consistency and quality in design of tests and questionnaires. Many scales have only undergone limited psychometric analysis. The majority of measures are shown to be reliable, but the presentation of data associated with validity is rare. The status of the SIQ (Martens, 1982) is of even greater concern as no published reliability information is, as yet, available. Studies examining the factor structure of existing measures provide details of factor analyses that share only token similarity. For example, the factor structure of the SQMI has been reported with varying numbers of resultant factors, however, the visual sense is consistently represented as an independent attribute between measures. Additionally, most research has only incorporated the use of exploratory factor analysis, with the more comprehensive procedure of confirmatory factor analysis greatly under utilised.

In terms of design, many styles of image stimulation and response format are exhibited within the current set of imagery ability measures. The MIQ and MIQ-R, for example, are measures regularly used in research, however, the activities participants are asked to undertake to complete the questionnaire, which involve the physical performance of movements, can restrict the samples for which the instrument is appropriate. Other problems detected with imagery measures that can affect the response quality include the use of reverse-scored Likert scales, imprecise anchors, and a small range in response options. A fundamental basis for this review, therefore, was to substantiate the importance of ensuring that psychometric qualities, appropriate response techniques, and imaginal components are carefully considered in the development of a sport imagery ability evaluation device.

Finally, the overview of the role of imagery in the areas of motor and sports performance provided an indication of characteristics relevant to individual differences that warrant inclusion within measures of sport-oriented imagery skills. No single test or questionnaire that is currently available can consistently differentiate between groups of athletes of contrasting ability levels or sporting backgrounds. The opportunities for experimental investigations of imagery abilities in sport are limited due to the existing measures focussing on different imagery constructs, and the lack of a validated sport-oriented measure. Sound research examining imagery abilities remains to be undertaken in relevant areas associated with athletic performance, such as team and individual sport comparisons, imagery training effectiveness, and evaluation of the skills of elite athletes. For quality research to occur on sport imagery ability, quality instrumentation must be accessible to interested researchers.

The primary purpose of this literature review was to create an information base for the development of the Sport Imagery Ability Measure (SIAM). It has most appropriately facilitated access to the full spectrum of theoretical perspectives and the outcomes of relevant research to support the construction of a reliable and valid multi-modal, multi-dimensional imagery assessment device, suitable for use within the field of sport psychology. The present thesis will integrate the outcomes of this review within the four studies, detailing the program of test construction and analysis of the SIAM. Without a reliable and valid measure of sport imagery ability, many areas of understanding imagery in relation to sport performance are restricted.

Specifically, the research constitutes four studies designed to examine the psychometric properties of the multi-dimensional, multi-modal Sport Imagery Ability Measure (SIAM). The purpose of Study 1 was to develop the item base and response framework of the measure. In addition, this study evaluated the logical validity, internal consistency, test-retest reliability, and factor structure of the SIAM. The second study involved the revision and refinement of the SIAM, re-evaluation of the reliability of the measure, and examination of its factor structure using confirmatory factor analysis. This study also reported on criterion validity of the SIAM, by comparing individual differences in the imagery ability scores of athlete groups participating in varying levels of competition. Study 3 explored evidence of convergent and discriminant validity by examining the relationships between the SIAM and existing measures of general imagery, movement imagery, and non-image-based measures of cognitive processing. The aim of the fourth study was to examine the concurrent validity by examining the relationship between modality and dimensional scores derived from the SIAM and corresponding independent indicators of imagery processing. The study incorporated concurrent verbalisation and content analysis procedures to identify and quantify the imagery characteristics reported by athletes who completed a set of sport-oriented imagery tasks. The thesis concludes with a review of the evidence of the reliability and validity of this new measure and presents perspectives of the conceptualisation of sport imagery and the evaluation of imagery abilities in the area of physical performance.

CHAPTER 3: DEVELOPMENT AND RELIABILITY OF THE SPORT IMAGERY ABILITY MEASURE (SIAM)

Introduction

The assessment of mental imagery ability has been undertaken for over a century in the discipline of general psychology. Although the history of the measurement of this cognitive process is significantly shorter within the field of sport psychology, many of the imagery ability test instruments used in sport psychology have been taken directly from mainstream psychology, rather than developed or adapted specifically for assessment of the imagery abilities of athletes. Only since the mid 1980s has there been any attempt to design measures that are based upon the conceptualisations of movement or sport-related imagery. In contrast to the substantial interest in mental imagery in both research and practice within sport psychology, the development of suitable imagery ability assessment devices has remained a relatively under-addressed issue in this field.

This chapter presents a report of the initial development, preliminary reliability and validity analyses, reliability data, and possible factor structures of a measure of sport imagery ability. The Sport Imagery Ability Measure (SIAM) is a self-report assessment device designed with the key purpose of examining differences in the abilities of individuals who are involved in sport to experience images of sport scenes and activities. The SIAM represents a sport-based test that could be used as a possible diagnostic tool prior to the involvement of athletes in a imagery rehearsal based psychological skills training program.

Development of the Sport Imagery Ability Measure

The following section presents details of the procedures related to the conceptualisation and construction of the SIAM. The section also details results of the reviews of the measure for comprehensibility, face validity, and content validity.

Test Construction

On the basis of the review of literature, analyses of existing instruments, and consultation with experts, I decided to develop a task-oriented, multi-dimensional, multi-modal test designed to assess self-reported imagery ability related to sport. I named the measure the Sport Imagery Ability Measure (SIAM) (Appendix A).

The first stage of test construction involved the development of an item pool. Items were generated through the examination of relevant imagery theories, analysis of research work in the field of imagery ability, and review and analysis of a number of existing measures of imagery ability, used in the areas of sport and general psychology. I determined that items should broadly examine five dimensions, namely vividness, controllability, ease of generation, speed of generation, and the length of time the image was held (duration). The questionnaire also assesses six sense modalities, namely the visual, auditory, kinaesthetic, olfactory, gustatory, and tactile senses. In addition, the test measured the experience of the emotions associated with imagery. The dimensions and modalities included in the SIAM represent those imagery abilities regularly discussed within sport psychology literature (e.g., Perry & Morris, 1995; Vealey & Walter, 1993; Weinberg & Gould, 1995) and outlined in substantial detail within the literature review of this thesis.

The task-oriented component of the test comprised six imagery scenes, which were training session, home venue, recreational activity, slow start, fitness activity, and successful competition (see Appendix A). Each scene required 12 responses, one for each dimension and sense, including emotion. Thus, each dimension and sense modality involved six ratings that represented a subscale across the scenes. The test employed directed imagery of scenes reflecting familiar occurrences in sport. Participants attempt to generate active images relevant to their own sports. I felt that this method was more sensitive than a global rating of one's imagery ability with no context. Ahsen (1990, 1997) has noted that imagery varied depending on the context. Thus, to assess a performer's imagery in their chosen sport, the generation of images from that sport seemed to be the most appropriate activity. The image content of the scenes used generic wording, to make it possible to examine a wide range of sports within the same form. The measure incorporates items based on an analogue scale response format. Participants place a cross on a 100-mm line, separating verbal anchors for each dimension/modality (e.g., no image, perfectly clear image; no taste, very clear taste). The test includes 72 items with each item generating a score out of 100. The physical location of the cross in millimetres on the 100-mm response line represents the response score. This format provided an easy method of response that tends to be relatively sensitive to small variations. In both the general instructions and the descriptions of the specific scenes, we made every effort to avoid linguistic bias toward any particular sense modality or dimension.

Comprehensibility

I reviewed the measure for comprehensibility as part of the initial construction process. Secondary students (*N* = 5), aged 15 - 16 years, considered by teaching staff to be of average language and academic ability, read the initial test draft. Each student highlighted words or expressions with which they were not familiar or could not understand. The students did not complete the measure. Students discussed the instrument individually with me and answered questions that referred to their level of comprehension (e.g., Were the instructions easy to understand?; Did you understand what to do to respond to items?). No specific areas of concern were identified regarding the language used in the measure by these five students

Face and Content Validity

Because the initial version of the SIAM presented no comprehensibility problems, I sent this version of the measure for review by six expert researchers and practitioners in sport psychology, familiar with the use of imagery ability measures. Each expert examined the draft measure and completed a set of review questions on an attached proforma (Appendix B). I asked the six experts to complete five general tasks. These tasks were to (a) distinguish between items they considered to be good and poor indicators of imagery ability, (b) assess the suitability of the questionnaire for examining dimension and modality categories, (c) comment on the clarity of the administration instructions, (d) report on the comprehensibility of questionnaire instructions and the clarity of the item format, and (e) make observations on the appropriateness of the analogue rating scale response format. Each expert reviewed all items and responded to all questions on the review proforma. Comments and suggested modifications provided by the respondents' were analysed and are summarised in Appendix C. Some of the main suggestions were the modification of particular anchors to be more descriptive, simplification of vocabulary in specific cases, clarification of instructions related to the placement of the cross on the analogue response line, and the importance of ensuring that there is no delay between presentation of scenes and ratings, because this time interval may cause a loss of concentration. This initial analysis represented an important step in establishing face and content validity. Any suggestions or modifications considered to be beneficial in refinement of the SIAM were incorporated into the final draft. I then examined the modified version of the SIAM for reliability and factor structure.

Examination of Reliability and Factor Structure

The examination of the psychometric properties of the SIAM involved a large-scale study. The primary areas of interest within this study were the internal consistency, test-retest reliability, item analysis, and factor structure of this new measure of sport imagery ability. I present the details of the research process in the following section.

Methods

Participants

Participants from a broad range of sports and social backgrounds took part in the study of reliability and factor structure. I based the size of the participant numbers on satisfying the sampling requirements (participant to variable ratio) of the data reduction analyses undertaken in the study (Gorsuch, 1997). The sample comprised a combination of secondary school students, physical education teachers, physical education and recreation university students, and athletes from a local sports club. I approached the Department of School Education and they provided approval and support for the participation of high school students in the study. Final composition of the sample drawn from Melbourne and Victorian regional centres included 474 participants, 268 male and 206 female, with an age range of 14 to 52 years ($M = 18.42$, $SD = 4.50$). Sporting interests of the sample covered 32 different sports and physical activities. The three specific groups of volunteer participants were:

1. Players from the Melbourne Tigers U/20 basketball squad, $n = 19$.

2. Victorian Department of School Education secondary school students and teachers participating within the Specialist Sport in Schools program, $n = 279$.

3. Post-graduate and under-graduate students participating in sport psychology subjects at Victoria University of Technology, $n = 176$.

Each participant or parent (in the case of underage participants) completed an informed consent form that explained the procedures, the use of results, and the participant's right to withdraw at any time.

Measures

Personal details information sheet. Each participant completed an information sheet that asked for details regarding gender, age, and main sporting interests. The sheet also included a participant code number and the date of the test or retest session (Appendix A).

Sport Imagery Ability Measure (SIAM). This task-oriented imagery ability measure requires participants to decide on a specific version of each of six sport-related scenes in one sport that is meaningful to them. Participants have 60 seconds to image each scene. They then respond to 12 items designed to assess imagery dimensions (five items), experience of the senses during imagery (six items), and experience of emotion during imagery (one item). Participants respond on analogue scales that require the placement of a cross at the point on a 100-mm line that best reflects their experience of the imagery. The line separates two opposing anchor statements. For example, on the tactile item the anchors are *no feeling* and *very clear feeling*. The test comprises 72 items with each item given a score out of 100 by measuring the location of the cross on the 100-mm line in millimetres from the left end. The calculation of the twelve subscale scores requires the adding together of the relevant dimension or sensory item scores for the six scenes (e.g., six vividness scores, six visual scores). This procedure results in a score out of a possible 600 for each dimension or modality.

Shortened Marlowe-Crowne Social Desirability Scale (SM-C SDS). The 33-item SM-C SDS (Reynolds, 1982) assesses a person's need to portray themselves in a socially acceptable light (Crowne & Marlowe, 1960). Reynolds (1982) developed the 13-item short form (SM-C SDS) (Appendix D) and reported an adequate internal consistency of .76, using the Kuder-Richardson-20 technique, and a high correlation of .93 with the original M-C SDS. This reliable and valid short form provides researchers with a brief, easy-to-administer social desirability measure (Reynolds, 1982). I used this scale to analyse the impact of social desirability on the sport imagery ability measure.

Procedure

Depending on the participant group, I undertook various procedures to facilitate testing sessions. In each case, I contacted the individual responsible for the specific group and informed them about the study and what was requested of participants. Appendix E includes examples of information and consent forms. In the school settings, I posted consent forms to schools, which teachers then gave to participants for completion by their parents or guardians prior to testing. I arranged a test date and then visited the school, collected consent forms, and conducted group testing with a variety of different group sizes. For the basketball group, I gave consent forms to all players prior to testing and then collected them before a player was involved in any other aspect of the study. I conducted testing in small groups following training sessions on a number of occasions until all participants were tested. I provided the university student groups with consent forms prior to the testing sessions, and all testing was undertaken as a component of one lecture or tutorial session.

I followed the same administration procedure during test sessions for all groups. I waited for participants to be seated comfortably, introduced myself, and asked if the session could be conducted with a minimum of unnecessary noise. I gave the participants a verbal outline of the research as described in the consent form, informed them that their involvement would be completely confidential, participants being identified by code numbers, and then asked if they had any questions. After I answered questions, I then distributed the measure and asked participants to complete the personal information sheet, read carefully through the introduction page, and attempt the example. Following a second opportunity to ask questions, I informed participants that for each scene they would be requested to read through the description, image the scene for 60 seconds, and then respond to the 12 scales. When I felt that all participants had finished reading the scene description I used a stopwatch to time the imaging activity with the following start and stop instructions: "start imaging now" and "go ahead and complete the questions." I asked participants to place their pens or pencils down upon completing the scales. When all participants had finished responding, I asked them to read the next scene. I repeated this procedure for each of the six scenes. After a four-week interval, to examine test-retest reliability, a group of 47 of the university students (matched through code numbers) completed the imagery ability measure a second time.

In addition to the imagery ability measure, 72 high school students and 96 undergraduate university students completed the SM-C SDS immediately after completing the SIAM. I told these participants that they were completing a very short questionnaire that examines their attitudes to different social situations.

I debriefed all participants and thanked them for their involvement at the end of their final testing session. In the debriefing, I provided a more detailed explanation of all measures and the relationship of this research to imagery training. I then offered an additional opportunity to ask questions. I also provided specific details of how individual participants could find out at a later date how they performed on the SIAM.

Analyses

The primary goals of the data analysis were the examination of reliability and factor structure of the new measure. The statistical analyses involved the following procedures:

1. Descriptive statistics for specific subgroups for each subscale, including means, standard deviations, and skewness, were computed. Frequency distribution of age, gender, specific sport, and level of participation were determined.

2. A reliability coefficient of stability was calculated for the test-retest data.

3. The internal consistency of the test was assessed by calculating the Cronbach's alpha coefficient for each of the twelve subscales.

4. The degree to which each item was a good exemplar of the subscale to which it was proposed to belong was examined by calculating item-subscale correlations. Item-deleted alpha coefficients provided further information on this issue.

5. Factor structure was examined through the use of exploratory factor analysis. Two exploratory factor analyses were undertaken, the first using individual item scores as variables, the second using subscale scores as variables. The factor analysis procedure used in examining the factor structure of the SIAM was principal axis factoring extraction with oblique rotation (direct oblimin) found within the Statistical Package for the Social Sciences (Norusis, 1993). Principal axis factoring extraction was considered an appropriate procedure in the item analysis phase because it allows for communality estimates and includes an error term within its model, thus, avoiding the assumption within principal components analysis that the variables are perfectly reliable (Gorsuch, 1997). Oblique rather than orthogonal rotation was selected because the nature of imagery ability is such that there is a high possibility of correlation between the variables being examined in the SIAM. For example, measures of vividness and control of imagery have typically been found to correlate substantially (e.g., Shaw & DeMers, 1986; White et al., 1977; Wolmer, Laor, & Toren, 1999). It was decided to use the Kaiser (1958) criterion of eigenvalues of one or greater rather than the 'scree test' (Cattell, 1966), to determine the number of factors to be rotated. This is because of the more definitive format of the Kaiser criterion, thus minimising any ambiguity in the final number of factors extracted, a problem sometimes attributed to the 'scree test' (Kaiser, 1970). Variables with loadings greater than .50 (25% of the variance of the variable associated with that factor) were used to interpret the factors. I selected this relatively high loading level, for such a large sample size (Child, 1990), as it

is probable that the variables having loadings above .50 will contribute to a higher degree of factor independence (Comrey & Lee, 1992).

6. Subscale correlations were calculated to demonstrate the level of association between the dimensions and modalities represented within the SIAM.

Results

Descriptive Statistics for the SIAM Subscales and Scenes

The means and standard deviations for each of the SIAM subscales and scenes for the total sample and for each of the three participant subgroups are shown in Table 1. Subscale scores for each participant were derived by totalling the six individual scene items representing that subscale resulting in a possible score range of 0 – 600 for each subscale. Adding together scores of the twelve subscales formulated the scene total for each participant.

Generally, the subscale scores followed a similar pattern for each of the three groups with respect to means and standard deviations for each group and for the total sample. Mean scores for the sensory subscales (except for the visual) were lower than for the dimensions. There was also generally less variability in the dimensions than in the sensory subscales (excluding vision). Within each group, the scores of the gustatory and olfactory subscales were substantially lower and showed greater variability than other subscales. The scores also highlight variation between groups on all subscales. Generally, the basketball group scored higher and showed less variability than either of the other groups, whereas the university group had the lowest mean score for every subscale.

Table 3.1

Means and Standard Deviations for SIAM Subscale and Scene Scores for the Total Sample and the Specific Subgroups

	Total		High School		University		Sport Group	
	(N = 474)		(n = 279)		(n = 176)		(n = 19)	
Subscale	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Gustatory	168.0	122.4	174.9	124.6	151.7	118.1	216.2	111.1
Olfactory	192.9	128.3	199.4	131.5	178.3	124.2	233.2	106.3
Auditory	326.8	113.4	336.5	116.3	310.5	109.4	336.3	91.7
Tactile	351.4	118.5	363.2	120.4	332.0	113.6	356.8	117.6
Kinaesthetic	362.5	115.8	366.3	116.1	355.9	115.4	366.6	118.5
Emotion	391.1	109.3	395.5	112.4	379.7	105.0	433.9	89.9
Duration	411.8	101.9	424.4	101.6	390.6	101.7	421.4	79.0
Control	416.7	96.0	428.7	96.9	393.4	91.9	457.1	74.3
Vividness	435.9	85.4	444.1	84.1	419.8	87.6	464.2	57.5
Visual	444.5	86.1	449.5	85.7	433.6	88.0	470.2	62.8
Speed	446.1	88.9	448.8	88.1	438.0	90.3	480.9	80.7
Ease	446.3	88.4	452.6	87.5	431.3	88.7	492.0	75.5
Scene								
Training	641.5	192.6	644.8	188.1	630.2	202.2	699.1	161.5
Home Venue	728.4	219.2	737.4	217.5	706.9	225.3	796.1	166.7
Recreation	750.0	235.1	756.2	241.1	732.0	229.6	825.9	176.9
Slowstart	675.7	261.7	712.2	246.5	616.6	276.4	685.4	251.1
Fitness	762.3	229.3	768.1	230.4	744.0	228.7	846.7	205.8
Competition	836.5	220.6	865.9	212.1	785.8	227.8	876.1	197.4

Scene scores for the total sample and each subgroup demonstrated a pattern in which the training scene typically resulted in lower scores and the competition scene resulted in higher scores. Participants also scored the slow start scene lower than all except the training scene. Totals computed for the home venue, recreation, and fitness scenes were all similar in value within the total sample and within each of the subgroups.

Internal Consistency, Test-Retest Reliability, and Social Desirability of the SIAM Subscales.

Internal consistency (Cronbach's alpha coefficient), test-retest correlations, and correlations with the social desirability measure were computed for each of the twelve subscales. These values are presented in Table 2, in the same subscale order as Table 1.

Table 3.2

Internal Consistency Coefficients, Test-Retest Reliability, and Correlations with Social Desirability for SIAM Subscales (N = 474)

Subscale	Internal Consistency	Test-Retest	Social Desirability
Gustatory	.80	.83	.06
Olfactory	.81	.78	.06
Auditory	.68	.51	-.13
Tactile	.76	.70	-.04
Kinaesthetic	.74	.68	-.02
Emotion	.76	.63	-.02
Duration	.72	.57	.01
Control	.73	.61	-.03
Vividness	.70	.59	-.06
Visual	.68	.51	-.03
Speed	.65	.44	-.03
Ease	.63	.44	-.02

The Cronbach alpha values showed moderate to high internal consistency with coefficients ranging from r =.63 (ease of generation subscale) to .81 (olfactory subscale). Internal consistency was higher for the subscales where mean imagery was low. Test-retest results revealed moderate to high subscale correlations, varying from r =.44 (speed) to .83

(gustatory). None of the subscales was found to correlate meaningfully with the Marlowe-Crowne Social Desirability Scale.

Item Analysis

Analysis of individual items was conducted using both item-subscale correlations and item-deleted alpha coefficients. Item-subscale correlations show how well an item corresponds with the subscale with which it is associated. Strong items show high correlations with the subscale, positive for direct items and negative if the item is reversed with respect to the subscale. Item-subscale correlations for the SIAM ranged from $r = .30$ to .67 and were consistent within each of the twelve subscales. Item-deleted alpha coefficients indicate whether the internal consistency of a subscale would be improved if that item was deleted. Item-deleted alpha coefficients that are notably higher than the alpha coefficient for the subscale indicate that the subscale has greater internal consistency without that item. Low item-deleted alpha coefficients suggest a weak subscale when that item is removed. For the 72 items of the SIAM, the item-deleted alpha coefficients were all close to the corresponding subscale alpha coefficient. The subscale alpha coefficients were in the acceptable $r = .60$ to .80 range. These item-subscale correlations and item-deleted alpha coefficient values suggest that all 12 subscales had coherent internal consistency.

Exploratory Factor Analyses

The initial factor analysis was carried out using the individual items of the SIAM as the variables. The resultant factor pattern is presented in table form as Appendix F, rather than in this section because it is an extremely large table. Using the principal axis factoring method, 11 factors with eigenvalues greater than one were extracted accounting for 68% of the total variance. Direct oblimin rotation converged in 36 iterations. Examination of the factor loadings greater than .50 failed to provide any real insight into the factor structure of the SIAM. Six of the factors were representative of the specific items relating to each of the scenes used within the SIAM, rather than consistently representing dimensions or modalities (one factor was related to the gustatory and olfactory items). The remaining factors comprised only one or two items representing any one particular modality or dimension and were not considered to be interpretable. In general, this factor analysis was unable to highlight significant information supporting the hypothesis that imagery ability is a multi-dimensional, multi-modal trait. I assumed that the problems in establishing a relevant factor structure could be attributable to structure, content, and format of items within the measure.

I determined that a second exploratory factor analysis should be undertaken using the miniscale approach Gorsuch (1997) proposed. This approach uses the subscale scores of similar items as variables within the factor analysis. Subscales of the SIAM originated from the conceptual development of the measure in which a number of specific dimensions and sense modalities were identified. This conceptualisation was then used as the basis for the construction of the SIAM, so that it consisted of a number of the same items representing each subscale. I decided that the SIAM data was suitable for this type of analysis because the initial item pool was sufficiently large to be reduced to miniscales, and the items representing specific dimensions and modalities were the same for each of the six scenes (Gorsuch, 1997). In addition, Gorsuch suggested the improved reliabilities of subscales over individual items is advantageous within this type of analysis. The internal consistencies of the specific SIAM subscales were sufficiently large to support the examination of the subscale scores as specific variables for use in a factor analysis. Finally, the miniscale approach is also considered more applicable for the use of the Kaiser criterion in determining the number of factors for rotation, because the uniqueness of individual items is averaged out across the miniscales (Gorsuch, 1997).

Table 3.3

Rotated Factor Pattern Matrix for SIAM Subscales (N = 474)

Subscale	Factor 1	Factor 2
Vividness	.92	-.01
Control	.85	.05
Ease	.96	-.09
Speed	.88	-.12
Duration	.77	.09
Visual	.86	.05
Auditory	.33	.55
Kinaesthetic	.42	.50
Olfactory	-.10	.90
Gustatory	-.14	.87
Tactile	.35	.59
Emotion	.45	.43
Eigenvalue	7.12	1.89

The second factor analysis was undertaken using the SIAM subscale scores as variables. Using the principal axis factoring method, two factors with eigenvalues greater than one were extracted accounting for 75% of the total variance. Direct oblimin rotation converged in six iterations. Variables with loadings greater than .50 (25% of the variance of the variable associated with that factor) were used to interpret the factors and are shown in the rotated factor loading patterns, which are reproduced in Table 3.3. The identity of the factors was relatively clear and examination of these loadings suggests the following labels for the factors: Factor 1, dimensions and visual modality and Factor 2, modalities minus visual modality. Although the emotion variable has no loadings greater than .50, both the loadings for this variable were very close to that criterion. I decided that the emotion sub-scale could not be confidently assigned to either factor on the basis of the results that emerged from this factor analysis.

Subscale Inter-Correlations

The intercorrelation matrix of the SIAM subscales is presented in Table 3.4. Results show that the relationships between dimensional subscales and between similar modality subscales are higher than expected, but follow patterns that are representative of the findings relating to the factor structure detailed within the second exploratory factor analysis. All correlations reported, including those less than $r = .20$, were significant at the $p = .01$ level, due to the effect of the large sample size used. For this reason, I discuss correlations in relation to their actual value rather than whether the values were or were not significant.

Correlations between the dimensional subscales were generally high with minimal variation, and ranged from $r = .69$ to .88. These results revealed only a very limited degree of independence for the five dimensional imagery characteristics examined within the SIAM. The visual subscale correlated strongly with each of the five dimensions highlighting the association of this sense with the imagery characteristics related to generation and manipulation. Correlations for the visual subscale with the other modality subscales ranged from moderate to small which is indicative of a degree of independence for this sense in comparison to the five other senses examined.

Table 3.4

Inter-Correlations of the SIAM Subscales (N = 474)

Subscale	1	2	3	4	5	6	7	8	9	10	11	12
1. Vividness	1.0											
2. Control	.84	1.0										
3. Ease	.84	.77	1.0									
4. Speed	.73	.69	.88	1.0								
5. Duration	.73	.78	.69	.64	1.0							
6. Visual	.86	.77	.81	.73	.72	1.0						
7. Auditory	.54	.51	.50	.41	.52	.55	1.0					
8. Kinaesthetic	.57	.57	.53	.46	.58	.58	.62	1.0				
9. Olfactory	.30	.32	.25	.21	.31	.34	.56	.51	1.0			
10. Gustatory	.25	.27	.20	.17	.26	.28	.52	.44	.81	1.0		
11. Tactile	.54	.55	.50	.44	.55	.54	.62	.72	.57	.52	1.0	
12. Emotion	.59	.57	.56	.46	.55	.57	.56	.68	.45	.41	.70	1.0

The auditory, kinaesthetic, and tactile subscales show similar degrees of moderate to high correlation with both the dimension and modality subscales, $r = .41$ to .72, and generally around the $r = .50$ level. Olfaction and gustation were the two senses that showed only small correlations with the dimensional and visual subscales ($r = .17$ to .34). These two senses also correlated in the moderate range with the auditory, kinaesthetic, and tactile subscales whereas they correlated strongly with each other.

Results of the correlations of the emotion subscale with both the dimension and modality subscales ranged from, $r = .41$ for the gustatory, to $r = .70$ for the tactile subscale. This pattern of moderate correlations indicates that the imagery associated with the experience of emotion does not clearly relate to either the dimensional or modal characteristics examined within the SIAM.

Discussion

The conception of imagery ability as a multi-dimensional, multi-modal construct has been both analysed theoretically and tested empirically through a variety of measurement approaches (Kihlstrom et al., 1991; Lane, 1977; Richardson, 1994; Switras, 1978). Although a variety of existing measures have been used to examine imagery ability in a range of sport performance and motor skills development studies, no test has emerged as a widely accepted assessment device. The primary reasons that this situation exists are lack of agreement about the number of dimensions or senses that should be assessed and substantial variation in test characteristics such as item style, response format, and number of items. In addition, the neglect of certain test developers to apply rigorous reliability and validity techniques to ascertain the psychometric adequacy of their measures has contributed to the limited usage of certain instruments (Lane, 1977; Martens, 1982; Switras, 1978). The first study in this thesis provided preliminary evidence of the psychometric qualities of a measure devised specifically to assess imagery ability in sport, the SIAM. The development strategies implemented for the SIAM also addressed a number of the current problems in the imagery ability assessment of athletes.

Relationships with Research and Theory

Descriptive Data

The examination of the descriptive statistics of the SIAM revealed specific characteristics, related to the design of imagery ability measures, which highlight the influence of both test content and structure. Of particular importance are the assessment of both type and number of senses. The means and standard deviations of the SIAM modality subscales are similar to response patterns observed within previous research. Several studies that used multi-sensory imagery ability tests have shown the olfactory and gustatory senses to have lower mean scores than the other sense modalities (Kihlstrom et al., 1991; Lane, 1977; Sheehan, 1967b; White et al., 1977). These low scores may be due to the limited use and accessibility of the senses of smell and taste within the reporting of personal imagery experiences or, the lower frequency of their stimulation (Ahsen, 1997) with respect to both general human behaviour and performance in sporting situations.

The visual modality has been the most regularly analysed of the senses, either as a single modality or within multiple-modality measures. As in similar multi-modal studies (Kihlstrom et al., 1991; Lane, 1977; Sheehan, 1967b; White et al., 1977) the results reported here highlight that vision is the dominant sense in which participants image. This response pattern could exist because participants typically think of imagery as being associated with the visual sense or because of the key role that the visual sense plays in the actual performance of sport skills. Additionally, a great deal of the language used within imagery research, such as "mental picture" or "visualisation," relate imagery to the visual sense (Ahsen, 1990, 1997). In constructing the scene descriptions of the SIAM I took great care to avoid language with a visual bias.

The descriptive statistics showed that the participants' mean scores on the first scene were lower than the mean scores on each of the other five scenes. Mean scores also varied in an ascending direction from the second scene to the sixth scene, but differed to a much smaller extent than between the first two scenes. Although elements of these variations may be attributable to the content of the six scenes stimulating stronger responses over the duration of the measure, I decided the key factor to be the ineffectiveness of the example presented to appropriately prepare participants to complete items related to the first scene. The first scene seemed to be operating as a warm-up activity for the completion of the following five scenes. I decided that a suitable resolution to this problem would be to provide a practice scene very closely resembling the structure, content, and format of the subsequent test scenes. This approach would provide participants with a clearer understanding of the task requirements than the example currently used to introduce the SIAM, and would facilitate accurate responses to the scored items of the measure.

Reliability

Reliability and item analysis data presented here for the SIAM were satisfactory for a psychological self-report measure in the early stages of development, and relatively consistent with reliability findings reported for other multiple subscale imagery ability measures (Lane, 1977; Switras, 1978; White et al., 1977). Richardson (1994) detailed a substantially greater number of reports of internal consistency data than test-retest reliability information for a large set of multiple subscale imagery ability measures. Only one of the imagery measures reviewed, the MIQ (Hall et al., 1985), included findings relating to item analysis data. Procedures undertaken in the development of the MIQ were consistent with those used in the item-analysis of the SIAM. Unfortunately, this inconsistency in the availability of information examining the fundamental reliability properties of imagery ability measures is an on-going problem (Moran, 1993; Ostrow, 1996).

White et al. (1977) found test-retest subscale reliabilities of the SQMI over a 12-month interval for specific modalities ranged from $r = .29$ (kinaesthetic) to $r = .60$ (olfactory). Evans and Kanemoto (1973) reported much higher reliabilities for the SQMI, over a 6-week period, which ranged from $r = .61$ (organic) to $r = .82$ (tactile). Hall et al., (1985) estimated test-retest reliability of the visual and kinaesthetic subscales of the MIQ to be, $r = .83$ over a one-week interval. Although the test-retest reliability sample was relatively small, examination of the SIAM results reveal a similar range of correlations. Differences between the present findings and those of earlier studies are attributable to the variations in retest period, the number of imagery characteristics being examined, and the use of a non-Likert scaling procedure within the SIAM, that is more likely to inhibit recollection of previous responses. These findings indicated that imagery ability does fluctuate over time, possibly due to mediating factors such as motivation, emotional state, test fatigue, the recency of using imagery, or familiarity with the objects or scenes imagined. Ahsen (1990) has repeatedly shown that different contexts and "filters" can influence the vividness of imagery and that unvivid images can provide important information.

Results relating to the internal consistency of specific subscales of various imagery measures were generally around the acceptable level of, $r = .70$, suggested by Nunnally (1978). Closer examination of the findings reveals a trend in which the larger the number of items for a given subscale, the higher the alpha coefficient. Switras (1978) reported Cronbach alpha coefficients for the subscales of the SMI ranging from, $r = .68$ (somesthetic) to .90 (gustatory), with the number of subscale items ranging from 10 to 16. Lane (1977) found, in examining a modified version of the SQMI that subscales consisting of five items had alpha coefficients in the range, $r = .46$ (Tactile) to .64 (Olfactory). Cronbach's alpha for the MIQ subscales of 9 items each was, $r = .87$ for the visual, and, $r =$ .91 for the kinaesthetic. The alpha coefficients resulting from the analysis of the SIAM subscales, ranged from, $r =$. 63 to .81. These subscale internal consistencies are certainly respectable when compared to other available multiple subscale imagery measures, particularly considering that I designed the SIAM with only six items per subscale.

Subscale Inter-Correlation

Correlations among imagery measure subscales have provided only basic support for the concept of individual modalities and dimensions as separate constructs. Richardson (1994) cited correlations between modality subscales for the original Betts' QMI as ranging from, $r = .40$ (visual and olfactory) to $r = .78$ (olfactory and gustatory). Similar results were reported within Richardson's (1969) own early research with the modality correlations of the same measure ranging from, $r = .44$ (visual and olfactory) to $r = .68$ (auditory and tactile). Kihlstrom et al. (1991) conducted subscale comparisons and presented data that closely resembled elements of this latter set of correlations. They reported that the relationships between SQMI subscales ranged from, $r = .33$ (visual and olfactory) to $r = .59$ (gustatory and tactile). The only other multiple modality measures for which subscale correlations are available are the MIQ and MIQ-R. For both measures, there appears to be significant association between the visual and kinaesthetic subscales. Hall et al. (1985) reported a subscale correlation of, $r = .58$, for the MIQ and Moritz et al. (1996) detailed an association between the two modalities of the MIQ-R of, $r = .44$. An interesting point made by Kihlstrom et al. (1991) that could explain the reduction in the level of subscale correlation between the original and revised versions of the MIQ was that because "the correlation between two variables increases with the reliability of their measurement and, as a rule, longer scales are more reliable than shorter ones" (p. 138). Because the original MIQ contains twice the number of items, the relationships between subscales is likely to be stronger.

The modality subscale relationships determined for the SIAM follow a pattern similar to the above set of findings. Correlations between the senses examined ranged from, $r = .28$ (visual and gustatory) to $r = .81$ (olfactory and gustatory). These types of SIAM subscale relationships do indicate the presumed level of association between dissimilar (low) and more closely aligned sensorial processes (high). The visual and kinaesthetic subscales showed a very similar level of association ($r = .58$) to that reported for the MIQ subscales. Generally, the SIAM modality subscale correlations provide basic evidence to suggest that differences do exist as to how athletes generate sensory images. It should also be stated that further investigation of the SIAM will consider that certain associations are an effect of test format, in that the strong correlation between olfaction and gustation represents the strength of the relationship between the two lowest scored subscales. Correlations between these two senses reported for the QMI were only moderate, suggesting the possibility that a more accurate representation of individual differences may be available when individual items are successfully able to prompt the generation of images rather than resulting in low scoring responses.

Comparisons between the modality and dimensional subscales of the SIAM highlight the strong association of the visual modality with all of the dimensional characteristics examined. Other modality-dimension comparisons indicate no clear relationship pattern except for the minimal correlations for the senses of smell and taste. The emotion subscale also followed no clear pattern of association with either dimensions or modalities. Previous research has rarely reported these types of results, so relevant comparisons were difficult to find. Hall and Martin (1997) indicated the correlation between the visual subscale of the MIQ and VMIQ ($r = .65$), a vividness measure, was greater than the similar comparison for the kinaesthetic subscale ($r = .49$). This relationship pattern may be due to modality function, as the VMIQ also emphasises the visual sense. The interaction of modality and dimension within the formation of images, and the role that emotion plays, are areas that most definitely require further investigation.

Relationships observed between the SIAM dimensional subscales indicate little independence between the individual characteristics. Unfortunately, comparisons with other research made at this point are based on studies that have compared complete measures of different dimensional emphasis rather than independent subscales. Correlations between the SIAM dimensional subscales ranged from $r = .88$ (ease and speed) and $r = .64$ (speed and duration) and were generally above $r = .70$. The types of associations observed between imagery dimensions within the SIAM are typically higher than the correlations reported in studies involving the comparison of total scores of imagery measures. The SQMI (vividness) and GTVIC (control) have regularly been found to correlate at around the $r = .40$, substantially less than the $r = .84$ found between the corresponding subscales of the SIAM. Comparisons of the MIQ (ease) with the VMIQ (vividness) and VVIQ (vividness) presented by Hall and Martin (1997) produced correlations $r = .58$ and $r = .54$, respectively. Although smaller than corresponding correlations found for the SIAM, this level of association does not support genuine construct specificity. This fact is further exemplified when the correlation between the visual MIQ subscale and VMIQ ($r = .65$) is examined. As yet, support for the uniqueness of imagery dimensions is very limited, and the smaller correlations found between imagery measures may be a result of variations in their assessment methodologies rather than true individual differences in the generation and control of images.

Factor Analysis

Previous factor analyses of imagery ability measures have shown little consistency in the procedures used to determine factor structure. I based the analysis framework adopted within the present research upon three key components of a methodology suggested by Gorsuch (1997). These components are: (a) the parceling of similar items into miniscales to increase the range of scores and reliability; (b) the use of oblique rather than orthogonal rotations to account for the likelihood of correlations among the subscales and to avoid any general factor being obscured; and (c) the use of a common factor extraction method in preference to principal components analysis, to ensure an error term is included. Gorsuch argued that this avoids inflated loadings.

The result of the initial exploratory factor analysis of individual items tended to highlight more problems than it resolved. The key problem is that the derived factor pattern is representative of the content, presentation, or format of items rather modality or dimensional structure. Lane (1977) and Kihlstrom et al. (1991) also reported similar factorial composition problems. They obtained large numbers of factors that related very poorly to the specific imagery characteristics being examined. This type of uninterpretable factor structure is indicative of a need to review both the scenes and particular items of the SIAM. The goals of such revision would be to improve the content, format, and structure of the measure by deleting or modifying particular scenes or items that appear to be replicating each other.

Factors derived from the second exploratory factor analysis are more easily interpreted and representative of the findings of related research studies (Richardson, 1994; Sheehan, 1967a). Although I can propose a framework based on the dimensional and modal representation of the derived factors, the more complex concept of the multi-dimensional, multi-modal structure of imagery ability cannot be supported. A hierarchical structure, as shown in Figure 3.1, may be more representative of the findings, in which there is a general imagery ability factor and additional second order dimension and modality factors. These latter factors did not appear within the individual items factor analysis, broadly emerging, only from the factor analysis using subscales as specific variables. The pattern of correlations between the subscales also supports the resultant factor structure. Based on the acceptable internal consistency results for the specific subscales, a third level that highlights individual dimensions and sense modalities could be added to this model.

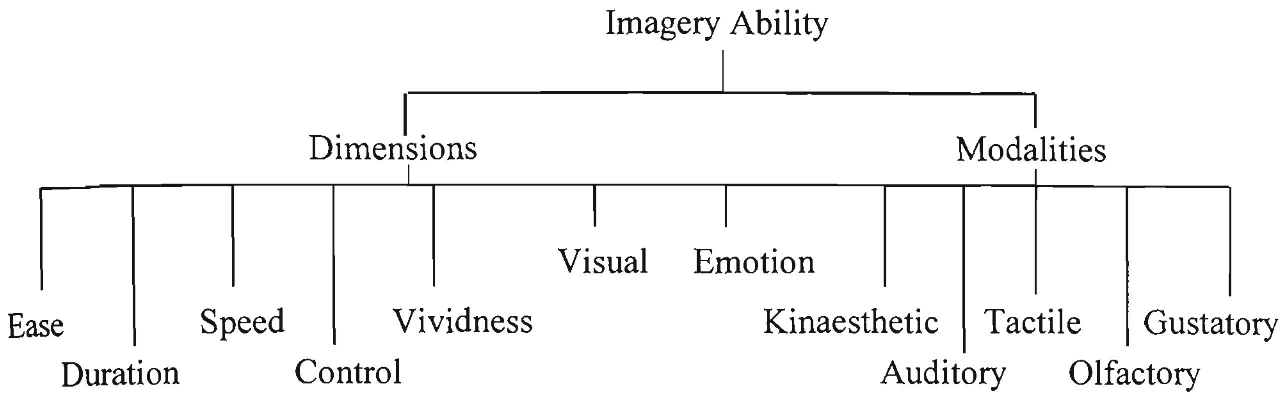

Figure 3.1. Proposed hierarchical model of imagery ability.

The factor analysis by sub-scale scores does raise several issues. The first problem with the proposed hierarchical framework is that the visual modality loaded with the dimensions. This has occurred either because most people tend to assess dimensions based on their visual experience, the visual modality usually being dominant sense in imagery, or because of the location of the visual items directly after all the dimension items for every scene within the questionnaire. White et al. (1974) reported that, in principal components analysis of the SQMI, the visual sense loaded on a large vividness factor whereas four other senses (tactile, kinaesthetic, smell, and taste) loaded on a smaller separate factor. That the visual sense is usually the dominant modality with respect to imagery would appear to be consistent with these findings. Within any revision of the SIAM, it would be best to modify the item format so that the visual modality item does not follow any set pattern with respect to dimension or modality. White et al. (1978) found that a randomised version of the short Betts' SQMI was less affected by response set bias and, therefore, more accurately reflected cognitive organisation than the older version of the SQMI. Nonetheless, it is likely that, unless explicitly directed otherwise, most respondents will assess the dimensions primarily based on their visual experience during imagery (Ahsen, 1997).

Another problem facing a hierarchical conceptualisation is that emotion did not clearly load on the dimension factor or the sense modality factor. This would suggest that emotion necessitates consideration as an additional second order factor within the proposed hierarchy. It is possible that the isolation of the emotion subscale factor relates to the location of the emotion item as the final response scale for each scene. Revision of the SIAM should attempt to resolve questions relating to the association of the emotion factor with either the dimension or the modality factor, or substantiate the uniqueness of the factor. In the ISM or Triple Code Model, Ahsen (1984) proposed that emotion is part of the somatic (S) component. He argued that the somatic mode of imagery should be broadly defined to include all aspects of the soma, including muscular and visceral activity, affect, and emotion. Further exploration of the location of emotion would, thus, represent a useful test of the somatic component of Ahsen's model, which predicts that emotion should be more closely associated with the sense modalities.

Other researchers have reported difficulty in highlighting consistent differences between dimensions when multiple measures or multi-dimensional measures have been factor analysed. When the dimensions of vividness and control were the focus for examination, the majority of studies have reported that they load on the same factor (Hiscock, 1978: Kihlstrom et al., 1991; Lane, 1977; Richardson, 1994; Switras, 1978) with only one study finding a factor unique to the dimension of vividness (Richardson, 1994). The broad dimension factor found here can be explained by a difficulty in differentiating between the nature of the imagery dimensions themselves. An individual who experiences very vivid images may well be expected to easily control them, and to generate them relatively rapidly, whereas someone reporting unclear images may also be unable to control them, might report that they were hard to generate and could indicate that it was difficult to maintain them for very long. It is, therefore, reasonable to expect that there will be considerable covariance among the dimensions related to imagery ability (Lane, 1977).

No clear pattern with respect to the multi-modal nature of imagery has yet been established. The SQMI has been the measure most frequently factor analysed and only a small number of studies have reported any distinction between the assessed modalities (Kihlstrom et al., 1991; White et al., 1974). Switras (1978) was able to highlight six specific modality factors from the seven assessed modalities of the SMI. Lane (1977), however, found no clear structure with respect to modality in analysing an adaptation of the SQMI. The key difference between these two measures is that the SMI analysed both vividness and control with respect to modality, whereas the Lane (1977) measure only examined the controllability of specific modalities. These ambiguous reports, in conjunction with the current analysis, certainly suggest that it is useful to continue investigation of the operation of both the sense modalities and emotion in imagery, to determine their status as unique factors or as a more homogenous representation of the role of the senses and emotion in imagery.

Summary

Following both the examination of the relevant research related to imagery ability and the analysis of the results of the current study, several key issues can be highlighted. Currently, many imagery ability measures fail to follow any rigorous on-going psychometric evaluation, with the SQMI the only measure to present sufficient data to suggest that it is both reliable and valid. Few of the existing sport or movement imagery ability measures have reported any results other than basic reliability data and factor structure. Only recently have basic investigations been undertaken to substantiate the validity of the questionnaires (Eton et al., 1998; Hall & Martin, 1997). The MIQ is the measure in which current psychometric data appears most acceptable, but a reliance on the physical performance of movements restricts the application of this test. There is also little evidence that a measure of basic physical movements relates to imagery ability with respect to highly skilled sport performance. The data reported here for the SIAM indicate that this sport-oriented measure possess acceptable levels of reliability, determined using a large sample and appropriate psychometric procedures.

Research examining the factor structure of imagery ability measures has provided a wide range of findings. Generally, studies have been able to support the existence of specific modality factors when only a few senses are being assessed. As the number of modalities examined increases to incorporate the full range of senses, as recommended by Suinn (1993), the derived factor structure becomes less representative of the original modality framework of the measure. Only limited development of multi-dimensional measures of imagery ability has occurred, with investigations more likely to be an examination of multiple measures with varying dimensional emphases. Results of such studies have generally not differentiated dimensions as specific factors. Factor analysis of the SIAM was designed to include a greater range of examined dimensions and modalities, with an emphasis on achieving an interpretable factor structure. I directed attention toward both the specific factor analysis procedures used to analyse the factor structure of the measure and the most appropriate type of data to be used in the analysis (item scores or subscale scores). Results indicated that a basic two factor structure exists, however, additional modification of the SIAM could lead to the interpretation of models that present a representation of the imagery process that distinguishes characteristics such as dimension, modality, and emotion.

Future Research

Further research examining sport imagery ability should be conducted using a revised version of the SIAM. Revisions should involve the reduction in the number of scenes, the inclusion of a more appropriate practice scene, and the randomisation of items within each scene. The internal consistency, test-retest reliability, and factor structure of the revised measure should then be analysed. The examination of factor structure should incorporate confirmatory methods rather than exploratory techniques, as an existing basic model relating to sport imagery ability, suitable for model testing, now exists. Convergent and discriminant validity of the revised SIAM should be examined, comparing it with other imagery ability measures and with some non-image-based measures of cognitive processing. Criterion validity of the SIAM warrants examination by comparing the subscale scores of athletes performing at the elite and non-elite levels. This would provide an indication of the measure capacity to discriminate between athlete on the basis of their imagery abilities. SIAM dimension and modality scores should also be compared with independent indicators of the use of imagery in a sports context, as a measure of concurrent validity. This type of data could be facilitated by the examination of the continuity between an athletes personal description of their imagery behaviours and their responses to the SIAM style, self-report format. Finally, the revised SIAM should also be examined for reliability and validity with a range of different sport, social, and cultural groups.

The data presented here from the current analysis of the SIAM, in conjunction with the information derived from the review of psychometric evaluation studies of other imagery ability measures, support the establishment of studies to examine the reliability, factor structure, and validity of a multi-dimensional, multi-modal measure of sport imagery ability. Additional research, once the psychometric merit of the SIAM is fully established can be undertaken to generate additional information regarding the manner in which athletes process imagery, and those imagery characteristics that may differentiate both sports performers and performances.

Implications for Practice

Imagery is a technique that is widely practised in sport. Ahsen (1990) has argued that imagery varies in relation to context. Thus, it would appear that a sport specific measure of imagery would be most likely to reflect imagery ability in that context, yet nobody has developed a reliable and valid measure of imagery in the sport context. The development process I followed for the SIAM establishes its face and content validity. The findings I have presented here in terms of test-retest and internal consistency reliability and factor structure suggest that the instrument has promise as a measure of imagery ability in sport. Although further reliability data and information regarding validity remain to be detailed, and before the construct validity of the SIAM is established, the results to date suggest that this measure has great potential for use in sport psychology programs.

I believe that a particular strength of the SIAM is its use of generic sport scenes. Context is important to imagery (Ahsen, 1990). Imagery ability is typically measured before the start of an imagery program, as a guide to the design of that program. Thorough practitioners then measure imagery ability periodically during a program to monitor changes in various aspects of imagery ability that might result from the imagery exercises they recommend. As imagery programs in sport typically involve imaging sport performance in training and competition contexts, any measure of imagery ability used to guide and monitor such programs, should involve imagery of those contexts. The scenes included in the SIAM meet this requirement. Further, the imagery scenes used in measures of imagery in sport should be applicable to a wide range of sports. I developed the wording of the scenes very carefully to make them generic. Informal comments of participants from more than 30 sports indicated that they experienced no difficulty in generating imagery for the six scenes we devised. One exception to this was that some swimmers found the Slow Start scene problematic. They stated that this was because they have no breaks in which to regroup, as is found in sports like tennis or basketball. Through discussion, it is envisaged a slightly modified version of this scene could be devised for short duration, racing events. In general, the SIAM can be used across a wide range of sports, in all cases allowing performers to image themselves in contexts that they commonly experience and that are highly meaningful to them. This should enhance the usefulness of their SIAM sub-scale scores for guiding imagery program design and modification.

The SIAM is constructed so that it is possible to remove or replace scenes with relative ease. The measurement sub-scales remain the same; all that needs to be changed is the specific scene description. One possible application of this observation is that the reliability and validity of short forms of the SIAM could be examined by removing two or three scenes. If, as we would predict, this does little to alter the relative location of performers on each sub-scale, then a short form could be used for repeated testing, such as during the monitoring of an intensive imagery program. Another possible use is that, in applied contexts, scene descriptions could be developed that are specific to the context of the imagery program. I predict that this should enhance the predictive validity of the scale in that particular context.

Conclusion

Through the examination of the reliability and factor structure analyses of a new measure of imagery ability in sport, I have raised a number of important issues related to the measurement of imagery, in particular concerning the development of reliable and valid tests of imagery ability. I have identified a number of steps that can be taken to facilitate such psychometric analysis, especially with reference to the factor structure of imagery ability measures. Researchers and practitioners need the availability of trustworthy measures for use within their work.

In the present thesis, through the processes described in this chapter, the developmental methodologies, initial reliability and factor analyses have demonstrated that the SIAM is measure of psychometric merit. Minimal support for the existence of a multi-dimensional multi-modal framework of sport imagery ability remains the most important area of concern. The results and discussion presented here provide a balanced analysis of the positive and negative qualities of the SIAM. The findings generally suggest that the measure warrants on-going development and psychometric evaluation. Possible areas of further investigation outlined in the future research section will be examined in the subsequent chapters of this thesis.

CHAPTER 4: RELIABILITY, FACTOR STRUCTURE, AND CRITERION VALIDITY OF THE REVISED SPORT IMAGERY ABILITY MEASURE (SIAM)

Introduction

A primary component of the development of psychological assessment instruments is the on-going review and revision of the measure. This chapter details the second phase of the psychometric analysis of the Sport Imagery Ability Measure. Findings presented in Chapter 3 of this thesis provided an appropriate framework to facilitate revision of the test. Many of the existing imagery ability instruments used in the field of general psychology, such as the Shortened Questionnaire Upon Mental Imagery (SQMI; Richardson, 1969) and the Individual Differences Questionnaire (IDQ; Paivio, 1971) have undergone revision procedures over several decades in an effort to enhance both the psychometric quality and functional usefulness of the measures. Only two measures developed for application within sport psychology, the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac et al., 1986) and the Movement Imagery Questionnaire (MIQ; Hall et al., 1985) have been subjected to procedures representative of on-going instrument review. As yet, no studies examining any measures of sport imagery ability are available that detail evidence related to review and revision of the original measure. Due to this paucity of research on sport imagery ability measures, I considered it vital that I implemented the appropriate research procedures to generate information regarding the reliability and factor structure of a revised version of the SIAM.

The assessment of individual differences in imagery abilities has been an important variable considered in the examination of the psychological characteristics relevant to superior athletic performance. Studies have incorporated methodologies that measure imagery ability as one component of multiple factor psychological skills inventories (e.g., Mahoney et al., 1987) or based on scores derived from general, movement, or sport-oriented imagery ability measures (e.g., Eton et al., 1998; Hecker & Kaczor, 1988; Isaac & Marks, 1994). This chapter presents evidence of the capability of the revised SIAM to discriminate between athletes participating at the elite and non-elite levels. Due to the multi-modal and multi-dimensional design of the SIAM, the information generated within this study represents a useful source for the provision of a detailed analysis of the specific components of sport imagery ability that may differentiate athletes of varying skill levels and sporting backgrounds. Previous research has generally been unable to highlight the full range of sensory or image generation properties that may be involved within the imagery of exceptional athletes. This limitation has primarily been due to the lack of suitable measures to examine sport imagery ability. Thus, this study aims firstly, to ascertain if the revised SIAM is a measure that can provide reliable data concerning the key characteristics of sport imagery ability. Secondly, this study will determine if the use of the SIAM can generate information that enhances the understanding of the conceptualisation of sport imagery, and the role that this important psychological attribute performs in athletic performance.

Revision of the Sport Imagery Ability Measure

Following the examination of reliability and factor structure of the Sport Imagery Ability Measure (SIAM) reported in Study 1, it became apparent that design elements of the questionnaire required revision. In the development of the revised measure, the intent was to reduce the length by removing two scenes least associated with actual sports performance, to randomise the order of presentation of individual dimension and modality items within each scene, and to introduce a more sport-oriented procedural familiarisation scene.

The initial revision involved the reduction of the SIAM from six scored scenes to four scored scenes and a practice scene. Although this modification only reduced administration time by around five minutes, I considered this change to be appropriate, because it should reduce test fatigue due to the similarity in response requirements over the original six scenes. The two scenes removed, primarily on the basis of their face validity, were the recreational and fitness scenes. These scenes are the least representative of actual sporting participation, and are, thus, likely to be less relevant in the context of generating sport-oriented images. The final decision, however, centred on the need to shorten the questionnaire, and the removal of entire scenes rather than eliminating dimensional or modal items appeared to be the most logical strategy. This approach did not affect the general multi-modal, multi-dimensional framework of the measure, which was a key element of its original design. In revising the Movement Imagery Questionnaire, Hall and Martin (1997) suggested that it is important that tests avoid being too long, as there can be restrictions in the amount of time available for imagery ability assessment.

Examination of participant response patterns and factor analysis of the original study data revealed that scores on the visual modality item resembled the scoring pattern found for the dimension items, and loaded on the same factor as the dimension items. Although this may be attributable to similarities in the nature of visual imagery to the imagery experienced and reported in a dimensional context, it should be acknowledged that the visual modality item immediately followed the five dimensional items for each of the six scenes, as the sequence of items remained the same across all the scenes. Responses to the olfactory and gustatory items were of a similar pattern across scenes. These findings highlighted the possible existence of response patterns based on test design rather than imagery functioning. Consequently, I decided it would be best to modify the test format so that items did not follow any set pattern regarding dimension or modality. White, Ashton, and Law (1978) concluded that a randomised version of the SQMI was less affected by response set bias and, therefore, should more accurately reflect cognitive organisation than the original version of the SQMI. The term cognitive organisation relates to the possibility that participants may respond in an organised pattern when items are presented in a set order throughout a questionnaire. In the revised version of the SIAM, the dimension and modality items are presented in different random orders for each of the four test scenes.

From reviewing the descriptive statistics (Table 3.1), I found that the participants' mean scores on the first scene were consistently lower than the mean scores on each of the other five scenes. Although elements of this response pattern may be attributable to the nature of the scene, I considered that participants' responses may have been affected by an increased need to concentrate on the task elements of the activity rather than the imagery. I decided that a procedural familiarisation scene that more closely resembled the structure, content, and format of the test scenes, than the original basic non-sport example, would provide participants with a clearer understanding of the task requirements and suitably prepare them to complete the scored items of the measure. The procedural familiarisation scene selected was the fitness scene from the original version of the SIAM. In the revised SIAM, it is completed prior to the other scenes under assessment conditions, but respondents are informed that its purpose is to familiarise them with the requirements of the measure. The fitness scene was selected for this 'warm-up' activity, because I felt that its exercise focus provided a general similarity with the nature of the images participants were subsequently required to generate in the sport-based scenes. The use of a scene-based preparatory activity, incorporating all 12 subscales seemed appropriate, as the standard testing regimen was directly applicable to its completion. Subscale responses for this scene are, therefore, not be included as scored items within the revised measure.

Internal Consistency, Test-Retest Reliability, Factor Structure, and Criterion Validity

The primary aim of the second, large-scale study was to examine a number of the psychometric properties of the revised SIAM. The first area of interest within this study was the evaluation of the reliability of the revised measure.

Secondly, I examined the factor structure of the randomised version of the test. As a general factor structure was determined within Study 1, and in consideration of the methodological strategies proposed by experts in this area (e.g., Marsh, 1999; Schutz & Gessaroli, 1993), I decided that confirmatory factor analysis rather than exploratory, was the appropriate technique. Recent discussions of the development of inventories for use in sport psychology have supported the on-going need for exploratory factor analysis (EFA) as a preliminary step, but concluded that factor structure should be more rigorously examined through the use of confirmatory factor analysis (CFA) (Schutz & Gessaroli, 1993; Marsh, 1998). Marsh (1998) indicated that Schutz and Gessaroli expressed concern at the lack of demonstration of the CFA process prior to 1993. He recently proposed that CFA procedures are rapidly replacing older EFA approaches in factor analysis of sport psychology measures. Demonstrations of the CFA process in the context of imagery abilities assessment are severely lacking (Hall, 1998). Presently, only one measure from either general or sport psychology was identified, for which test developers have used structural equation modeling to confirm their possible factor structure (Babin & Burns, 1998). Irrespective of the accepted difficulties in the assessment of the imagery process (Richardson, 1994), understanding in the field can only be enhanced through the application of the most appropriate statistical tools to demonstrate the relationship between measured variables and latent constructs.

Finally, I examined the differences in the SIAM subscale scores between the participation level groups (elite and non-elite) to generate evidence relevant to the criterion validity of the questionnaire. Details of the research process are presented in the following section.

Method

Participants

Participants from a broad range of sport and social backgrounds took part in the reliability and factor structure analyses of the revised SIAM. The sample comprised a combination of secondary school students from nine schools, physical education and recreation students from three universities, athletes from five specific sport groups, and Australian Institute of Sport (AIS) athletes. All except two groups came from metropolitan and regional Victoria. The Australian under-18 girls' hockey squad was in Melbourne preparing for an upcoming competition and the AIS group was in New South Wales at a training camp. Each participant completed the questionnaire as a component of either the test-retest study, convergent and discriminant validity study, or concurrent validity study. Each participant or parent (in the case of underage participants) was required to complete an informed consent form explaining the procedures, the use of results, and the participant's right to withdraw at any time. The Department of School Education provided approval and support for the participation of the high school students in the study. Following discussion of the research with course co-ordinators, they approved approaching university students during lectures to participate in the study. Initially, I contacted sporting groups at the administration level and the administrators subsequently directed me to coaches for approval to contact players to participate in the study.

The final composition of the sample included 633 participants, 334 males and 299 females, with an age range of 12 to 55 years (M = 18.77, SD = 4.60). The participants all volunteered to be involved in the study. Specific participant numbers from the four groups were:

1. Athletes from specific district, state, and national sporting groups (n = 150).
2. Victorian Department of School Education secondary school students participating

within the Specialist and Exemplary Sport in Schools programs (n = 199).

3. Undergraduate students participating in physical education courses at Victoria University of Technology, Deakin University, and Ballarat University (n = 278).
4. Australian Institute of Sport (AIS) athletes involved in the swimming program, (n = 6).

An additional breakdown of participants, grouping them according to highest level of sport participation and sporting background, indicated that the athletes or former athletes had involvement in 33 different sports at the following levels: 64 national, 208 state, 276 district, and 85 local. The participants ranking of their participation level formed the basis of compiling elite and non-elite athlete groups. Athletes that were involved at either the national or state level were classified at the elite level, whereas, athletes involved at the district or local levels were classified as non-elite.

Measures

Personal Details Information Sheet. Each participant completed an information sheet that asked for details regarding gender, age, main sporting interests, and highest level of participation, e.g., national, local. The sheet also included a participant code number and the date of the test or retest session.

Revised Sport Imagery Ability Measure (SIAM). As described earlier in this chapter, the SIAM was revised in the following manner. The number of scored scenes was reduced from six to four (72 to 48 items), the fitness scene of the original questionnaire was used as a practice scene, and the items were presented in a randomised manner for each scene. Otherwise, the SIAM was presented in the format described in Study 1. The revised version appears in Appendix G.

Procedure

Depending on the participant group, the organisation of testing sessions necessitated different procedures. In each case, I contacted the individual responsible for the specific group and informed them of the nature of the study and what was required of participants. In the school settings, consent forms were posted to schools and given to participants by teachers for completion by their parents or guardians prior to testing. After arranging a test date, I visited the school, collected consent forms, and conducted group testing with a variety of different group sizes. For the sporting groups, depending on their age, consent forms were sent to the coaches of the younger squads, who distributed them to players for parents or guardians to sign. Adult athletes were given consent forms prior to testing and returned completed forms before administration of the SIAM. In the case of under-age participants, whose parents gave their consent, completion of the SIAM constituted an indication of the consent of the participant. Testing was undertaken in small groups following, or as a component of, training sessions. This happened on a number of occasions, until all participants were tested. The university student groups were given consent forms prior to the testing sessions and all testing was undertaken as a component of a lecture or tutorial session.

I conducted all the testing, except for the AIS group. Trainee sport psychologists from the School of Human Movement, Recreation, and Performance at Victoria University, who were undertaking supervised practicum in sport psychology at the AIS, tested these participants. Prior to their involvement in testing, I provided a detailed verbal overview of the testing procedure to their supervisor, and provided written instructions of testing for each of the testers (see Appendix N). The same administration procedures were followed during test sessions for all groups. The tester waited for participants to be seated comfortably, introduced themself, and asked if the session could be conducted with a minimum of unnecessary noise. Participants received a verbal outline of the nature of the research as stated in the consent form, information that their involvement would be confidential through being identified by code numbers, and they were asked if they had any questions related to the procedures. Once the tester answered questions, they distributed the measure, and asked participants to complete the personal information sheet, read carefully through the introduction page, and attempt the example. Following a second opportunity to ask questions, participants received instructions that for each scene they would read the description, image the scene for 60 seconds, and then respond to the 12 scales. Participants then read a procedural familiarisation scene. When the tester felt all participants had finished reading the scene description, they used a stopwatch to time the imaging activity with the following start and stop instructions: "start imaging now" and "go ahead and complete the questions". The tester asked participants to place their pens or pencils down upon completing the scales. When all participants had finished responding, the tester asked if they had any questions regarding the procedure. The tester then informed participants that the scored section of the SIAM would now commence and to read the next scene. The testing procedure was repeated for each of the four scenes. After a four-week interval, a group of 58 university students completed the imagery ability measure a second time, to examine test-retest reliability. Testers debriefed and thanked all participants at the end of their final testing session. In the debriefing, I (or the AIS testers) provided a more detailed explanation of all measures and the relationship of this research to imagery training. An additional opportunity to ask questions was then offered, and the details were provided for individual participants to find out the shape of their SIAM profile at a later date.

Statistical Analyses

The primary goals of the data analysis were the examination of reliability, factor structure, and criterion validity of the revised measure. The following statistical procedures were undertaken:

1. Descriptive statistics for specific subgroups for each subscale, including means, standard deviations, and skewness, were computed. Frequency distribution of age,

gender, and level of participation were determined.

2. A reliability coefficient of stability was formulated using the test-retest data collected.
3. The degree to which each item was a good exemplar of the subscale to which it was proposed to belong was examined by calculating item-subscale correlations. Item-deleted alpha coefficients provided further information on this issue.
4. The internal consistency of the test was assessed by calculating the Cronbach's alpha coefficient for each subscale separately.
5. Factor structure was examined through the use of confirmatory factor analysis. Confirmatory factor analyses were undertaken using AMOS 4.0 software (Arbuckle & Wothke, 1999). The CFA procedure is considered to generate more definitive empirical evidence of the underlying factor structure of a measure in comparison to EFA (Cramer, 2000). The maximum likelihood estimation procedure was selected as it is recommended for use with ordered categorical data of varying degrees of skewness (Conroy et al., 2000) and is the standard method of testing a structural equation model (Kowolski & Crocker, 2001). Several models were constructed *a priori* for both the item and subscale data sets. The sample was appropriate for CFA model testing because (a) participant numbers were greater than 300 and (b) the ratio of sample size to variables was greater than 5:1 for the individual item model and 10:1 for the subscale model (Conroy et al., 2000). Model solutions were evaluated using the following fit indexes. The chi-square goodness of fit statistic, which is regarded as a measure of the badness of fit of models, such that a small value corresponds to a good fit and a large value represents a poor fit (Joreskog & Sorbom, 1993). It should be noted that chi-square and the chi-square/degrees of freedom (df) indices are affected by large sample sizes (>200) (Kline, 1998; Marsh, Balla, & McDonald, 1988). The adjusted goodness of fit index (AGFI) is an absolute fit index that indicates the

proportion of the observed variance and covariance explained by the specified model (Motl & Conroy, 2000). The normed fit index (NFI) demonstrates the degree of improvement in fit of the specified model compared to the independence model. The independence model, represents a model where the observed variables are assumed to be uncorrelated with each other, and the model is so severely constrained that a poor fit is expected from any reasonable set of data (Arbuckle & Wothke, 1999). The Tucker-Lewis index (TLI) is a type-2 index and indicates the improvement per degrees of freedom of the specified model over the independence model, and is less affected by sample size than other indices (Conroy et al., 2000). The comparative fit index (CFI) is a type-3 index and indicates reduction in poor fit (Conroy et al., 2000). Finally, the root mean square error of approximation (RMSEA) is an indication of the specified model's lack of fit, taking into account degrees of freedom. It represents the disconfirmability of a model (Kowolski & Crocker, 2001). These indices were selected on the basis of examination of the fit indices suggested within reputable multivariate analysis techniques texts (e.g., Hair, Anderson, Tatham, & Black, 1995; Pedhazur & Schmelkin, 1991) and the review of recent articles related to measure development in sport psychology (e.g., Conroy et al., 2000, Kowolski & Crocker, 2001).

5. Evidence of the criterion validity of the SIAM was generated using the t-test for independent samples. Differences between the mean scores, for each of the SIAM subscales of the elite and non-elite athlete groups were analysed.

Results

The presentation of the results of Study 2 of this thesis detail findings associated with the descriptive statistics, reliability analyses, subscale inter-correlations, confirmatory factor analyses, and criterion validity of the revised SIAM.

Descriptive Statistics for the Revised SIAM Subscales

The means and standard deviations for each of the SIAM subscales for the total sample and for each of the two participant level subgroups are shown in Table 4.1. Subscale scores for each participant were derived by totalling the four individual scene items representing that subscale (e.g., the four auditory items or the four duration items) resulting in a possible score range of 0 - 400.

Table 4.1

Means, Standard Deviations, and Skewness for Revised SIAM Subscale Scores for the Total Sample and the Participation Level Subgroups

	Total (N = 633)			Elite (n = 272)		Non-elite (n = 361)	
Subscale	*M*	*SD*	*Skew*	*M*	*SD*	*M*	*SD*
Gustatory	128.2	98.1	.46	128.36	91.39	128.01	102.90
Olfactory	146.8	102.0	.32	145.56	93.37	147.77	108.23
Auditory	249.2	91.6	-.62	254.00	81.14	245.50	98.77
Tactile	255.0	89.0	-.77	259.40	84.88	251.69	91.94
Kinaesthetic	267.8	82.3	-.79	278.71	81.28	259.63	82.30
Emotion	279.8	75.3	-.92	289.14	75.87	272.75	74.16
Control	291.0	74.1	-.93	297.58	72.32	286.06	75.07
Duration	295.3	73.1	-1.00	300.89	70.35	291.11	74.86
Vividness	309.3	64.1	-1.23	316.45	61.12	303.92	65.83
Speed	310.4	65.5	-1.15	311.86	66.09	309.29	65.11
Ease	312.1	63.6	-1.24	313.78	62.07	310.75	64.70
Visual	315.8	63.0	-1.34	322.86	62.89	310.52	62.65

Generally, the subscale scores followed a similar pattern for each of the groups with respect to means and standard deviations. The pattern of subscale scores was also similar to the pattern found in descriptive statistics of the original measure. Mean scores for the sensory subscales (except for the visual) were lower than scores on the dimension subscales. Typically, there was less variability in the dimensional subscales than in the sensory subscales (excluding vision). Within each group, the scores of the gustatory and olfactory subscales were substantially lower and showed greater variability than other subscales. The visual subscale scores were the highest for both the total sample and the elite group and the second highest by a minimal margin for the non-elite group. The scores also highlight differences between the groups on all subscales. Generally, the elite group scored higher and showed slightly less variability than the non-elite group.

Results revealed a degree of variability in the level of skewness for each of the 12 subscales. The values ranged from .32 (olfactory) to -1.34 (visual). High levels of negative skew were found in all the dimensions and the visual modality. These are the subscales that have been typically associated with the assessment of imagery ability.

Test-Retest Reliability and Internal Consistency, of the Revised SIAM Subscales

Test-retest correlations and internal consistency (Cronbach's alpha coefficient) were computed for each of the twelve subscales. These values are presented in Table 4.2. The Cronbach alpha values show good to very good internal consistency with coefficients ranging from .66 (speed subscale) to .87 (gustatory subscale). The test-retest reliability results reveal moderate to very good correlations for the specific subscales, varying from .41 (auditory) to .76 (gustatory).

Table 4.2

Internal Consistency Coefficients and Test-Retest Reliability for Revised SIAM Subscales

Subscale	Alpha	T-R
Gustatory	.87	.76
Olfactory	.84	.65
Auditory	.75	.41
Tactile	.80	.61
Kinaesthetic	.77	.58
Emotion	.75	.75
Control	.79	.66
Duration	.77	.59
Vividness	.75	.56
Speed	.66	.53
Ease	.67	.50
Visual	.76	.67

Generally, the correlations reported from the internal consistency analyses of the revised scale are higher than those found for the original measure. Comparison of the test-retest results of the two versions of the SIAM reveals improvement in certain subscales (emotion and visual) and a reduced level of correlation for other subscales (auditory and tactile).

Subscale Inter-Correlations

The inter-correlation matrix of the Revised SIAM subscales is presented in Table 4.5. Results show that the relationships between dimensional subscales and between modality subscales follow a similar pattern to that reported in the analysis of the original SIAM. The patterns are again representative of the findings relating to the factor structure detailed within the exploratory factor analysis of the revised measure. All correlations were significant at the $p = .01$ level and ranged in value from $r = .25$ (gustatory and duration) to $r = .87$ (visual and vividness). Correlation values were considered in the context of their actual size within the matrix (e.g., gustatory and vividness, $r = .27$, low; vividness and ease, $r = .84$, high) rather than their level of significance, as even the very low values were significant.

Table 4.3

Inter-Correlations of the Revised SIAM Subscales (N = 633)

Subscale	1	2	3	4	5	6	7	8	9	10	11	12
1. Vividness	1.0											
2. Control	.77	1.0										
3. Ease	.84	.76	1.0									
4. Speed	.77	.70	.89	1.0								
5. Duration	.78	.77	.76	.72	1.0							
6. Visual	.87	.74	.79	.76	.74	1.0						
7. Auditory	.55	.46	.47	.43	.46	.50	1.0					
8. Kinaesthetic	.58	.57	.52	.47	.55	.56	.58	1.0				
9. Olfactory	.34	.35	.33	.30	.31	.33	.57	.45	1.0			
10. Gustatory	.27	.28	.26	.25	.23	.26	.51	.41	.81	1.0		
11. Tactile	.59	.57	.51	.45	.52	.58	.64	.75	.53	.49	1.0	
12. Emotion	.57	.51	.51	.45	.51	.52	.62	.69	.49	.49	.67	1.0

Differences in correlation values from the original to the revised version were largest between the olfactory subscale and the speed subscale which varied from $r = .21$ (original) to $r = .30$ (revised), the gustatory subscale and the speed subscale ($r = .17$, original, to $r = .25$, revised), the olfactory subscale and the ease subscale ($r = .25$, original, to $r = .33$, revised), and the duration subscale and the speed subscale ($r = .64$, original, to $r = .72$, revised).

Confirmatory Factor Analyses

The results of the confirmatory factor analyses are presented in two stages. The initial analysis tested the fit of a model incorporating each item of the SIAM as observed variables and the 12 subscales as latent variables. The model is shown as Figure 4.1 and the CFA fit indices listed in Table 4.4. The results indicated that the model did not represent a good fit for the data and that substantial modification of the specified model would be required to facilitate improvement in fit indices. This result suggested an alternative method for analysing the SIAM data was required. As an outcome of the EFA of the SIAM data in Study 1, I proposed that the data may be better represented by a model based on the subscale scores. Because all four items that relate to each imagery variable are worded the same, only minimal differentiation exits between items and, thus, they could be interpreted as representing a single variable rather than multiple indicators of one variable.

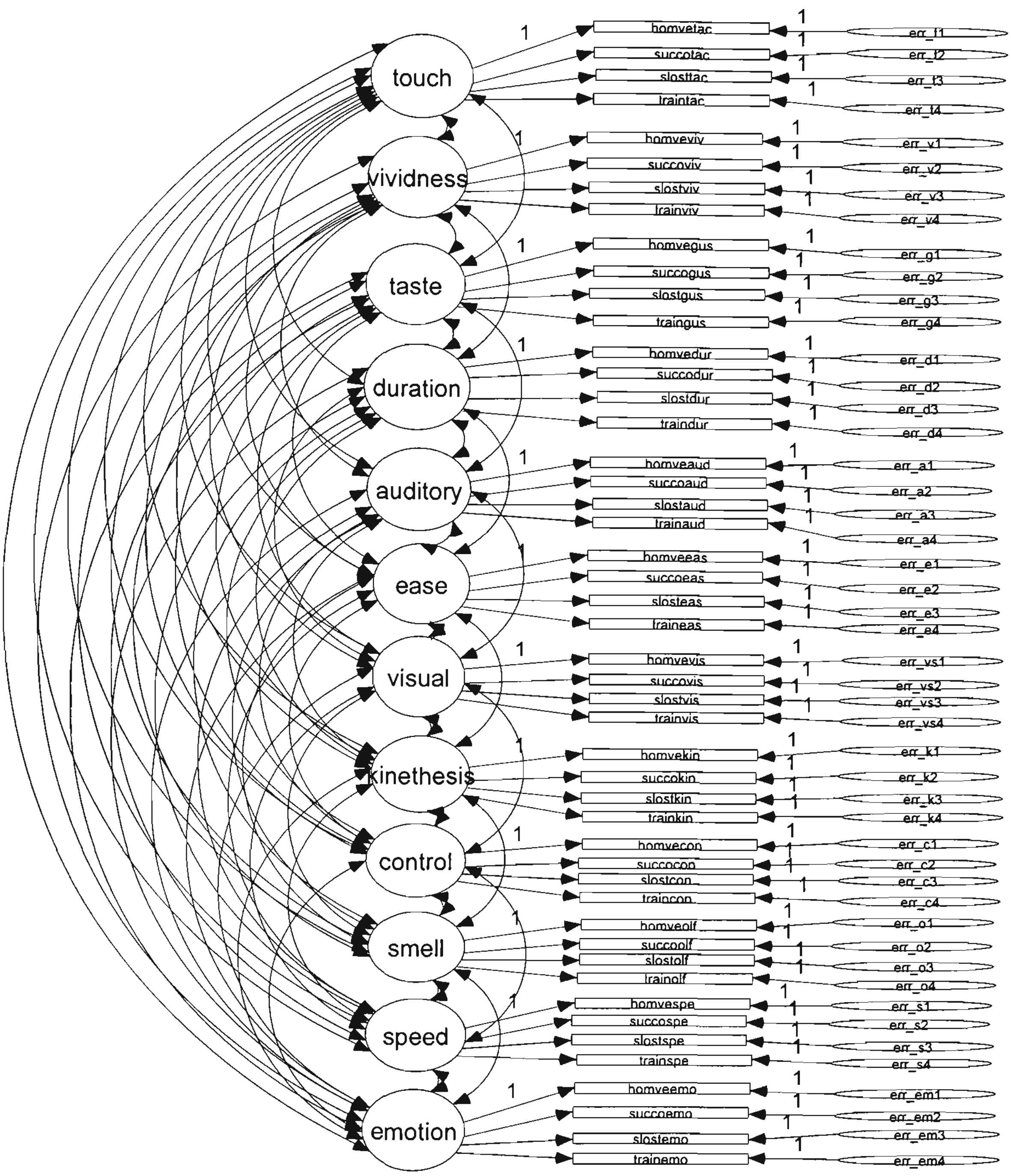

Figure 4.1. Specified individual item CFA model for the revised SIAM

A second set of confirmatory factor analyses was completed using subscale derived models. Subscale scores represented the observed variables and the latent variables varied on the basis of the model specification (e.g., two-factor, three-factor).

Table 4.4

Goodness of Fit Indices for CFA Individual Item Model for the revised SIAM

Model	χ^2 (df)	AGFI	NFI	CFI	TLI	RMSEA	Model Description
M-II1	9960.54 (1014)	.339	.599	.623	.581	.118	Individual item 12 factor

Results of the CFA for the four models tested are shown in Table 4.5. In general, all chi-square statistics were significant due to the large sample size. Because of the use of subscale, rather than item, scores (substantially reduced degrees of freedom) all of the chi-square/df statistics were greater than two, the recommended minimum (Arbuckle & Wothke, 1999). Overall, no model achieved a RMSEA of less than .10, the maximum recommended by Arbuckle & Wothke (1999), as an indication of model fit. Figure 4.2 shows the first model (M1) of two factors (visual/dimensions; non-visual/emotion). The model was derived directly from the EFA undertaken in Study 1. The model did not represent an adequate fit for the data for any of the indices calculated.

The second model (M2) of three factors (visual/dimensions, non-chemical senses, chemical) was a substantially better fit, with all three comparisons to the independence model (NFI, CFI, and TLI) above the recommended level of .90 (Arbuckle & Wothke, 1999). The model was developed on the premise that the proposed latent factors represented a breakdown of the second factor (Non-visual) of model 1, into factors representing the chemical and non-chemical senses. Review of the correlations of variables with the latent factors of Model 1 (see Figure 4.2) also indicated that the two chemical senses shared substantially less variance with that factor than the non-chemical senses. The parsimonious fit measure, the AGFI, was less than the level of .90, recommended by

Arbuckle & Wothke, however, this is often the level recommended for the unadjusted goodness of fit index (GFI), and other authors have suggested that an AGFI of .80 is indicative of a good fit (Pedhazur & Schmelkin, 1991). The AGFI of .832 of M2 indicates a reasonable degree of fit. The third, and fourth models were above or very close to this AGFI level.

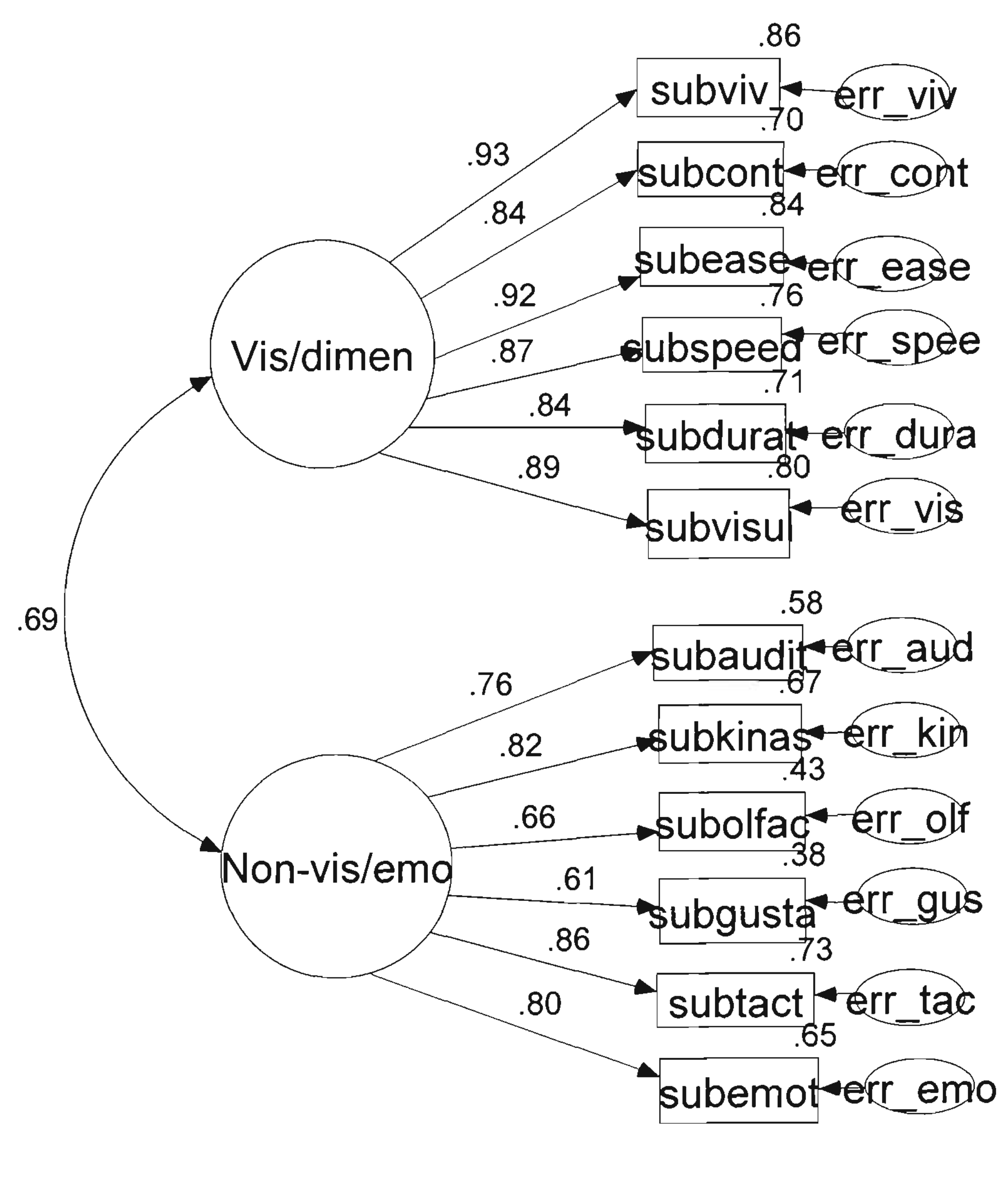

Figure 4.2. EFA derived two factor model (M1) including standardised estimates

The third model (M3) shown as Figure 4.3, also involved three factors. The factors were auditory sense grouped with the other single organ senses of taste and smell, visual/dimensions, bodily feeling. It was proposed that this constituted an appropriate representation of a dimensional and sensorial representation of imagery ability. The premise that a combined factor incorporating the feeling senses and a combined factor incorporating the single senses (e.g., taste, audition, smell) could represent the non-visual senses seemed plausible and warranted testing. This model had a slightly lower AGFI level, but each of the other comparison fit indices were above or close to the .90 level.

The final model (M4) of four factors (visual/dimensions, body feeling, chemical, emotion/auditory) produced the best fit indices for the data. Nonetheless, the combination of the emotion and auditory variables as a latent construct was considered implausible.

Table 4.5

Goodness of Fit Indices for CFA Models for SIAM Subscale Data

Model	χ^2 (df)	AGFI	NFI	CFI	TLI	RMSEA	Model Description
M1	894.72 (53)	.730	.872	.879	.849	.158	EFA derived two factor
M2	457.86 (51)	.832	.935	.941	.924	.112	Three factor – olfactory and gustatory factor
M3	617.63 (51)	.788	.912	.918	.894	.132	Three factor – auditory with chemical
M4	425.81 (48)	.834	.939	.946	.925	.111	Four factor – emotion and auditory factor

Review of the standardised estimates for M3 (Figure 4.3) indicated that the subscales assigned to the visual/dimension latent factor demonstrate a high degree of association with that factor. A similar pattern can be observed with the second latent factor with both the standardised regression weights and the squared multiple correlations of values indicating that the subscale scores adequately represent the feeling factor. Results for the third latent factor indicate that the olfactory and gustatory subscales are strongly associated with the single organ latent factor.

Standardised estimates for the auditory subscale indicate that it is less strongly associated with the third latent factor than all other subscales associate with latent factors. This could affect the overall values of the fit indices for this model.

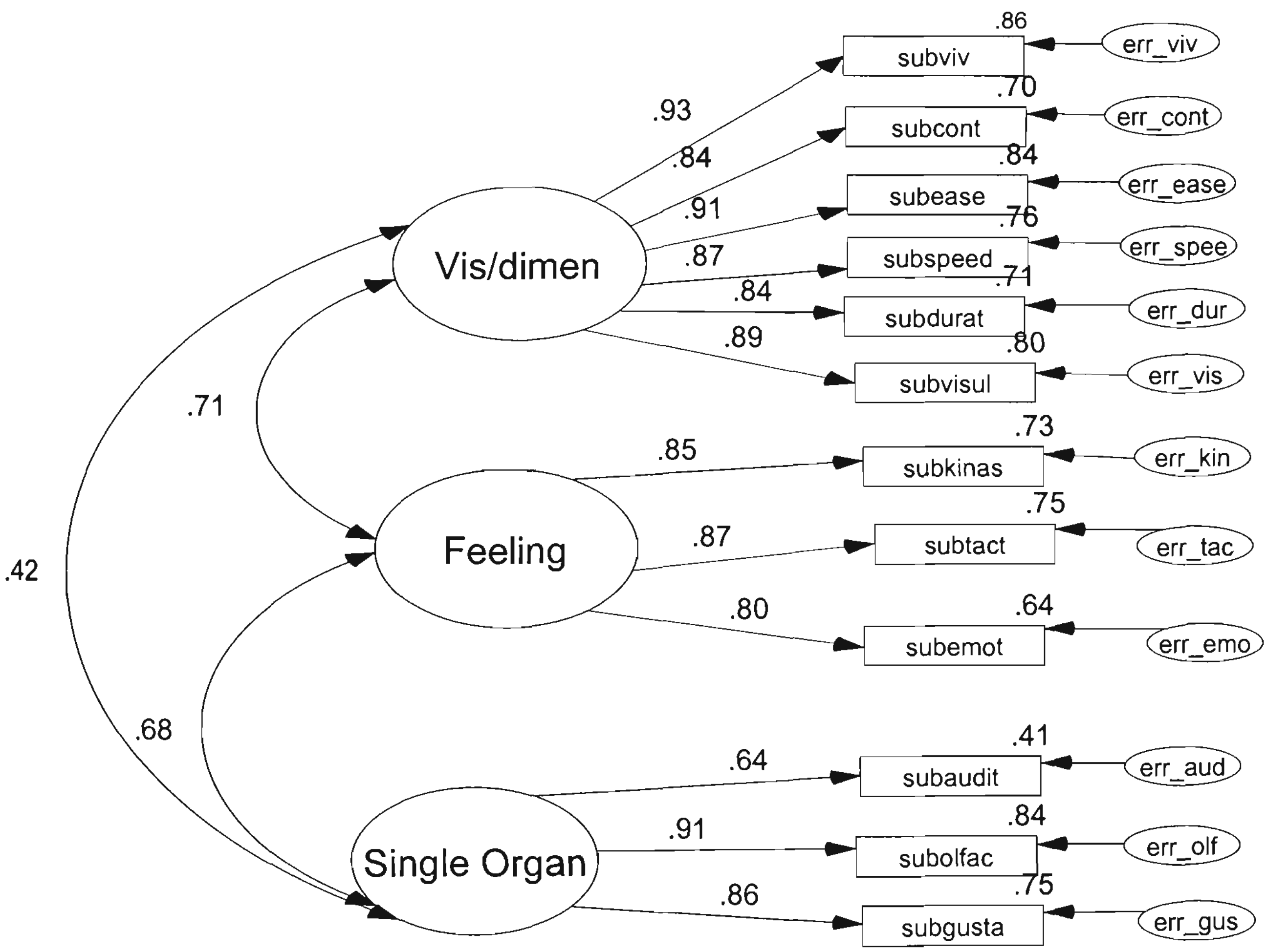

Figure 4.3. Specified Three-Factor Subscale Model (M3) for revised SIAM data including standardised estimates

Correlations between the latent factors for M3 calculated within the CFA (see Figure 4.3) indicated moderate degrees of association between the visual/dimension and feeling factors, and between the feeling and single organ factors. There was a substantially smaller level of association between the visual/dimension factor and the single organ factor.

Evidence of Criterion Validity

The *t*-values, probabilities, and effect size for the Revised SIAM subscale differences between the elite and non-elite groups are presented in Table 4.6.

Table 4.6

Summary of Differences between Elite and Non-elite Groups

	Difference between Elite and Non-elite		
Subscale	*t*-Value	*p*	*E.S.*
Gustatory	0.04	.96	.00
Olfactory	-0.28	.78	.02
Auditory	1.19	.24	.09
Tactile	1.08	.28	.08
Kinaesthetic	2.90	.01	.24
Emotion	2.73	.01	.22
Control	1.94	.05	.16
Duration	1.67	.10	.13
Vividness	2.45	.02	.20
Speed	.49	.62	.04
Ease	.59	.55	.05
Visual	2.45	.02	.20

Athletes who selected the national or state options for sport participation level were grouped as elite. Athletes who selected the district or local/school options for sport participation level were grouped as non-elite.

Significant differences at the $p < .05$ level were found between the groups for the vividness, visual, kinaesthetic, and emotion subscales. A significant difference at the $p = .05$ was found for the control subscale. No significant group differences at the $p = .05$ level were found for the other seven subscales. Cohen effect sizes for the differences between groups were small and ranged from .00 to .24.

Discussion

The general purposes of the second study of this thesis were to evaluate the psychometric properties and confirm the factor structure of the revised SIAM. Additionally, this study examined differences in the imagery abilities of athletes involved at varied levels of sport participation. Measures of imagery ability require on-going revision and refinement in a manner similar to all reputable self-report tests and questionnaires used in the field of psychology. Of the general imagery ability instruments, the QMI has undergone two important revisions since its original development (Richardson, 1994). In relation to measures used within the sporting domain, Hall and Martin (1997) recently revised a measure of movement imagery, the MIQ. Thus, in line with the accepted processes in the development of psychological assessment devices, an important outcome of the analysis of the original SIAM was the identification of certain weaknesses in the design of the measure that required revision. It is recognised that both the QMI and MIQ were used for many years prior to revision, however, on the basis of the findings of Study 1 the process of revision of the SIAM was warranted as an important phase in the development of the measure.

This second large scale study of the reliability and factor structure of the SIAM centred upon the implementation and psychometric evaluation of the proposed revisions to the measure. Evidence of the factor structure of the original SIAM, derived from the exploratory analyses of Study 1, formed the framework of a more rigorous investigation of the construct of sport imagery ability through the use of confirmatory factor analysis. In addition, this study assessed the capability of the revised SIAM to determine differences in the imagery abilities of athletes at different skill levels. This latter procedure generated evidence of criterion validity that would contribute to the overall construct validation of the revised SIAM.

General Conclusions

This section of the discussion presents an overview of the conclusions associated with the analyses undertaken in this study. Findings are discussed in relation to the following areas of the evaluation of the revised SIAM, which are descriptive statistics, reliability data, subscale inter-correlations, factor structure, and evidence of criterion validity.

Descriptive Statistics

Examination of the descriptive statistics for the revised SIAM substantiates several key findings reported from the analysis of the original measure. The distributions of the means of modality subscale scores indicate that the visual modality is the most involved in sport-related imagery. This finding is similar to that reported for the original SIAM and to those described in previous imagery research (Hall & Martin, 1997; White et al., 1977; Young-Overby, 1990). These results also provide support for the conclusion that the gustatory and olfactory senses are the modalities least involved in the formation of sport-related images. Previous findings of studies using multiple-modality general imagery measures have typically reported these two senses as the most difficult to imagine (Lane, 1977; Kihlstrom et al., 1991).

The subscale scores reported for the auditory, kinaesthetic, and tactile modalities represent a moderate level of involvement within sport-related images. In modality distributions of the SQMI, the auditory, kinaesthetic, and tactile senses typically fall between the visual and the olfactory and gustatory senses (Kihlstrom et al., 1991; White et al., 1977). Alternatively, Lane (1977) reported that these three senses were the most easily imagined within his measure of multi-modal imagery control. Considering this evidence, I have outlined three conclusions regarding the functioning of the senses within sport imagery. Firstly, the visual modality is clearly the dominant sense overall. Secondly, the involvement of the kinaesthetic modality is less than vision, but greater than the remaining senses. Finally, the representation of the olfactory and gustatory modalities is only minimal within sport-based images.

Patterns of distribution regarding the dimensions assessed in the SIAM indicate little variation between the means of these subscales. Mean scores for the dimensions are at the high end of the scale. Previous research has shown that scores relating to imagery dimensions such as vividness or control are typically negatively skewed (Hiscock, 1978; Kihlstrom et al., 1991). It appears that the majority of athletes are not only able to create vivid images, but can also control, generate, and maintain them to a similar degree.

Emotion subscale scores of the revised SIAM suggest a reasonable degree of involvement of this characteristic within sport-oriented imagery. Mean score for this subscale was smaller than the mean scores of the dimension and visual subscales, but greater than the other five senses assessed. Unfortunately, empirical evidence seems unavailable in relation to the role that the experience of emotion performs in mental imagery. Recent discussions of imagery in the sport psychology literature, however, have noted the important function that emotion has in the creation of sport images (Martens, 1987; Suinn, 1993; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). The data reported in the present study, and within Study 1, has provided support for the proposition that emotion is a characteristic that warrants assessment when examining imagery abilities.

Reliability Data

Data related to the reliability of the revised version of the SIAM generally indicates improvement or stability in the internal consistency values compared to the original version. Alpha coefficients for 10 of the 12 subscales were above $r = .7$. Only the ease and speed of generation subscales, $r = .67$ and $r = .66$, were marginally smaller than the $r = .7$, proposed by Nunnally (1978) for measures of hypothesised constructs still in the developmental phase. Subscale alpha coefficients improved for all but the emotion subscale, which was only minimally smaller ($r = .75$ to $r = .76$). This is a very positive result, because the revision involved reduction in the number of items per subscale from six to four. Several studies have provided internal consistency data related to revision of an existing imagery questionnaire (Hiscock, 1978; Vadocz et al., 1997). Hiscock (1978) revised the IDQ from 86 items to 72 items, and modified the response format from true-false to a 5-point Likert scale. Alpha coefficients for the original version were reported as $r = .80$ for the imagery subscale (39-items) and $r = .83$ for the verbal subscale (47-items). The revised version proved to be more reliable than the original with alpha coefficients reported as $r = .87$ for the imagery subscale (34-items) and $r = .88$ for the verbal subscale (38-items). Vadocz et al. (1997) reported the internal consistencies of the MIQ-R as, $r = .79$, for both the visual and kinaesthetic subscales of the shortened version. Thus, the revised SIAM has demonstrated acceptable and improved levels of internal consistency, a necessary outcome of the revision of psychological assessment instruments.

Analysis of the stability over time of the revised SIAM provides a less consistent pattern of results than for the internal consistency data. Evidence derived from the test-retest scores indicates that although six subscales showed increased reliabilities when compared to corresponding values for the original measure, six subscales demonstrated reduced levels of test-retest correlation.

The subscales that showed the greatest reduction in test-retest value were the gustatory, olfactory, auditory, tactile, and kinaesthetic. These subscales would appear to represent the senses that are less familiar to individuals when using imagery in relation to sport. Revisions related to the randomisation of the SIAM items may have contributed to these variations. In the original version of the measure, the higher reliabilities were attributed to the possibility that participants patterned their responses, because the response format was the same for each scene. Participants may have responded in a similar manner from scene to scene, particularly in the senses they were having the greatest difficulty in imagining. In the revised version, it was more difficult for participants to follow a pattern due to the randomisation. This modification encouraged participants to consider each item independent of test format. For the less familiar senses, stability in response for the revised version may have proven difficult. Regardless of this previous finding, only the auditory subscale is at a level of reliability ($r = .41$) representative of instability. Each of the other four subscales of the revised measure have reliabilities above, $r = .6$, indicating a moderate level of stability over time.

Comparison of the dimensional subscale correlations between the original and the revised versions for test-retest reliability showed small increases in value for four of the five dimensions. Only the vividness subscale did not follow this pattern. The value of this correlation remained relatively unchanged ($r = .59$ to $.56$). These findings indicate that the revisions made to the SIAM have contributed to a small improvement in the stability of the measure. The moderate values of the correlations reported for the revised version ($r = .50$ to $.66$) suggest that dimensions as assessed by the SIAM are not highly stable psychological characteristics. A possible reason for this is that the participants may not fully understand the meaning of the dimensional labels used in the SIAM. For example, a participant could be unsure of terms such as 'control' or 'clear' in relation to their images. As a result, their responses might represent a level of guesswork, rather than an accurate report of that particular dimensional quality. Overall, the pattern of dimensional test-retest reliabilities provides basic support for the stability of these imagery characteristics.

Results revealed that the visual and the emotional subscales showed the largest improvement in their levels of test-retest correlation between the original and the revised versions. The visual subscale correlation increased from, $r = .51$ to .67, and the emotional subscale correlation increased from, $r = .63$ to .75. The randomisation of the revised measure encouraged participants to respond on the strength of individual items, rather than possibly following a pattern of subscale responses across scenes. In the original version, the visual item followed the dimensional items and the emotional item was the last item of the twelve items on each scene. The general high scoring patterns of the preceding dimensional items could have influenced responses to the visual items, and participant test fatigue may have affected the emotional item responses. The repositioning of these two items in a random pattern in the revised SIAM may have allowed participants to gauge their responses on the strength of their visual and emotional imagery, and limited the influence of response patterns to previous items. Sport psychologists consider the characteristics of visual and emotional imagery to have significant involvement in sport-based images (Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). Athletes' familiarity with these characteristics and the improved independence of the items generated through the revisions to the SIAM, are contributing factors in the increased stability of participants' visual and emotional responses.

Revisions to the SIAM have contributed to an improvement in both the internal consistency and stability of the majority of the measure's subscales. Only the emotional subscale showed a very small decrease in its alpha coefficient. Increases in the alpha coefficients of the other subscales was an encouraging finding, considering the revised version had four items per subscale compared to the six items of the original. The decrease in test-retest reliabilities of the non-visual sensory subscales remains a concern in analysis of the measure's overall reliability. Possible reasons for this pattern are that most participants have limited experiences with imaging these non-visual senses and subsequently may demonstrate an inconsistency in generation, and thus, a variation in reliability levels observed between administrations of highly similar imagery measures. Additionally, the general effect of the unstable nature of image creation, suggested by previous research (Ahsen, 1987; Eton et al., 1998; McKelvie, 1995), could have had an impact on the observed level of reliability. In sum, the reliability data does indicate that the revised SIAM is a more reliable instrument than the original version.

Subscale Inter-Correlation

Comparison of the inter-correlation matrix of the original measure with the matrix for the revised measure revealed only minimal variation in the correlation values between all dimension and modality subscales. The pattern of subscale correlations for the revised measure was also similar to the pattern observed for the original measure. Correlations between each of the dimensional subscales and between the dimensional and visual subscales were high. Correlations between similar sense modality subscales (e.g., kinaesthetic and tactile, olfactory and gustatory) were high. Correlations between unrelated modalities (e.g. tactile and gustatory) and correlations between non-visual modalities and the dimensions were low to moderate in value. Correlations between the emotion subscale and all other subscales were in the moderate range. The greatest variation in subscale correlations between versions was only $r = .09$, for the olfactory and speed subscales. The majority of the differences in the 66 correlations were of a value of $r = .03$ or less. This high degree of similarity in the subscale relationships between the two versions provides support for the following conclusions. Participants that are capable of generating vivid visual images are typically able to utilise the other assessed dimensional qualities of control, ease, speed, and duration at similar levels. Very few participants (typically less than 20) demonstrated patterns of low vividness and low visual abilities, high vividness and low visual abilities, or low vividness and high visual abilities, suggesting that these are uncommon representations of the manner in which athletes generate images. The senses of audition, touch, and kinaesthesis have shown a consistent degree of moderate association with all other dimensional, sensory, and emotional subscales. These smaller correlations may be due to greater variability in athletes' abilities at generating images in relation to these senses, particularly when compared with the consistently high ability of athletes to create visual images. Relationships between the emotional subscale and all other subscales also operate in the moderate range, indicating this imagery characteristic has similar levels of association with both the senses and dimensions. The slightly stronger correlations between the emotional subscale and the tactile and kinaesthetic subscales ($r = .67$ and .69) are more likely to indicate a similarity in the patterning of responses by participants on the analogue scale, rather than genuine congruity between the imagery characteristics. Many of the participants' scores for these variables were in the middle range of response values, with scores for the subscales of approximately 270.

The large correlations found between the kinaesthetic and tactile subscales prompt the suggestion that participants involve these two senses within their images with a similar degree of ability. The characteristic of 'feel' within imagery appears to be relevant to both senses. A strong association also exists between the olfactory and gustatory senses. As these were the lowest scored of the subscales, the strength of this association may be due to a consistent lack of ability in participants to involve these senses within their images. Kihlstrom et al. (1991) suggested, however, that the physiological substrates of certain senses, such as chemical (olfactory and gustatory) or muscular or galvanic innervation (tactile and kinaesthetic) provide a possible basis for these types of sensory associations within imagery. Finally, the strong correlations found for the relationships between the visual subscale and the dimensions indicate that this is the preferred sense participants' use as the modality base for interpreting the generation and manipulation qualities of their imagery.

Factor Structure

Following the revision of the SIAM, the factor structure derived from the confirmatory factor analysis of the 48-item, twelve-factor model indicated that the representation of sport imagery in the context of independent dimensions and modalities is difficult to substantiate. It would seem that modality generation requires an association with a dimension of some form to facilitate its generation. Alternatively, dimensions appear to be perceived in the context of their association with visual imagery. Subsequently, these results provided the stimulus to examine the factor structure of the SIAM from the perspective of subscale scores, rather using individual item scores. The initial two-factor model did not reflect strong indexes of fit. Fortunately, all of the other models proposed produced fit statistics that were approaching or above accepted values, based on current interpretations (e.g., Comrey et al., 2000; Kowolski & Crocker, 2001).

The confirmatory factor analyses of the subscale scores of the revised SIAM demonstrated several important similarities and differences to the resultant EFA factor structure reported for the original measure. In the original factor analysis of Study 1, the visual modality loaded with dimensional subscales and not with the sensory subscales. Each model developed for the CFA incorporated the visual subscale within a latent factor that included all the dimensional subscales. This combination of observed variables (dimensions and visual) appeared to represent the latent factor appropriately. Therefore, this finding provides support for the suggestion that visual images may create the base from which the dimensional qualities of sport imagery are evaluated. Current discussions of mental imagery in sport, although acknowledging a potential polysensory framework, continue to highlight the significant involvement of the visual sense (Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). Many of the participants of the current study appeared to be gauging their responses to the dimensional variables of the revised SIAM in relation to images that are primarily visual in nature. This was also the case for response patterns observed in relation to the original SIAM.

The results of the CFA of the revised SIAM indicated that the revisions to the measure did not affect the grouping of the five dimensions within one factor. This finding is consistent with the factor structure reported for the original measure and with the results of other EFA investigations that were unable to demonstrate dimensional uniqueness (Hiscock, 1978; Lane, 1977; Richardson, 1994; Switras, 1978). Dimensions such as vividness and control tend to show a moderate to high level of covariance when examined as either specific subscales within measures or when independent measures of each dimension are factor analysed. Given these types of findings, it seems that the differentiation of dimensional constructs remains a difficult task. It would, therefore, seem appropriate to conclude that individuals who report an ability to create vivid images, also report similar levels of the abilities of ease, control, and maintenance. Consequently, an outcome of the review of these response characteristics was the labelling of the latent factor, representative of the nature of the observed dimensional and visual variables, as image generation.

The three models evaluated in the CFA of the revised SIAM represented a variety of observed variable groupings in relation to the non-visual sensory subscales and the emotion subscale. As stated earlier, the best fit indices were achieved with the fourth model (M4-four-factor), however, the grouping of the emotion and auditory subscales as a latent factor does not seem relevant to existing interpretations of sport imagery (e.g., Perry & Morris, 1995, Vealey & Greenleaf, 1998) nor does it seem to make any physical or psychological sense. For this reason, the other models were more closely examined as plausible foundations for a factorial structure of sport imagery, with due acknowledgement of their slightly inferior levels of fit. The second model (M2-three-factor), grouped the tactile, kinaesthetic, auditory, and emotion subscales as a latent factor, and the olfactory and gustatory subscales as a latent factor. Again, the fit indices were acceptable but the rationale of grouping these four subscales, which was that they are neither chemical nor visual-oriented senses, is weak. Finally, the third model (M3-three-factor), produced fit statistics at the lower level of acceptability, but provided the most logical representation of the sport imagery construct as it was examined within the revised SIAM. In addition to the image generation latent factor, a second latent factor comprising the tactile, kinaesthetic, and emotion subscales, and a third latent factor comprising the auditory, olfactory, and gustatory subscales formed the basis of this model. The second latent factor represents those image characteristics associated with diffuse body feeling states. The third latent factor represented the non-visual senses associated with a defined body organ related to the detection of stimulus sensations. This grouping of observed variables represents a framework of imagery characteristics that appears to have the strongest conceptual clarity and is partially supported by the fit indices selected to evaluate the model. Only the RMSEA index is at a level (0.132) that indicates poor fit or that alternative representation of the model is warranted.

It is acknowledged that the generation of models of imagery processing that fully satisfy CFA fit index criteria is a difficult procedure, rarely undertaken in published research (e.g., Babin & Burns, 1998). In addition, ambiguity in the presentation of the exploratory factor analysis results indicates that the unique sensory and dimensional representation of the imagery construct, in relation to multi-modal or multi-dimensional measures, is yet to be consistently reported in a coherent model format (e.g., Kihlstrom et al, 1991; Switras, 1978; White et al, 1974). At this point, M3, which combines variables in the context of latent factors that represent generation and manipulation of images, somatic/feeling responses, and the senses controlled by a single organ (e.g., hearing), constitutes a suitable basic framework of sport imagery profiled by responses to the revised SIAM. As Martin, Moritz, & Hall (1999) have done in relation to imagery use, I present this model of imagery ability independent of absolute theoretical conclusions about the imagery phenomenon. The current CFA of the revised SIAM contributes to the establishment of a valid model of sport imagery ability. This model will provide a foundation to support both the evaluation of existing phenomenological representations of imagery ability and the more intricate process of imagery theory development.

Evidence of Criterion Validity

The final purpose of the present study was to compare participants' scores on the revised SIAM on the basis of their self-reported level of athletic performance. The power of the SIAM to discriminate between athletes from different participation levels (e.g., local, national) would provide evidence for the criterion validity of the measure. Previous research has indicated that imagery ability is a psychological variable that can distinguish between elite and non-elite athlete groups (e. g., Eton et al., 1998; Isaac & Marks, 1994). The SIAM is a measure designed to provide a broader profile of the nature of the dimensional and modal characteristics of sport imagery ability than existing indicators of the construct. This particular feature of the instrument has allowed for a more detailed analysis of specific areas of imagery ability that are involved in the sport imagery of athletes from different levels of sports performance.

The means for 11 of the 12 subscales showed a pattern of higher scores for higher level of participation. Only the olfactory subscale did not follow this trend. The differences between the groups observed for the gustatory subscale were negligible. It is important to acknowledge that in general the group differences were small in relation to the large mean subscale scores. There are several reasons that make it difficult to demonstrate differences between groups in relation to imagery ability. Firstly, almost all individuals are capable of generating images and very few report low levels of imagery, so it is common for imagery ability scores to be negatively skewed. Secondly, it is difficult to find a format for distinguishing between elite and non-elite athletes on the basis of self-reported participation level in a mixed sport sample. In consideration of these limitations, these results do indicate that elite athletes are generally more capable of involving a broad spectrum of dimensional and modal characteristics in creating sport-related images than non-elite athletes.

Specific analysis of the subscale scores, using *t* tests to discriminate between the two groups, produced evidence that highlighted the imagery variables that clearly defined the nature of the between group differences. Significant differences existed between the groups for the vividness, control, visual, kinaesthetic, and emotion subscales. The duration, auditory, and tactile subscales were closer to significance than the speed, ease, gustatory, and olfactory subscales. These latter four subscale differences resulted in very small *t*-values. The effect sizes for all the subscale differences, including those that reached significance, were small. When this set of results is considered in total, the findings are representative of the general pattern of results described in previous research (e.g., Eton et al., 1998; Highlen & Bennett, 1983; Isaac & Marks, 1994) that elite athletes report more vivid and controlled imagery than non-elite athletes. Unfortunately, the lack of research information available regarding the multi-dimensional, multi-modal structure of sport imagery limits the types of comparisons possible using the revised SIAM data.

Previous investigations examining differences in imagery ability in relation to athletic ability have typically involved the dimensions of vividness and control and the visual and kinaesthetic senses. The present study demonstrated that the scores for elite athletes were superior to non-elites on each of the revised SIAM subscales that examined these four imagery characteristics. Eton et al. (1998) found that movement imagery vividness scores, assessed using the VMIQ, discriminated between athlete and non-athlete categories, but not between recreational and varsity level athletes. The fact that the SIAM assessed vividness in relation to sport imagery rather than movement imagery explains the significance of the current elite and non-elite athlete comparison. This finding supports the suggestion that instruments reflecting the exact nature of the area of imagery of interest more accurately examine differences in the imaging abilities of athletes than non-sport measures.

Regarding the imagery variable of control, the SIAM scores demonstrated that significant differences between athletes grouped on the basis of participation level exist. This result is consistent with Jopson et al. (1989), whose findings showed that elite level junior gymnasts scored higher on the visual and kinaesthetic control subsets of the Survey of Mental Imagery (Switras, 1978) than a similar aged, non-elite group of gymnasts. Highlen and Bennett (1983) and Meyers et al. (1979) reported that image control was a contributing factor in discriminating between athletes who performed better in sporting competitions. In contrast, Barr and Hall (1992) found that items from the IUQ examining imagery control did not discriminate novice and elite rowers, whereas, vividness items did highlight group differences. It should be noted, that the instrument used by Barr and Hall was specifically modified for rowers and included only two vividness, and two control items, of which only one vividness item showed that the elite group scored significantly higher. Overall, the basic discriminating pattern of this set of findings, in conjunction with the SIAM result in relation to imagery control, provide limited support for the conclusion that control is a relevant variable warranting consideration in the assessment of sport-oriented imagery abilities.

Both the visual and kinaesthetic subscale scores of the revised SIAM were able to highlight differences between the elite and non-elite athlete groups. Review of the results from several related studies demonstrates support for this finding. Jopson et al. (1989) found that the visual and kinaesthetic scores of the SMI and MIQ discriminated between elite and non-elite junior gymnasts. Subsequently, the authors concluded it was necessary to undertake additional analyses controlling for age of athlete. In this second analysis, only kinaesthetic imagery differentiated the two groups. Barr and Hall (1992) reported that elite rowers scored higher than novice rowers on items from the IUQ related to visual and kinaesthetic imagery. These discriminating items of the IUQ were oriented toward sport images rather than movement or general imagery. The SIAM also emphasised sport imagery as an important design characteristic. This sport orientation is a contributing factor in capacity of the SIAM to highlight differences in visual and kinaesthetic imaging abilities of elite and non-elite athletes.

A review of the results of athlete group comparisons, based on scores of either the MIQ or MIQ-R, measures designed specifically to assess the visual and kinaesthetic aspects of movement imagery ability, highlight an unexpected trend. Mumford and Hall (1985) found that more experienced figure skaters were significantly higher in kinaesthetic imagery ability, but not visual imagery ability, than less experienced groups. Vadocz et al. (1997) described a similar pattern of results in the comparison of the MIQ-R scores between medalists and non-medalists at the North American Roller Skating Championships. Several researchers suggested that the discriminating capacity of the MIQ, relating to the kinaesthetic sense, may reflect the importance that athletes place on the development of this characteristic as they gain more experience within their sport (Mumford & Hall, 1985; Rodgers et al., 1991; Vadocz et al., 1997). It could also be the case that kinaesthetic imagery ability is a more important variable than visual imagery within the context of movement imagery. These results emphasise the need for specific comparisons of the imagery ability of athletes to be determined using measures that appropriately represent the area of interest. Sport imagery measures should be used instead of movement imagery measures in situations where athletes are compared on the basis of sporting performance, rather than motor performance.

Examination of the emotion subscale scores revealed a significant difference between the elite and non-elite athlete groups, with the elite group reporting higher scores than the non-elite This finding contributes evidence toward substantiating the importance of this imagery characteristic as a component in the assessment of sport imagery ability. The inclusion of this variable within the SIAM is one of the features of the instrument that distinguish it from other measures of general and movement imagery ability. Although a number of recent discussions of imagery within the sport psychology literature (e.g. Vealey & Greenleaf, 1998; Weinberg & Gould, 1999) have emphasised the involvement of the emotions, I was unable to find any relevant empirical studies related to athletic ability and emotional imagery. This paucity of investigative evidence is aptly demonstrated by the fact that the variable was included in the Sport Imagery Questionnaire (SIQ; Martens, 1982), but to date research information concerned with the applied use of this measure is limited. Kenitzer and Briddell (1991) and Thomas and Fogarty (1997) provided data related to the pre-test and post-test SIQ scores of athletes following imagery training programmes. Both studies highlighted change scores in the SIQ mood variable that suggested that this characteristic could be evaluated in the context of a self-report measure. Unfortunately, the lack of reliability data for the SIQ limits the veracity of any conclusions drawn from these studies. The on-going use of the SIAM will provide a reliable framework for the collection of data regarding the strength of the emotional experience during sport-oriented imagery.

Support for the present findings regarding the involvement of the emotions within imagery was found from the results of several survey style investigations of elite level athletes. Ungerleider and Golding (1991) found that approximately 75% of the 373 respondents that were competing at the 1988 Olympic track and field trials reported that the emotions associated with their imagery were moderately strong or greater. Hall et al. (1998) discussed several important findings related to the emotional context of imagery use in their analysis of the psychometric properties of the Sport Imagery Questionnaire (SIQ) (different to the SIQ of Martens, 1982). They found that athletes reported imagining specific emotion-related goals and behaviours, such as winning a medal, being applauded or congratulated for a good performance, and the excitement and emotions of competing. This set of findings, in association with evidence from the present study, provide support for the suggestion that the imagery associated with emotion is an important variable that differentiates athletes from various levels of sports participation and performance.

As shown in Table 4.6, four of the six modality subscales of the SIAM did not significantly differentiate between the elite and non-elite athlete groups. The small differences between the groups in relation to the auditory, tactile, gustatory, and olfactory subscales may be attributable to the limited attention these senses receive as components of imagery ability typically associated with sports performance. Jopson et al. (1989) only used the visual and kinaesthetic subscale items of the SMI, even though the measure assesses vividness and control of imagery in seven modalities. Ungerleider and Golding (1991), in their study of the mental practice strategies of Olympians, described survey items designed to assess imagery use in a range of senses (e.g., visual, auditory, kinaesthetic), but only presented results related to the visual sense. In general, research examining the relationship between the modal components of imagery ability and athletic performance has typically involved the measurement of only the visual and kinaesthetic senses (e.g. Eton et al., 1998;

Isaac, 1992; Isaac & Marks, 1994; Young-Overby, 1990; Rodgers et al., 1991). This trend, observed within the imagery ability research field, is in contrast with the applied sport imagery literature in which a multi-modal approach to imagery training is emphasised (e.g., Sargent, 1996; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). Such equivocation between the applied and research areas, as to the particular senses to attend to within sport images, is reflected in the limited involvement that the elite athletes in the present sample reported in relation to the senses of audition, touch, olfaction, and gustation.

Results of previous research appear to be limited to examination of the auditory sense (of the four lesser utilised modalities) as a discriminating imagery characteristic between athletes of varying ability levels. Salmon et al. (1992) found that provincial level soccer players had significantly higher scores than a local level group, on items that examined the extent to which they hear the opposition players and coaches during imagery. Players participating at the national level did not differ significantly from the groups involved at the lower competitive levels. Particular items of the SIQ motivational-specific subscale, described within the research of Hall et al. (1998), imply a level of auditory involvement within the images generated. For example, items such as 'I image the audience applauding my performance' and 'I image myself being interviewed as a champion' describe images in which the respondent could incorporate the sense of hearing. The motivational-specific subscale was found to significantly predict the performance of male national level athletes, but did not significantly predict performance for male athletes at the varsity or high school levels. Although the auditory subscale of the SIAM did not significantly differentiate the elite group from the non-elite group, the elites did score higher on the subscale. The involvement of the auditory sense within sport images is an area of imagery ability assessment that requires further investigation. Irrespective of the previous research that has attended to the auditory variable directly, or implied its involvement within sport-based images, substantive support for the inclusion of this imagery modality in the assessment of sport imagery has yet to be fully explored.

The results of the present investigation indicated very small differences between the elite and non-elite groups for the ease and speed of generation subscales, whereas the duration subscale differences approached significance. The small between group differences and high mean scores for the ease and speed subscales suggest that these are the dimensional characteristics that most clearly demonstrate the overall capacity of all individuals to create images. Previous discussions of individual differences in general imagery ability (Kihlstrom et al., 1991; Richardson, 1994; Sheehan, 1967) have concluded that the negatively skewed trend of imagery test scores shows that the generation of familiar images is an ability "present in most, if not all, organically intact individuals" (Richardson, 1994, p. 60). This feature of the assessment of imagery ability creates a problem in demonstrating differences between groups on the basis of their scores on certain imagery characteristics (Kihlstrom, 1991). It appears that SIAM between group differences for the dimensions of ease and speed of generation are limited by this problem. The SIAM duration subscale differences were not significant but the elite group did score higher than the non-elite group. An athlete's ability to maintain an image is an important characteristic in the context of sport imagery skills training. Maintaining an image over a longer time period increases the opportunity to involve the senses, experience an emotional response, and manipulate the image in the desired manner.

Imagery dimensions, such as duration, speed, and ease of image generation are characteristics that have received considerably less attention within sports performance research than the dimensions of vividness and control. The MIQ and MIQ-R are tests that include items on which athletes rate the ease of creating various movement-related images. Moran (1993), in his review of imagery measures used in sport, categorised these items as assessing vividness rather than ease. Hall (1998) in his recent discussion of the measurement of imagery ability did not refer to the MIQ or MIQ-R as measures of imagery vividness, but maintained, as in earlier descriptions (e.g., Hall et al., 1985), that the measures examine the ease and difficulty of generating the visual and kinaesthetic sensations of movement images. If the dimension that these measures examine is classified as ease then several studies in which they were used provide valuable evidence related to their capacity to discriminate between athletes of varying levels of sporting ability. Mumford and Hall (1985) reported that senior level figure skaters found it easier to generate kinaesthetic movement images than novice skaters and Vadocz et al. (1997) found that the same variable of the MIQ-R was the main discriminating factor in distinguishing elite level roller skating medalists from non-medalists. These results, when considered in conjunction with the marginal SIAM findings, provide limited support for the on-going inclusion of ease of generation as a discriminating imagery ability variable for use with athletic populations.

Relationships to Existing Theory and Conceptualisations

Similar to other areas of imagery research in sport psychology, the assessment of imagery ability has received only limited attention in terms of the theoretical explanations of the imagery process. Older theories, such as the psychoneuromuscular (Jacobson, 1930, 1932) and symbolic learning (Sackett, 1934) theories, focus on too few of the imagery characteristics posited within the multi-dimensional, multi-modal representation of imagery ability examined by the SIAM, for these theories to be considered as adequate explanations of the present findings. Both theories are related more to the area of motor skill learning that involves mental practice strategies, such as imagery, than to a broader perception of sport imagery as a contributing factor in performance enhancement (Martin et al., 1999). Several theories and models recently described in the sport psychology literature (Martin et al., 1999; Weinberg & Gould, 1999) constitute appropriate frameworks for the discussion of a theoretical basis for the findings of the present study.

Particular elements of both the bioinformational theory (Lang, 1977, 1979) and the triple code theory (Ahsen, 1984) are supported by aspects of the descriptive, reliability, and criterion validity evidence generated within these results. A second feature of the work of Ahsen (1985) is his examination of the contrast between the vividness and the unvividness of various components of mental images. This simple explanation as to a possible cause of variations in the level of involvement of particular imagery characteristics represents a basis to clarify the substantial subscale score differences between the various senses (e.g., olfactory versus visual). Finally, the most recent overview of imagery use in sport (Martin et al., 1999) detailed the important role that imagery ability has in relation to the manner in which athletes use imagery, and its possible effect on the outcomes of the use of imagery.

The bioinformational theory centres upon the relationship between stimulus propositions (descriptive characteristics) of the imagined scene and the response propositions, which outline the possible physiological and overt responses to the scene described. The descriptive results indicated that sufficient detail existed within the sport-based scenarios (that included stimulus propositions) used in the SIAM to generate strong responses for athletes to certain of the imagery variables (e.g. vividness, visual sense), but were unable to stimulate strong responses related to other senses, such as audition, olfaction, and gustation. This may be due in part to the limited emphasis on these characteristics within the scene scripts of the SIAM. Weinberg & Gould (1999) have suggested that the involvement of both stimulus and response propositions is an important aspect in the development of quality imagery scripts. On-going script review, therefore, remains an essential element in the development of the SIAM.

Only recently has the work of Ahsen been considered in the context of imagery research in sport psychology. Murphy (1990) originally suggested consideration of the triple code theory because of his belief that the existing theories concerning imagery functioning in relation to physical performance were inadequate. Ahsen (1984) described three important elements of the imagery process within the triple code theory that were the image itself (I), somatic response (S), and meaning of the image (M) (ISM model). The image component represents the cognitive creation of the image as a reflection of the realistic attributes that the imager is capable of utilising. Responses related to the dimensional variables of the SIAM and the degree of involvement of the senses could be interpreted as measurable components that represent the image part of the triple code model. The high mean scores for the dimensions for all participants and the group differences observed for the vividness and control dimensions indicate that the realistic representation of an image is a significant aspect of sport imagery that athletes experience and a feature that becomes more important for those performing at the elite level.

Self-report data, rather than actual physiological assessments of the sensory responses to the generated image, provided an indication of somatic response within the SIAM. Ahsen (1984) stated that "upon seeing an apple, one experiences color, texture, taste, and smell" (p. 34). The aim of the sport scenarios used in the SIAM was to facilitate the generation of possible sensory responses as an outcome of the imagery process. Although a reasonable degree of variation existed with respect to which senses the athletes in this study incorporated in their images, the SIAM did demonstrate it was capable of providing useful information regarding the use of all the senses. Of particular importance to athletes performing at the higher participation levels was the somatic representation of the visual and kinaesthetic senses.

Finally, the meaning component of the triple code theory represents the significance of the image to the individual. The inclusion of the emotion subscale in the SIAM, a key aspect in its design that differentiates it from other measures of imagery ability used in sport, provided an opportunity for the participants to indicate if the imagined scene had an associated emotional meaning. The relatively high mean score for this subscale indicated that emotional context is a characteristic that athletes incorporate within their images. The significant difference between the elite and non-elite level athletes suggests that emotion is a critical factor in the development and implementation of imagery-based interventions. Again, script characteristics provide the initial stimulus for the generation of meaning in relation to imagery. The SIAM in its revised form did not include an item that directly referred to image meaning, however, responses associated with the emotion variable did provide an indication as to the level of meaning that the script and resultant image had for the respondent.

The results of the CFA produced a model that supports elements of Ahsen's ISM model. The first latent factor, generation, is representative of the image element of the ISM model. Characteristics associated with the second latent factor, feeling, are similar to elements of the somatic element of the ISM model. As stated earlier, no item directly related to image meaning, and only a single emotion-oriented subscale, did not allow for the construction of a model that may have produced a latent factor indicative of the meaning element of the ISM model. This represents an important area in the future development of the SIAM, particularly, in relation to ensuring that the measure appropriately examines the characteristics of imagery that experts and theorists in the field consider to plausibly represent the process.

Ahsen (1985) described another important aspect of the imagery experience, unvividness, that necessitates that researchers in this field should attend not only to the vivid elements of an image, but also to the unvivid (vague or dim) elements. Recent research undertaken by Eton et al. (1998) comparing elite and non-elite athlete groups, on the basis of their VVIQ and VMIQ scores, generated some interesting conclusions concerning the unvividness paradox. Central to their sport-oriented discussion regarding imagery unvividness is the viewpoint presented by Ahsen (1985) that "images can never be complete in every detail, nor are they expected to be, and if they were it would be most surprising and unnatural" (p. 2). Eton et al. suggested that information related to the vagueness of particular images or components of an image, such as crowd noise or sensations of fatigue, could be as important as reports concerning those images or components that are vivid. They concluded that the assumption that vivid images are more useful than dim images is no longer appropriate. The authors also suggested that both vividness and vagueness of imagery are related to the function of the imagery process. Evaluation of both these conclusions and the work of Ahsen in relation to the present data, prompted the re-interpretation of the unvivid responses found for certain subscales of the SIAM. For example, following the generation of an image depicting a crucial point in a sporting contest an athlete may indicate a low level of auditory involvement. Because the crowd noise could be a factor that interferes with performance, the athlete might keep it unvivid in their imagery. Another athlete may indicate a high level of auditory response, because the sensation of spectators barracking has a motivational effect within their image. Unvividness of particular sport-oriented sensory images may therefore represent (a) a lack of capacity to generate a response, (b) the possibility that those sensations were not considered, or (c) the inhibition of the sensation because of the negative effect it has on performance. The concept of unvividness provides support for the on-going inclusion of the sensory subscales of the SIAM that typically led to scores indicative of lesser involvement. The analysis of these responses may generate useful information regarding the full spectrum of the sensory characteristics of sport imagery and provide response opportunities for sport participants in events that emphasise different sensory characteristics (e.g. rifle shooting – visual, olfaction, audition)

Recently, Martin et al. (1999) presented a model of imagery use in sport that includes imagery ability as a moderator variable, operating between the type of imagery used and the outcomes of imagery use (see Chapter 2 for a detailed discussion of the model). Type of imagery concerns the cognitive and motivational uses of imagery for sport. The authors suggested that the development of imagery ability assessment inventories that go beyond the MIQ and MIQ-R is important. Any new measure should assess the ability to image "sport-related experiences such as goal achievement (MS imagery) and game strategies (CG imagery)' (p.257). The SIAM has the capacity to represent these uses of imagery within the content of the scenarios that athletes completing the measure are asked to generate. The multi-modal, multi-dimensional design of the SIAM provides substantially greater information regarding the characteristics of imagery ability than was available from using other movement-oriented imagery ability measures. The acceptable reliability data, coherent factor structure, and evidence of criterion validity generated for the revised SIAM are findings that support the measure's use within this model of imagery use in sport.

Methodological Issues

Review of the procedures concerned with data collection and analyses of the revised SIAM resulted in the identification of several methodological issues. The key areas of concern were the appropriateness of the use of the test-retest method as an estimate of stability over time, efficacy of the procedure used to differentiate the elite and the non-elite athlete groups, and confidence that the participants clearly understood the task requirements. These methodological concerns are discussed and possible solutions presented in the following section.

The variation in the test-retest values between the revised SIAM subscales highlighted a possible problem with the use of the test-retest method. Sutherland, Harrell, and Isaacs (1987) described imagery vividness as a stable characteristic, but acknowledged that the ability to "engage in vivid imagery should not be seen as an immutable trait" (p.102). The present results indicated the possibility that the images generated within the SIAM may vary over time. This level of instability resulted in changes to the response patterns to certain imagery characteristics between administrations. Recent discussion of the assessment of the stability of psychological traits related to sport (Schutz, 1998) has criticised the use of the test-retest method. Schutz suggested that unless it is assumed that the underlying trait is perfectly stable or that the measurement procedures are perfectly reliable the use of the test-retest reliability coefficient is inappropriate. Schutz outlined a new method for determining trait stability using structural equation modeling and testing over multiple time periods. Future investigations of the stability of the SIAM may benefit from the use of this type of methodology.

The examination of the criterion validity of the SIAM demonstrated that significant differences existed between the elite and non-elite athlete groups for five of the subscales assessed. Of concern was the very small effect sizes found in relation to the group differences. Several reasons for the magnitude of this effect size were proposed. Firstly, the criterion used to discriminate between the groups might have not been as effective as other possible grouping procedures. For example, the grouping of national level senior swimmers with national level under 17 female softball players may not necessarily reflect absolute skill level or time involvement in their sport. Eton et al. (1998) criticised their grouping procedure and suggested future research might benefit by comparisons that involve "professional athletes versus collegiate athletes, or Olympians versus collegiate athletes" (p. 133). Hall et al. (1998) used athletes from a single sport (track and field) and grouped the athletes based on an objective measure of performance that scored the athletes' best performance. Although this method is objective, a cut-off point must be determined to separate the groups for comparison. Precision in the selection of the criterion variable within sport-oriented imagery research is a problem that requires on-going attention (Richardson & McLean, 1994). Secondly, differences in imagery ability between athletes participating at the higher levels of performance are likely to be small (Murphy, 1994). The majority of the elite group comprised state level athletes and the non-elite group included mostly district level athletes. The athletic performance differences between these groups might be quite small, resulting in a limitation in the observed differences in imagery ability. Large differences are more likely if the comparison is between elite athletes and recreational level athletes. The problem arising from this procedure is in formulating substantial group sizes to make these types of comparisons. Finally, previous imagery training or knowledge of imagery processes needs to be considered as an extraneous variable that could affect the size of the differences between groups. Including an item related to previous imagery experience within the demographic data collection phase would allow for the consideration of this variable during data analysis.

Findings of the present study resulted from data derived from a self-report imagery questionnaire. These types of measures were criticised on the basis that participants might modify their responses if they discern the investigation's hypotheses (Isaac & Marks, 1994; Sheehan & Neisser, 1969). Procedures implemented during data collection avoided stating directly that group comparisons would be performed. Some participants may have considered this possibility, when completing the demographic item related to participation level, and modified their responses to the questionnaire. The collection of demographic material following the administration of the SIAM rather than before would limit this potential problem.

One difficulty with the assessment of imagery ability is knowing whether all participants understand the references to dimensions or modalities within items, or that they fully understand the task demands of the imagery exercise. Although a prior comprehension survey was undertaken in which the participants reported that they understood requirements of the measure, large group testing of the type used in the present investigation did limit the possibility of extended discussion of specific aspects of the questionnaire. The assessment of smaller groups may represent a more efficient testing situation for the future use of the SIAM.

Implications for Research and Practice

Several implications for research and practice were identified as a result of completing the present investigation. This section will initially review directions for the on-going evaluation of the psychometric properties of the SIAM. Secondly, implications arising form the present study that may affect or stimulate future research in the area of sport imagery are addressed. Finally, the roles that both the SIAM and the process of imagery ability assessment in general, have in the applied context of sport psychology are discussed.

Further refinement of the SIAM could focus on modifications, possibly in the areas of script content and response anchors that lead to an improvement in the delineation of individual differences of the dimensional qualities of sport imagery. Additionally, consideration should be given to whether the present set of five dimensions examined in the measure overlap to such a point that certain subscales (e.g., speed and ease of generation) could be combined or could be removed.

The on-going revision of the SIAM may necessitate the inclusion of additional subscales that provide opportunities for the continued use of CFA to test existing and proposed models of the imagery processes. For example, the inclusion of an item representative of the image element of the ISM model, and the addition of a second emotion-oriented subscale could facilitate the creation and testing of a CFA model including all three elements of the ISM model. This study has highlighted the significant role that the CFA procedure can play in both the on-going evaluation of the factorial structure of the SIAM and as a medium for using SIAM responses to analyse existing conceptualisations of imagery functioning.

Future investigations using the SIAM should be directed toward the validation of the measure. Studies examining convergent and discriminant validity, by comparing the SIAM with other imagery ability measures and with a set of non-image based tests of cognitive functions represents research to be conducted in the next chapter of this thesis. Analysing the verbalisations of athletes as they engage in sport-oriented imagery exercises should generate qualitative data. Athletes' verbal reports could be examined for material pertaining to dimensional or sensorial qualities of sport imagery. This material should then be compared with the athletes' responses to the SIAM as a measure of concurrent validity.

Other potential areas of investigation include intervention studies comparing SIAM scores of athletes participating in imagery training programs with the scores of matched controls. This would involve the comparison of pre- and post-test SIAM scores for each of the sample groups, and evaluating the capacity of the SIAM in evaluating program effectiveness in relation to the development of imagery abilities. Differences between the imagery abilities of athletes from a variety of classifications of sports, such as open versus closed or individual versus team, should be examined. The influence of ethnicity or cultural background in relation to sport-based imagery abilities is an area in which the SIAM could be involved. For example, groups based from Asia, Scandinavia, and the United States may demonstrate variations in the manner in which they generate images that warrant examination.

On-going investigation of differences between elite and non-elite athletes in relation to imagery abilities will necessitate a more effective method of determining group membership. Classifications based on competitive level may need to be grouped with additional indicators of performance involvement, such as time spent in training and competition. The determination of appropriate discriminating processes in relation to sporting ability is an issue within sport psychology that goes beyond the role of imagery abilities in relation to performance.

Sport psychologists need to ensure that athletes in imagery training programs understand the specific areas of imagery (e.g., vividness, control) incorporated in their program. The use of a measure, such as the SIAM, as a diagnostic tool in applied settings is recommended. The individual SIAM subscale scores provide a suitable foundation from which to develop a training program that focuses on the specific aspects of athletes' imagery abilities. Sensory or dimensional attributes that may need to be addressed because of low levels of ability would be identified within the SIAM responses. The practitioner could then focus on those imagery characteristics with which the athlete requires assistance to develop.

Substantial support exists for the examination of the imagery functioning of elite athletes as a treatment regimen in the consultative practice of sport psychologists (e.g., Simons, 2000). These interactions could be facilitated by the enhanced understanding of just how imagery works in relation to involvement in sport. The continued investigation of imagery ability as a key element of the imagery process will produce information to assist in the generation of theory and models that represent a valuable resource to the practicing sport psychologist.

Summary of Conclusions

As a result of the revision of the SIAM and the subsequent reliability and validity analyses of this second version of the measure, several important conclusions were determined. Firstly, the modifications to the presentation format and number of test items of the SIAM resulted in small improvements in both the internal consistency and test-retest reliability of the measure. Few of the existing measures of imagery ability used in sport psychology have been subjected to large scale investigations of these psychometric properties on an on-going basis. The adherence to the key principles of scale development in psychology (Clark & Watson, 1995) has resulted in an acceptable set of reliability data for the Revised SIAM. Psychometric research of this type was found in relation to only the MIQ and SIQ (formerly the IUQ), neither of which relate directly to sport imagery ability. For this reason, the revised SIAM should be promoted as a suitable device for investigations examining imagery ability in sport.

Secondly, the proposed CFA model of the factor structure of the revised measure suggested a clearly defined framework that is representative of the acknowledged processes associated with imagery ability. The genuine challenges are the development of statistically-supported factor models of the imagery processes and the continued refinement of aspects of the CFA procedure. Achievement of these tasks will support the sustained investigation of the factor structure of sport imagery ability.

Thirdly, differences between the elite and non-elite athlete groups were found in relation to imagery characteristics of vividness, control, vision, kinaesthesis, and emotional involvement. These particular variables have received the most attention in imagery research in both general and sport psychology (e.g., Eton et al., 1998; Hall et al., 1998) and are also the qualities of sport imagery typically emphasised in imagery training programs (e.g., Martens, 1987; Weinberg & Gould, 1999).

Finally, this set of findings as a whole provides evidence in support of several of the existing theories and models describing the underlying operation of imagery as a cognitive process (e.g., triple code theory, imagery use model). The Revised SIAM is a measure that can be used with some confidence in studies designed to generate quantitative data to aid in the understanding and further development of conceptualisations of imagery, and more specifically the imagery ability of athletes.

The present investigation has determined that the Revised SIAM is a reliable instrument suitable for use in the large-scale examination of the imagery abilities of athletes from a broad variety of skill levels and sporting backgrounds. Evidence generated from the use of the measure appears to be appropriate for use in both the research and applied areas concerned with imagery functioning in sport. The next phase in the development of the SIAM requires the comparison of the measure with existing imagery ability tests to generate evidence of convergent validity. In addition, comparison of the SIAM scores with non-imagery indicators of cognitive functioning will generate evidence of the discriminant validity of the measure. Finally, a future study is required that compares the SIAM scores of athletes with a direct evaluation of their imagery processing as a method of generating evidence of the concurrent validity of the measure. These important steps in the psychometric evaluation of the SIAM will be undertaken in the next two studies of this thesis.

CHAPTER 5: EVIDENCE OF THE CONVERGENT AND DISCRIMINANT VALIDITY OF THE REVISED SPORT IMAGERY ABILITY MEASURE (SIAM)

Introduction

Testing for evidence of the convergent and discriminant validity of the SIAM was the next psychometric procedure completed following the determination of reliability for the revised measure. These procedures provided information regarding the strength of the associations between the SIAM subscales and other measures of imagery ability (convergence). They also highlighted the uniqueness of the variables of sport-orientated imagery in comparison to other areas of non-imagery based cognitive processing discrimination). Generally, investigations of this type have received only minimal attention in the evaluation of tests and measures used in sport psychology research (Ostrow, 1996). Recent examples of the examination of the convergent and discriminant validity of measures designed for use in sport psychology are the studies of Marsh, Richards, Johnson, Roche, and Tremayne (1994) on the Physical Self-Description Questionnaire and Smith, Schutz, Smoll, and Ptacek's (1995) work the Athletic Coping Skills Inventory-28.

The typical orientation of research examining the relationships between specific imagery ability measures has been toward generating support for the uniqueness of the various dimensions or modalities examined (Richardson, 1994). Substantial evidence also exists on the association between components of imagery ability and nonimagery based cognitive variables such as memory, problem solving, and learning (Ernest, 1977; Hiscock, 1978). Unfortunately, analysis of the association of the measures currently used in the area of sport imagery, such as the MIQ and VMIQ, with other measures of imagery ability is rare (e.g., Isaac, Marks, & Russell, 1986). Very few investigations detailing the relationships between the MIQ or VMIQ with non-imagery based measures of cognitive functioning were available for review (Moritz et al., 1996; Vadocz et al., 1997). It would, therefore, seem appropriate that research examining athletes' responses to a variety of imagery measures, in association with the responses to nonimagery based cognitive measures, be explored.

The primary purpose of the present study was to examine possible convergent and discriminant evidence for the construct validity of the SIAM. Three general predictions in relation to the generation of evidence appropriately reflect the purpose of this study. Firstly, correlations between the movement imagery measure and the corresponding SIAM subscale will be higher than between the corresponding SIAM subscale and the general imagery measures. Secondly, correlations between the SIAM subscales and nonSIAM imagery variables of the same dimension or sense modality will be higher than between the SIAM subscales and non-SIAM imagery variables of different dimensions or modalities. Thirdly, correlations between the SIAM subscales and the imagery variables will be higher than between the SIAM subscales and the nonimagery measures.

Demonstrating whether measures or subscales representing similar traits correlate significantly to each other will generate evidence of convergence. For example, the visual modality subscale of the SIAM should show a moderate to high correlation with the visual subscales of the VMIQ and SQMI, and the SIAM vividness dimension subcale scores should correlate highly with the total scores of the SQMI and VMIQ. Research evidence has been inconclusive in supporting the concept of separate imagery dimensions as distinct or in reporting consistently high correlations between different dimensions. Richardson (1994) examined 20 studies in which the VVIQ and the GTVIC were correlated and reported values ranging from, $r = -.08$ to $r = .7$. The examination of evidence regarding the relationship between modalities has also been inconclusive. For example, Vadocz et al. (1997) reported that the correlation between the visual and kinaesthetic subscale of the

MIQ-R was, $r = .44$, and the authors suggested that although related, these modalities should be seen as separate.

A key purpose of the examination of discriminant evidence is an attempt to provide additional information in determining if the dimensions and modalities examined in the SIAM are distinct from each other. Discriminant validity will be evidenced by correlations smaller than the correlations that demonstrate convergence: (a) between different dimensions; (b) between different modalities; (c) between dimensions and modalities; (d) between the unique dimensional (ease and speed of generation, duration) and emotional subscales of the SIAM and all other assessed imagery dimensions and modalities; and (e) between two substests of a group administered intelligence measure, the Multidimensional Aptitude Battery (MAB; Jackson, 1984), and all assessed imagery dimensions and modalities. For example, scores on the SIAM duration subscale should not correlate highly with total scores on the GTVIC, and a low correlation should be found between scores on the auditory subscale of the SIAM and the MAB similarities subtest scores. I did not expect, however, that all dimensional and modality relationships would have low correlational values. Past research has shown that some of these facets of imagery ability are not orthogonal to each other (Moran, 1993; Richardson, 1994).

Method

Participants

Participants from a broad range of sports and social backgrounds took part in the convergent and discriminant validity analyses of the revised SIAM. The sample comprised a combination of secondary school students from nine government schools, physical education students from two universities, and athletes from five sport groups. All except two groups resided in metropolitan or regional Victoria. The Australian under-18 girls hockey squad was involved in testing while in Melbourne preparing for an international competition. Members of the Australian Institute of Sport swimming squad completed the measures while at a training camp in New South Wales. The Department of School Education provided approval and support for the participation of the high school students in the study. Following discussion of the research with course co-ordinators, they approved approaching university students during lectures to participate in the study. Initially, I contacted sporting groups at the administration level and the administrators subsequently directed me to coaches for approval to contact players to participate in the study. Following contact with the Australian Institute of Sport, Sport Science Division, the sport psychologist involved in the swimming program provided final approval for the participation of scholarship holders. Each participant or parent/guardian (in the case of underage participants) completed an informed consent form explaining the procedures, the use of results, confidentiality, and the participant's right to withdraw at any time.

During the testing period, 548 participants completed the first session of testing but only 438 were available for the second session. Two participants incorrectly completed one of the questionnaires and their results were not included. Thus, the final composition of the sample included 436 participants, 232 males and 204 females, with an age range of 12 to 55 years ($M = 18.35$, $SD = 4.89$). The participants were volunteers from four general groups. These groups were:

1. Athletes from specific district, state, and national sporting organisations, $n = 68$.
2. Victorian Department of School Education secondary school students participating in the Specialist and Exemplary Sport in Schools programs, $n = 206$.
3. Undergraduate students participating in physical education courses at Deakin University and Ballarat University, $n = 156$.
4. Australian Institute of Sport (AIS) athletes involved in the swimming program, $n = 6$.

An additional breakdown of participants, grouping them according to highest level of sport participation and sporting background, indicated that the athletes or former athletes had involvement in 33 different sports at the following levels: 36 national, 145 state, 195 district, and 54 local.

Measures

Personal Details Information Sheet. Each participant completed an information sheet that asked for details regarding gender, age, main sporting interests, and highest level of participation (e.g., national, local). The sheet also included a participant code number and the date of the test session.

Sport Imagery Ability Measure (SIAM). As described earlier in this thesis the SIAM was revised in the following manner: the number of scored scenes was reduced from six to four (72 to 48 items), the fitness scene of the original questionnaire was used as a practice scene, and the items were presented in a randomised order for each scene. Participants completed the revised version of the SIAM in this study.

Shortened Form of the Questionnaire on Mental Imagery (SQMI). Sheehan (1967a) developed a shortened form of the Questionnaire on Mental Imagery (Betts, 1909) that contains 35 items investigating imagery in seven major sensory modalities: visual, auditory, cutaneous, kinaesthetic, gustatory, olfactory, and organic (five items per modality), and is shown as Appendix H. Participants attempt to generate images suggested by the items and rate the vividness of their imagery on the Betts 7-point rating scale, which ranges from 7 (*no image present at all)* to 1 (*perfectly clear and vivid*). Correlation with the long version (Betts, 1909) was reported as, $r = .90$ (Sheehan, 1967a). Reliability for the entire test has been reported as an internal consistency of, $\alpha = .95$ (Juhasz, 1972) and test-retest reliability of, $r = .78$, over a seven-month interval (Sheehan, 1967b). Basic evidence of convergent validity has been demonstrated through correlation with the Vividness of

Visual Imagery Questionnaire of $r = .43$ (Lorenz & Neisser, 1985). Sheehan (1967a) reported a homogenous single factor structure (imagery vividness). The SQMI has proven to be both reliable and popular within imagery research but is restricted by its assessment of only the vividness dimension. I decided the most appropriate version to use for this research was the 35-item randomised version developed by White, Ashton, and Law (1978).

Gordon Test of Visual Imagery Control (GTVIC). The GTVIC (Gordon, 1949; Richardson, 1969) is a self-report test designed to assess, not how vivid the person's images are, but how well the person can manipulate and control them (shown as Appendix I). The test originally involved oral instructions, which preceded 11 questions relating to a suggested image, for example, a car, with questions relating to colour and physical position. Participants answered either *yes* or *no* depending upon their ability to manipulate evoked visual images. Richardson (1969) modified this format by adding a twelfth item and including a tripartite scoring scheme (*yes*, *no*, and *unsure*) and suggested the use of written rather than oral instructions. Reliability has been reported as a split-half value of, $r = .76$, and a test-retest coefficient of, $r = .84$, over a three-week interval (McKelvie & Gingras, 1974). Previous studies supported a single dimension of control represents the factor structure of the GTVIC (Di Vesta, Ingersoll, & Sunshine, 1971; White et al., 1977). The test has been widely used and is reliable, but is limited in its unidimensional design, focusing on controllability.

Vividness of Movement Imagery Questionnaire-II (VMIQ-II). The VMIQ-II (Isaac, 1993). is the current version of the VMIQ and represents only a minor modification of the original. Details of the measure's psychometric characteristics constitute those presented for the original (Isaac, Marks, & Russell, 1986). The VMIQ contains 24 items that measure the visual imagery of movement and the imagery of kinaesthetic sensations associated with movement. Items examine participants' ability to image basic body movements and movements requiring precision and control in upright, unbalanced, and aerial situations. The measure requires participants to rate the vividness of imagery for each item both with respect to "watching someone else" and "as if watching themselves". Participants respond to each item on a 5-point ordinal scale, which ranges from 1 (*perfectly clear and as vivid as normal vision)* to 5 (*no image at all, you only 'know' that you are thinking of the skill)*. The VMIQ has a basic format that makes it easy to administer to large groups. Isaac et al. (1986) reported a test-retest coefficient of, $r = .76$, over a three-week period. Moderate correlations with the VVIQ (Eton et al., 1998) and MIQ (Hall & Martin, 1997) form the basis of a minimal set of validation data. The VMIQ-II (Isaac, 1993) has yet to be validated, but appears to have face validity on the basis of comparison with the original measure (shown as Appendix J). The VMIQ-II has 18 items from the original VMIQ, with the addition of a third rating scale examining the kinaesthetic sensation described as "feeling it yourself". I decided that the shorter VMIQ-II constituted the best version for use in this multiple measure study in an effort to maintain an acceptable overall administration interval. The score used in this study representing the visual modality, is the combined scores of the two subscales concerned with watching the performance of the movement. The kinaesthetic score is derived from the feeling it yourself subscale.

Multidimensional Aptitude Battery (MAB). Jackson (1984) developed the MAB as a modification of the Wechsler Adult Intelligence Scale (WAIS, Wechsler, 1955) that was shorter and suitable for group administration. The MAB is a multiple-choice questionnaire divided into a verbal section and a performance section. Jackson reported the correlations between the verbal and performance subscales of the WAIS and the corresponding subscales of the MAB to be, $r = .94$ and $r = .79$, respectively. The verbal section includes the subtests of information, comprehension, arithmetic, similarities, and vocabulary. The performance section comprises the subtests of digit symbol, picture completion, spatial visualisation, picture arrangement, and object assembly. Reliabilities for the MAB subtests have been estimated by test-retest, split-half, and internal consistency methods, and are normally in excess of $r = .7$ (Murphy & Davidshofer, 1994). Factor analysis supports the distinction between verbal and performance factors (Vernon, 1985). The specific sections of the MAB used in this study were the spatial and similarities subtests (shown as Appendix K). I selected these substests on the basis that previous research had attempted to describe the relationships between similar types of objective measures of cognitive abilities and imagery ability (Moran, 1993; Richardson, 1994). Other authors have argued that imagery is simply a product of other cognitive processes such as spatial processing or memory (Ernest, 1977; Katz, 1983). The selection of these subscales was to test whether the subscales of the SIAM could be discriminated from them. The similarities subtest provides an appropriate assessment of verbal reasoning and memory and the spatial subtest a suitable measure of spatial visualisation. For each subtest, participants have seven minutes to answer as many of the multiple choice questions (four alternatives) as they can, from a possible 34 items (similarities) or 50 items (spatial).

Procedure

Depending on the participant group, I implemented a variety of procedures to facilitate testing sessions. In each case, I contacted the individual responsible for the specific group, informed them about the study, and outlined the test activities participants would undertake. In the school settings, I posted consent forms to schools and asked teachers to distribute forms to participants for completion by their parents or guardians prior to testing. Following the organisation of test dates, I visited the school, collected consent forms, and conducted group testing with a variety of different group sizes. For the athletes from the sports groups, depending on their age, I sent consent forms to the coaches of the younger squads who distributed them to players for parents or guardians to sign. In the case of adult athletes, participants completed consent forms prior to testing and returned them at the end of the test session. Generally, I conducted test sessions in small groups following, or as a component of, training sessions. I repeated this procedure until I had tested all participating athletes. The university student groups completed consent forms prior to the first test session. These groups completed testing as a component of a lecture or tutorial session.

Administration of the six-test battery required two 45-minute test sessions. Intervals between test sessions varied between 2 and 14 days, depending on group availability. I conducted all the testing, except for the AIS group. Trainee sport psychologists undertaking supervised practicum at the AIS tested this group. The test sessions followed the same administration routine for all groups. I or the tester waited for participants to sit comfortably, introduced ourselves, and requested that noise levels be kept to a minimum during the testing session. Participants received a verbal outline of the research as stated in the consent form, were informed that their involvement was anonymous, with participants only identified by code numbers, and then asked if they had any questions. Test sessions involved the presentation of measures in the following order:

Session 1: SQMI, MAB - Spatial, and VMIQ-II.

Session 2: SIAM, MAB - Similarities, and GTVIC.

Two important considerations determined the basis of the above pattern of measure presentation. Firstly, I decided that each session would include one general measure of imagery ability, one cognitive measure, and one measure based upon movement or sport related imaging abilities. Secondly, the grouping of tests ensured that each session required approximately the same amount of time to complete.

Following the distribution of each measure the tester introduced and explained each measure. They then asked participants to read carefully through the introduction page, attempt any examples, and the test then provided an opportunity to ask questions. The tester asked participants to sit quietly after they finished their measures until the last participant completed the questionnaire. Once all participants had finished the measure, or the time for MAB subtests had elapsed, the tester distributed and introduced the next measure, following the same introductory procedure as the first measure. The tester asked participants to write their code number from the SQMI on the first page or response sheet of each subsequent measure. They then asked them to write their name and code number on a code sheet kept by the tester. The participants undertook this latter task so that the tester was able to identify their code numbers for use in the second session. Collection of the measures occurred at the end of each test session.

The tester debriefed and thanked all participants at the end of their final testing session. In the debriefing, the tester provided a more detailed explanation of all measures, the specifics of the research, and the relationship of the research to imagery training. Finally, the tester offered the participants an additional opportunity to ask questions, and provided details for individual participants to find out at a later date how they performed on the imagery test battery.

Statistical Analysis

The primary goals of the data analyses were to examine convergent and discriminant validity of the revised measure. This involved the following statistical procedures:

1. Computation of descriptive statistics for specific subgroups for each subscale or total score for each of the six measures, including means, standard deviations, and skewness. Calculation of frequency distributions for age, gender, specific sport, and level of participation.

2. The use of multitrait-multimethod type analysis to examine the relationships between responses on the four imagery ability measures and the MAB subtests. Correlations between the revised SIAM subscale scores and (a) subscale scores of the SQMI and VMIQ-II, (b) total scores of the GTVIC, SQMI, and VMIQ-II, and (c) subtest scores of the MAB were examined to test predictions concerning convergent or discriminant evidence of the construct validity of the SIAM.

Results

The results are presented in two sections. The first section details the descriptive statistics for each of the measures used in the study. The second section reports on the relationships between each of the SIAM subscales and all the other convergent and discriminant validity variables.

Descriptive Statistics for all Convergent and Discriminant Validity Measures

The means and standard deviations for the total sample for the SIAM subscales, SQMI total score, SQMI subscales, VMIQ-II total score, VMIQ-II subscales, GTVIC total, and MAB subtests are shown in Table 5.1. The pattern of subscale scores for the revised SIAM was similar to that found in the earlier reliability study. Subscale mean scores increased from the gustatory sense through to the visual sense. The spread of the subscale scores decreased in a similar progression, with standard deviation of the gustatory subscale much greater than for the visual subscale. Distributions of all the dimension subscales and the visual subscale were negatively skewed with skewness values less than -1.00. Only minor variations can be seen between subscales of the VMIQ-II. Variations in subscale scores of the SQMI followed an unexpected trend. Results indicated low scores, representing higher imagery responses, for the kinaesthetic, auditory, and organic subscales, whereas, the visual subscale had the second largest mean score.

Table 5.1

Descriptive Statistics for all Convergent and Discriminant Validity Measures

Measures	*M*	*SD*	Skewness
SIAM-Visual	317.76	63.04	-1.39
SIAM-Ease	314.14	62.97	-1.39
SIAM-Speed	311.90	66.38	-1.28
SIAM-Vividness	311.09	64.77	-1.31
SIAM-Duration	299.30	71.12	-1.06
SIAM-Control	294.94	74.12	-1.10
SIAM-Emotion	287.61	71.10	-.97
SIAM-Kinaesthetic	276.27	79.39	-.89
SIAM-Tactile	264.51	83.39	-.82
SIAM-Auditory	258.66	88.87	-.68
SIAM-Olfactory	156.54	104.49	.26
SIAM-Gustatory	140.22	100.75	.34
SIAM-Total	3232.99	713.47	-.68
VMIQ-II-Visual	78.42	22.96	.42
VMIQ-II-Kinaesthetic	35.73	12.46	1.04
VMIQ-Total	114.16	32.10	.59
SQMI-Visual	15.92	5.79	.44
SQMI-Kinaesthetic	12.02	4.59	.76
SQMI-Auditory	14.29	4.77	.58
SQMI-Tactile	15.65	5.22	.52
SQMI-Gustatory	15.67	5.94	.47
SQMI-Olfactory	18.72	5.66	.26
SQMI-Organic	14.30	4.98	.60
SQMI-Total	106.59	28.06	.42
GTVIC-Total	19.83	4.22	-1.00
MAB-Spatial	27.15	8.44	-.27
MAB-Similarities	19.89	5.18	-.56

The olfactory subscale of the SQMI had the highest mean score, yet even this subscale mean is representative of approximately 50% of the strongest possible imagery vividness rating. The total score for the GTVIC was also negatively skewed, representing a high level of reported imagery control for this sample. Scores for the cognitive skills measures, the MAB similarities and the MAB spatial, were consistent with those reported in the test manual for similar groups (Jackson, 1984).

Relationship of SIAM Subscales with Convergent and Discriminant Validity Measures

Individual dimension and modality subscales of the revised SIAM were correlated with the following convergent and discriminant validity variables:

1. VMIQ-II: visual, kinaesthetic, and total score.
2. SQMI: visual, kinaesthetic, auditory, tactile, gustatory, olfactory, and organic subscales, and total score.
3. GTVIC: total score
4. MAB: similarities and spatial subtest scores

The tables of the correlations between measures do not show significance levels. Due to the effect of large sample size on reducing the correlation required for significance, all correlations above, $r = .1$, are significant at $p < 0.05$ for this sample. All correlations between all the imagery tests and subscales were significant. Comparison of the MAB subtest scores and the revised SIAM subscale scores resulted in only eight significant correlations, of a possible 24 correlations. The largest of these significant correlations was, $r = -.21$. The other significant MAB correlations were generally very close to the $r = .1$ level.

Consideration of three important factors forms the basis for interpreting the meaningfulness of the reported correlation coefficients. The first is the effect of large sample sizes allowing very low correlations to be significant. It is more appropriate to evaluate all significant correlations in terms of the shared variance (r^2) as a representation of the relationship between variables. Secondly, the skewing of scores of one or both variables reduces the level of correlation between them. A number of the SIAM subscales were negatively skewed (skewness < -1.00). Thirdly, consideration is required of the practical contribution the correlation, whether small or large, makes to the research (Kerlinger, 1986). The meaningfulness of the correlation coefficient can be confounded, with respect to distinguishing good or inadequate values, without appropriate reflection on the purpose for which the correlation was originally undertaken (Thomas & Nelson, 1996). Cronbach (1990) suggested that validity coefficients above, $r = .6$, are rarely found in psychological measures research and that a good validity coefficient is, "the best you can get" (p. 167).

Negative correlation coefficients are generally indicative of the scoring method for the psychological measures. Both the VMIQ-II and SQMI are scored in a manner that a low score is representative of higher levels of reported imagery ability, whereas, the SIAM and GTVIC are scored in the more conventional manner of a high score indicating higher levels of reported imagery ability. High scores for the MAB measures represent higher levels of ability at that particular task. Any negative correlations reported relating to the MAB measures were very close to zero and are representative of a minimal relationship between the cognitive measure and the SIAM subscale.

SIAM Vividness Subscale.

The Pearson Product-Moment correlations for the vividness subscale with all other convergent and discriminant validity measures are shown in Table 5.2. The strongest reported relationship was between this subscale and the GTVIC scores. The total score of the VMIQ-II, representing vividness of images, had the next strongest relationship, followed by the visual and kinaesthetic subscales of the VMIQ. The correlation between the SQMI total score, representing vividness, and this subscale was moderate. Correlations for each of the other imagery variables are smaller in value than the variables most associated with vividness. The cognitive measures demonstrated the smallest level of association with the vividness subscale, and were negligible in size.

Table 5.2

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Vividness Subscale

Measure	Correlation
GTVIC-Total	.43
VMIQ-II-Total	-.35
VMIQ-II-Visual	-.33
VMIQ-II-Kinaesthetic	-.30
SQMI-Total	-.30
SQMI-Kinaesthetic	-.27
SQMI-Visual	-.25
SQMI-Organic	-.24
SQMI-Gustatory	-.23
SQMI-Auditory	-.21
SQMI-Tactile	-.19
SQMI-Olfactory	-.18
MAB-Similarities	.08
MAB-Spatial	.03

SIAM Control Subscale.

The Pearson Product-Moment correlations for the control subscale with all other convergent and discriminant validity measures are shown in Table 5.3. The strongest relationship reported was between this subscale and the GTVIC scores. The total score of VMIQ-II and the visual and kinasthetic VMIQ-II subscales also had moderate correlations with this subscale. Correlations for each of the other imagery variables are smaller in value than the variables most associated with imagery control. The cognitive measures demonstrated a negligible level of association with the SIAM control subscale.

Table 5.3

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Control Subscale

Measure	Correlation
GTVIC-Total	.48
VMIQ-II-Total	-.38
VMIQ-II-Visual	-.36
VMIQ-II-Kinaesthetic	-.32
SQMI-Total	-.28
SQMI-Kinaesthetic	-.26
SQMI-Gustatory	-.25
SQMI-Visual	-.23
SQMI-Tactile	-.20
SQMI-Organic	-.19
SQMI-Auditory	-.17
SQMI-Olfactory	-.17
MAB-Similarities	.06
MAB-Spatial	.05

SIAM Ease of Generation Subscale.

The Pearson Product-Moment correlations for the ease of generation subscale with all other convergent and discriminant validity measures are shown in Table 5.4. The strongest relationship reported was between this subscale and the GTVIC scores. The total score of VMIQ-II was the only other imagery variable to correlate above $r = .3$ with this subscale. Correlations for each of the other imagery variables are smaller in value than those associated with the total scores of the GTVIC and the VMIQ-II. Except for the VMIQ-II visual subscale, the subscale correlations of the imagery measures are smaller than the total score correlations, with the ease of generation subscale. The cognitive measures demonstrated the smallest level of association with the SIAM ease of generation subscale.

Table 5.4

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Ease of Generation Subscale

Measure	Correlation
GTVIC-Total	.43
VMIQ-II-Total	-.31
VMIQ-II-Visual	-.29
SQMI-Total	-.28
VMIQ-II-Kinaesthetic	-.26
SQMI-Visual	-.27
SQMI-Gustatory	-.25
SQMI-Kinaesthetic	-.23
SQMI-Organic	-.23
SQMI-Tactile	-.19
SQMI-Auditory	-.17
SQMI-Olfactory	-.17
MAB-Similarities	.10
MAB-Spatial	.01

SIAM Speed of Generation Subscale.

The Pearson Product-Moment correlations for the speed of generation subscale with all other convergent and discriminant validity measures are shown in Table 5.5. The strongest reported relationship was between this subscale and the GTVIC scores. The total score of SQMI was the only other imagery variable to correlate at or above, $r = .30$, with this subscale. Correlations for each of the other imagery variables are smaller in value than those associated with the total scores of the GTVIC, the SQMI, and the VMIQ-II. The subscale correlations of the imagery measures were smaller than the total score correlations, with the speed of generation subscale. The cognitive measures demonstrated the smallest level of association with the SIAM speed of generation subscale.

Table 5.5

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Speed of Generation Subscale

Measure	Correlation
GTVIC-Total	.42
SQMI-Total	-.30
VMIQ-II-Total	-.29
SQMI-Gustatory	-.28
VMIQ-II-Visual	-.28
SQMI-Visual	-.25
VMIQ-II-Kinaesthetic	-.24
SQMI-Tactile	-.22
SQMI-Kinaesthetic	-.21
SQMI-Auditory	-.18
SQMI-Olfactory	-.17
SQMI-Organic	-.16
MAB-Similarities	.10
MAB-Spatial	.03

SIAM Duration Subscale.

The Pearson Product-Moment correlations for the duration subscale with all other convergent and discriminant validity measures are shown in Table 5.6. The strongest reported relationship was between this subscale and the GTVIC scores. The total score of VMIQ-II and the VMIQ-II visual subscale were the only other imagery variables to correlate at or above, $r = .30$, with this subscale. Correlations for each of the SQMI imagery variables are smaller in value than those associated with the total scores of the GTVIC and the VMIQ-II, and the subscales of the VMIQ. The correlations of the SQMI imagery variables follow a different pattern of association with the duration subscale than with the similar correlations shown for other SIAM subscales. The cognitive measures demonstrated a small level of association with the SIAM duration subscale. Unexpectedly, the SQMI olfactory subscale showed the smallest correlation with this subscale.

Table 5.6

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Duration Subscale

Measures	Correlation
GTVIC-Total	.44
VMIQ-II-Total	-.39
VMIQ-II-Visual	-.33
VMIQ-II-Kinaesthetic	-.26
SQMI-Visual	-.24
SQMI-Total	-.22
SQMI-Kinaesthetic	-.21
SQMI-Gustatory	-.17
SQMI-Tactile	-.15
SQMI-Auditory	-.14
SQMI-Organic	-.14
MAB-Spatial	.12
MAB-Similarities	.12
SQMI-Olfactory	-.10

SIAM Visual Subscale.

The Pearson Product-Moment correlations for the visual subscale with all other convergent and discriminant validity measures are shown in Table 5.7. The strongest reported relationship was between this subscale and the GTVIC scores. The total score of the VMIQ-II, representing vividness of images, had the next strongest relationship. The visual subscale of the VMIQ-II (representing visual orientation of movement imagery) showed a larger correlation with the SIAM visual subscale than did the kinaesthetic subscale of the VMIQ-II. All other correlations were less than, $r = .30$. The SQMI total score correlation was larger than those of the SIAM visual subscale with the individual SQMI subscale correlations with SIAM visual subscale. The SQMI visual subscale correlation was slightly greater than the other modality subscale correlations. The cognitive measures demonstrated the smallest level of association with the visual subscale.

Table 5.7

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Visual Subscale

Measures	Correlation
GTVIC-Total	.43
VMIQ-II-Total	-.35
VMIQ-II-Visual	-.33
VMIQ-II-Kinaesthetic	-.29
SQMI-Total	-.29
SQMI-Visual	-.26
SQMI-Organic	-.25
SQMI-Tactile	-.23
SQMI-Gustatory	-.23
SQMI-Kinaesthetic	-.22
SQMI-Auditory	-.17
SQMI-Olfactory	-.17
MAB-Similarities	.09
MAB-Spatial	.05

SIAM Kinaesthetic Subscale.

The Pearson Product-Moment correlations for the kinaesthetic subscale with all other convergent and discriminant validity measures are shown in Table 5.8. The strongest reported relationship was between this subscale and the GTVIC scores. The kinaesthetic subscale of the VMIQ-II, representing kinaesthetic orientation of images, had the next strongest relationship. The total score of the SQMI and the total score of the VMIQ showed correlations greater than, or at the, $r = .30$, level. All other variable correlations were less than, $r = .30$. The SQMI kinaesthetic subscale correlation was in the middle of the set of SQMI modality subscale correlations, with the SQMI visual subscale correlation the highest. The cognitive measures demonstrated the smallest level of association with the kinaesthetic subscale.

Table 5.8

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Kinaesthetic Subscale

Measures	Correlation
GTVIC-Total	.39
VMIQ-II-Kinaesthetic	-.31
SQMI-Total	-.31
VMIQ-II-Total	-.30
SQMI-Visual	-.27
SQMI-Gustatory	-.27
SQMI-Kinaesthetic	-.25
VMIQ-II-Visual	-.25
SQMI-Tactile	-.25
SQMI-Organic	-.25
SQMI-Olfactory	-.19
SQMI-Auditory	-.17
MAB-Similarities	.13
MAB-Spatial	.03

SIAM Auditory Subscale.

The Pearson Product-Moment correlations for the auditory subscale with all other convergent and discriminant validity measures are shown in Table 5.9. The strongest reported relationship was between this subscale and the GTVIC scores. All other variable correlations were less than $r = .3$. The SQMI auditory subscale correlation was only minimal but was the equal highest of the set of SQMI modality subscale correlations, with the SQMI visual subscale correlation at the same level. The SQMI total, the VMIQ-II total, and both VMIQ-II subscale correlations were small but greater than the SQMI auditory subscale correlation. The cognitive measures demonstrated very small negative levels of association with the auditory subscale.

Table 5.9

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Auditory Subscale

Measures	Correlation
GTVIC-Total	.32
VMIQ-II-Visual	-.27
VMIQ-II-Total	-.27
SQMI-Total	-.21
VMIQ-II-Kinaesthetic	-.20
SQMI-Visual	-.17
SQMI-Auditory	-.17
SQMI-Organic	-.16
SQMI-Kinaesthetic	-.15
SQMI-Tactile	-.15
SQMI-Gustatory	-.15
SQMI-Olfactory	-.12
MAB-Spatial	-.06
MAB-Similarities	-.07

SIAM Tactile Subscale.

The Pearson Product-Moment correlations for the tactile subscale with all other convergent and discriminant validity measures are shown in Table 5.10. The strongest reported relationship was between this subscale and the GTVIC scores. The SQMI total, the VMIQ-II total, and both VMIQ-II subscale correlations showed correlations greater than, or at the, $r = .30$ level. All other variable correlations were less than, $r = .30$. The SQMI tactile subscale correlation was small and in the middle of the set of SQMI modality subscale correlations, with the SQMI visual subscale correlation the highest. The cognitive measures demonstrated negligible levels of association with the auditory subscale.

Table 5.10

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Tactile Subscale

Measures	Correlation
GTVIC-Total	.40
VMIQ-II-Total	-.36
VMIQ-II-Kinaesthetic	-.34
VMIQ-II-Visual	-.33
SQMI-Total	-.30
SQMI-Visual	-.27
SQMI-Kinaesthetic	-.25
SQMI-Tactile	-.23
SQMI-Gustatory	-.23
SQMI-Organic	-.22
SQMI-Olfactory	-.21
SQMI-Auditory	-.20
MAB-Spatial	.04
MAB-Similarities	.01

SIAM Olfactory Subscale.

The Pearson Product-Moment correlations for the olfactory subscale with all other convergent and discriminant validity measures are shown in Table 5.11. In contrast to the sets of SIAM subscale correlations detailed earlier, all of the variable correlations were less than, $r = .30$. The strongest reported relationships were between this subscale and the GTVIC scores, VMIQ-II total, and SQMI total. The SQMI olfactory subscale correlation was small but was the second highest of the set of SQMI modality subscale correlations, with the SQMI gustatory subscale correlation the largest. The cognitive measures demonstrated the smallest level of association with the olfactory subscale, however they were both negative and above the, $r = -.10$, level.

Table 5.11

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Olfactory Subscale

Measures	Correlation
GTVIC-Total	.24
VMIQ-II-Total	-.24
SQMI-Total	-.24
VMIQ-II-Visual	-.23
SQMI-Gustatory	-.21
VMIQ-II-Kinaesthetic	-.20
SQMI-Olfactory	-.19
SQMI-Organic	-.19
SQMI-Kinaesthetic	-.17
SQMI-Tactile	-.16
SQMI-Visual	-.16
SQMI-Auditory	-.15
MAB-Spatial	-.11
MAB-Similarities	-.14

SIAM Gustatory Subscale.

The Pearson Product-Moment correlations for the gustatory subscale with all other convergent and discriminant validity measures are shown in Table 5.12. As reported for the olfactory subscale correlations, all of the variable correlations for the gustatory subscale were also less than, $r = .30$. The strongest reported relationships were between this subscale, the GTVIC scores, and the VMIQ-II total. The SQMI gustatory subscale correlation was small but was the highest of the set of SQMI modality subscale correlations. Correlations for the cognitive measures demonstrated a small negative level of association with the gustatory subscale, slightly greater than those reported for the other SIAM subscales. The MAB similarities subscale correlated with this subscale at, $r = -.21$. The MAB spatial subscale showed the smallest level of association with the gustatory subscale at, $r = -.11$.

Table 5.12

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Gustatory Subscale

Measures	Correlation
GTVIC-Total	.24
VMIQ-II-Total	-.24
VMIQ-II-Visual	-.22
SQMI-Gustatory	-.21
SQMI-Total	-.21
VMIQ-II-Kinaesthetic	-.20
SQMI-Organic	-.18
SQMI-Olfactory	-17
SQMI-Visual	-.16
SQMI-Auditory	-.16
SQMI-Kinaesthetic	-.12
SQMI-Tactile	-.12
MAB-Spatial	-.11
MAB-Similarities	-.21

SIAM Emotion Subscale.

The Pearson Product-Moment correlations for the emotion subscale with all other convergent and discriminant validity measures are shown in Table 5.13. In contrast to the other sets of SIAM subscale correlations, the strongest reported relationship was between this subscale and the VMIQ-II total. The GTVIC scores, SQMI total, the SQMI visual, and both VMIQ-II subscale correlations showed correlations greater than, or at the r = .30 level. All other variable correlations were less than, r = .30. No interpretable pattern of correlations of this subscale with the other SQMI modality subscales was apparent. The cognitive measures demonstrated the smallest level of association with the emotion subscale.

Table 5.13

Pearson Product-Moment Correlations between the Convergent and Discriminant Validity Measures and the SIAM Emotion Subscale

Measures	Correlation
VMIQ-Total	-.36
VMIQ-Kinaesthetic	-.35
GTVIC-Total	.34
VMIQ-Visual	-.31
SQMI-Total	-.31
SQMI-Visual	-.30
SQMI-Gustatory	-.26
SQMI-Kinaesthetic	-.24
SQMI-Organic	-.23
SQMI-Tactile	-.22
SQMI-Auditory	-.19
SQMI-Olfactory	-.16
MAB-Similarities	-.03
MAB-Spatial	-.02

Discussion

The primary purpose of the third study of this thesis was to explore evidence of the convergent and discriminant validity of the SIAM. Few studies exist designed specifically to examine these validity characteristics of available imagery measures, particularly in the area of sport psychology. Moran (1993) was highly critical of the lack of rigor in the examination of appropriate validity evidence for imagery tests and stated:

> We do not know if they hit the target because their convergent validity (i.e. the degree to which they converge on the imagery construct by being positively inter-correlated) and discriminant validity (i.e. the degree to which they diverge from unrelated constructs by being uncorrelated with them) have not been established. (p. 163)

The design and implementation of this study aimed firstly to determine the extent of the relationship between the SIAM and imagery measures used previously in sport psychology research. Secondly, the study attempted to discriminate between the SIAM dimensions and modalities and other indicators of imagery abilities assessed in nonsport imagery measures. The final aim was demonstrate differences between imagery and other nonimagery cognitive processes.

Existing research has typically involved two main methodologies to determine the extent of the relationships between the various imagery measures, and between these measures and other tests of cognitive performance. Firstly, comparisons are made with other imagery and cognitive variables on the basis of a measure's total score as representative of its dimensional or modality structure (e.g., Isaac et al., 1986; Lane, 1977; Morris & Gale, 1974; Richardson, 1994). Secondly, researchers conducted analyses, detailing the relationships between specific dimensional or modality subscales of the imagery measures (e.g., Hiscock, 1978; Kihlstrom et al., 1991; Switras, 1977) and other total or subscale imagery test scores and cognitive variables. Only one of the above mentioned studies indicated that the research represented an attempt to examine evidence of convergent or discriminant validity (Switras, 1977), and even in that investigation comparisons were only between subscales within the imagery measure and not with any other measures. The present research incorporated both methods to explore detailed evidence of the convergent and discriminant validity of the SIAM.

Relationship of Findings to Theory and Research

This section of the discussion details the examination of existing research and theory in relation to three areas of the statistical analyses conducted in this study. Specifically, the sub-sections discuss (a) the descriptive data, (b) the relationships between the SIAM and the non-SIAM imagery variables, and (c) the relationship between the SIAM and non-imagery variables.

Descriptive Data

Examination of the data of the imagery tests, including the SIAM, shows a high level of skew for a number of the total and subscale scores. The pattern of SIAM subscale score distributions reported for both previous studies in this thesis is similar to the pattern found in the current study. Skewed scores for the dimensional, visual, and emotional subscales of the SIAM indicate that few participants had difficulty in generating images, a trend reported in other imagery assessment research (Kihlstrom et al., 1991; Sheehan, 1967). There is also a substantial level of skew for the GTVIC and the VMIQ-II kinaesthetic subscale scores. The results show much smaller levels of skew for the other imagery variables examined. This finding indicates that participants report being more able to generate images related to their sport, along with higher levels of general imagery control and higher levels of vividness of kinaesthetic movement imagery. The finding is also congruent with the emphasis by sport psychology researchers on the importance of imagery control, sport specificity of the imagery measure, and the involvement of the kinaesthetic sense within sport imagery training programs (Morris, 1997; Weinberg & Gould, 1999)

The scores on the VMIQ-II, GTVIC, and SQMI in this study are similar to those reported in previous research. White et al. (1978) found a similar set of subscale scores for the randomised SQMI in which the kinaesthetic subscale was the highest in vividness and the olfactory the lowest. The visual and auditory subscales were in the middle of the distribution of subscale means. It would seem that the general imagery factor tapped by the SQMI is consistent across normal functioning young adult samples and not affected by athletic experience. Kihlstrom et al. (1991) reported a mean GTVIC score of 16.73 for a large student sample that is lower than the mean of 19.83 reported here. Lorenz and Neisser (1985), however, found a similar mean GTVIC score to that reported in the present study, but they employed a much smaller sample. Examination of the GTVIC data of the present study highlights two issues pertaining to the use of the measure. Firstly, that the GTVIC in its present form contains many items that are too easy for most individuals to image and requires a revision in an effort to reduce the level of skew (Mckelvie, 1992). Secondly, when considered in relation to the difference between the Kihlstrom et al. (1991) results and the present findings, the GTVIC represents an imagery dimension that athletic populations appear more capable of performing than the general population.

Previous research that examined the mean scores for the VMIQ has indicated differences between non-athletic samples and athletic samples (e.g., Eton et al., 1998; Isaac & Marks, 1994). Researchers reported both the VMIQ mean total scores and the VMIQ mean item scores. In the present study, I reported the mean total score and mean modality subscale scores. To assist in comparison with previous research using the VMIQ (48 items) rather than the VMIQ-II (54 items), I calculated the mean item score for the VMIQ-II items. For the present study the mean item score was 2.11. Eton et al. (1998) found a mean item score of 2.05 for athlete samples and 2.41 for non-athletes. Isaac and Marks (1994) reported a mean item score of 2.56 for non-athlete controls and a range of mean item scores of 1.60 to 2.50 for athletes depending on their specific sports. Comparison of this set of VMIQ findings with the VMIQ-II data indicated that the athletic sample examined in the present study is similar to other samples of athletes in their capacity to generate vivid movement-oriented images. The VMIQ-II mean item score is also noticeably lower than the VMIQ mean item scores found for the non-athlete samples of the Eton et al. and Isaac and Marks studies. The trends highlighted from the comparisons of these VMIQ scores provides basic support for the conclusion of previous movement imagery researchers that athletes experience more vivid movement imagery than non-athletes (Eton et al., 1998; Isaac & Marks, 1994).

The findings of the present study are consistent with existing research in relation to the participants' mean score on the MAB-spatial, but not with their mean score on the MAB-similarities. Carless (2000) reported mean scores for an adult sample of 29.17 for the spatial subtest and 25.55 for the similarities subtest, compared with 27.15 (spatial) and 19.89 (similarities) for the present sample. Although the present set of MAB scores are lower, this result is probably due to the greater number of high school student included in the sample. Jackson (1984) found a mean score for the similarities subtest of 22.14 using a sample that included a group of high school students. Overall, the results for the spatial subscale are similar to current findings, and to those of the MAB developer indicating that this athlete group possess spatial skills typical of the general adult population. The results for the similarities subtest, however, suggest that the reading or vocabulary skills of the present group are not as good as those of the other groups discussed. For many of the younger participants their reading and vocabulary skills are not yet fully developed, and may continue to improve into adulthood. The conclusion of Carless (2000), following her evaluation of the MAB, was that the measure is an effective tool for large scale cognitive testing for research purposes, when individual testing is difficult or impractical. As a clinical tool, Carless suggested that the effectiveness of the MAB is limited.

Relationship of the SIAM and Imagery Variables

Relationships between the SIAM subscales and VMIQ-II, SQMI, and GTVIC were examined to provide evidence of convergent and discriminant validity. Overall the correlations between the imagery variables were in the range of small to moderate, with no correlation greater than $r = .50$. All correlations above $r = .10$ were significant at the $\alpha < .05$ level. The size of the correlations would tend to suggest that the SIAM taps an element of imagery (sport-oriented) that is different from either movement imagery or general imagery. Several researchers have emphasised this differentiation of imagery types (reflected in the focus of specific imagery measures) as an important area of imagery ability assessment (Anderson, 1981; Martin, Moritz, & Hall, 1999; Munzert & Hackfort, 1999).

The first of the predictions I proposed was that SIAM subscales would be more closely related with the movement imagery measure than with the measures of general imagery. Correlations between the SIAM subscales and the VMIQ-II total, visual, and kinaesthetic subscale scores were generally second, third, and fourth largest of the correlation sets for each of the individual SIAM subscales. This pattern was particularly prominent in relation to the SIAM subscales examining the dimensions of vividness, control, ease of generation, and duration, the visual, kinaesthetic, and tactile modalities, and emotion. The most striking result of the set of correlations for the general measures was the relationship between the GTVIC and the SIAM subscales. For all except the olfactory, gustatory, and emotion subscales, the GTVIC had the strongest correlation with the individual SIAM subscales. In the case of these three subscales, the correlation with the GTVIC was equal to the largest, or only minimally smaller than the largest correlation. These findings highlight two key points. Firstly, Richardson (1994) made direct comment that the movement component is particularly important in considering the controllability of imagery, and that measures such as the VMIQ-II "may provide a useful set of items from which to construct a new measure of visual imagery control" (p. 30). The sport orientation of the SIAM would also lead participants to consider the control of movement within the context of the images they generated to complete the measure. Correlation patterns between the SIAM subscales and the GTVIC, although larger than the VMIQ-II values and higher than expected, seem plausible because both the SIAM and GTVIC require participants to tap aspects of imagery control.

Secondly, the finding that the SIAM subscales are generally more strongly correlated with the VMIQ-II than with the subscales of the SQMI indicates that, as predicted, sport imagery is more aligned with movement based imagery than with items that examine modality specific general imagery vividness. Munzert and Hackfort (1999) suggested in the assessment of imagery abilities related to motor learning and competition preparation that an important decision of the researcher is to differentiate between the use of measures that examine general or movement specific imagery processes. The authors also suggested that the relevance of the content of the various imagery measures to the underlying reasons for assessing the imagery abilities of athletes necessitates careful consideration of which instruments are used. The stronger correlations between the VMIQ-II and SIAM subscales in comparison to those between the SQMI and SIAM subscales indicate that the content of the SIAM is related more to movement rather than general vividness of imagery.

Earlier discussions of imagery assessment have outlined a problem in the use of the SQMI with specific populations such as athletes (Munzert & Hackfort, 1999) or patients being treated for phobias (Anderson, 1981). The rating of the imagery of everyday items included in the SQMI does not generate scores that most appropriately reflect the context of sport or movement imagery. If the contextual emphasis of the imagery activities is specific (e.g., phobic treatment, competition preparation), then the measures used to examine individual differences need to focus on the area of interest. I concluded that the correlation patterns for the SIAM subscales showed that sport imagery is indeed different from general imagery. The stronger association of the SIAM subscales with the VMIQ-II scores reflected the greater relevance of movement-oriented imagery within the generation of sport based images by athlete groups.

The second prediction of the present study related to the association of the dimensions and modalities examined by the SIAM and similar dimensions and modalities assessed within the other imagery measures of the study. The expectations were that stronger relationships exist (a) between similar dimensions than between less similar dimensions, and (b) between similar modalities than between less similar modalities. Overall, the convergent and discriminant evidence found in this component of the study constituted a comparatively interpretable pattern of correlations in terms of previous examinations of imagery dimensions and modalities (e.g., Hiscock, 1978, Kihlstrom et al., 1991) Individual correlations ranged from medium to very small. As a general framework for this discussion, it is more useful for understanding the relationship patterns to consider whether the expected correlation for the SIAM subscale of interest was higher or lower than the unexpected correlation, rather than their absolute value in terms of significance. For example, I expected that the correlation between the SIAM vividness subscale and the SQMI vividness score ($r = -.35$) would be higher than an unexpected relationship such as the SIAM vividness subscale and the SQMI gustatory subscale ($r = -.23$). This finding matched the predicition, however, both correlations were statistically significant. For this reason, the pattern of relationships provides important information.

The assessment of only vividness and control within the SQMI, VMIQ-II, and GTVIC limits the extent of the examination of the associations between the SIAM dimensional subscales and other dimensional variables. As discussed earlier, the GTVIC correlated the highest of the imagery variables with each of the SIAM dimensional subscales. The largest correlation, $r = .48$, was with the SIAM control subscale, a result that provides basic support for the convergent validity for the control subscale of the SIAM. Correlations of the GTVIC and the other SIAM dimensions were all of values of approximately, $r = .43$. These results, as suggested previously, highlight the influence of the dimension of control in the generation of movement-oriented images (Richardson, 1994). The style of the imagery required in the SIAM scripts encourages participants to manipulate their images through a particular scene (regularly incorporating movement elements), in a manner aligned to the image manipulations required within the GTVIC. Kihlstrom et al. (1991) suggested that imagery scenes involving manipulation or transformation of their original starting image, as the SIAM does, would also incorporate controllability elements. Irrespective of the minimally larger correlation value between the SIAM control subscale and the GTVIC compared to the other GTVIC and SIAM dimensional correlations, the consistently high values of the latter set of correlations suggest that participants may well evaluate responses related to the control of their images in association with their assessment of other dimensional characteristics examined by the SIAM such as vividness or ease of generation.

The total scores of the SQMI and VMIQ-II represented the nonmodality specific vividness variables in the present study. Review of the correlations between the SQMI total and the SIAM dimensional subscales revealed that the strongest association was for the SIAM vividness subscale. In the case of the VMIQ-II, the pattern of correlations with the SIAM dimensional subscales was not as supportive of the vividness dimension as those for the SQMI. The VMIQ-II correlated marginally higher with the SIAM control subscale (r = -.38) rather than the SIAM vividness subscale (r = -.35). Each of the other VMIQ-II and SIAM dimensional subscale correlations was slightly lower. This set of correlations provides basic evidence for the convergent validity of the SIAM vividness subscale but contributes little evidence in support of the independence of imagery dimensions. As was predicted, the SQMI total had a stronger association with the SIAM vividness subscale than the other SIAM dimensions. Vividness as examined by the SQMI is the imagery dimension most regularly discussed within the field of imagery research. The value of the correlation between this well-established general imagery variable and the SIAM vividness subscale tentatively indicates that the SIAM assesses a comparable dimensional characteristic of sport imagery. The pattern of correlations for the VMIQ-II and the SIAM dimensions suggests that vividness as represented within a movement imagery measure and a sport imagery measure may not necessarily be the same dimension. Once again the VMIQ-II correlation set highlights the suggestion by Richardson (1994) that vividness of movement imagery may be representative of image control as much as image vividness.

The pattern of correlations for the SIAM subscales of duration, ease of generation, and speed of generation with the other general and movement imagery variables provide little substantive evidence of the convergent and discriminant validity of the subscales. The correlations between the ease and speed SIAM subscales and each of the non-SIAM dimension variables demonstrate a consistent measure dependent pattern. For example the value of the correlation set for these SIAM dimensions with the SQMI total was approximately, r = -.27, approximately, r = -.30 for the VMIQ-II total, and for the GTVIC the value was approximately, $r = .42$. Correlation values for the SIAM duration subscale were similar to the ease and speed subscales for the GTVIC relationship, but varied slightly for each of the VMIQ-II ($r = -.39$) and SQMI ($r = -.22$) associations. As these three SIAM subscales evaluate characteristics that were originally conceived to be different from each other and from the dimensions of vividness and control, a higher level of discrimination was expected, particularly in relation to control and vividness of movement imagery. Such a result however, irrespective of equivocal correlations, provides support for the perception that imagery dimensions may simply represent individual facets of a broader imagery generation factor (White et al., 1977, Wolmer, Laor, & Toren, 1999).

Conclusively discriminating between the dimensional components of mental imagery, most commonly vividness and control, represents a significant problem regularly highlighted in discussions of the assessment of mental imagery by self-report (Anderson, 1981; Kihlstrom et al., 1991; Lane, 1977; Richardson, 1994; Shaw & DeMers, 1986; Sheehan et al., 1983; White et al., 1977; Wolmer et al., 1999). Correlations between general imagery measures of control and vividness are typically around the level of $r = .50$. Lane (1977) suggested that in completing measures such as the SQMI or GTVIC, a participant may incorporate imagery processes that involve the use of both vividness and control abilities within each measure. Hall and Martin (1997) reported a comparison of the MIQ, a measure of ease of generation of movement imagery, and the VMIQ, a measure of vividness of movement imagery, which resulted in a correlation of, $r = .58$. This finding provides additional supportive evidence of the associated nature of the dimensional characteristics assessed within imagery measures of a similar conceptual design, such as movement imagery.

The image evocation process expected in the completion of the SIAM involves the amalgam of each of the dimensions that the measure examines. The participant that creates an image with a high level of clarity may also have completed this task with control, ease, and rapidity. The result of this matched level of ability on these attributes of the SIAM could account for the similarity of the correlation values across dimensions with each of the non-sport imagery variables. Dimensions, if perceived as aligned cognitive functions, should "share a significant proportion of the variance and, therefore should not be treated as orthogonal functions but rather different aspects of a basic process" (Wolmer et al., 1999, p. 481). Based on the small to moderate correlation values between the measures of varying imagery emphasis it seems that general, movement, and sport imagery ability represent different processes likely to demonstrate varying proportions of shared dimensional variance.

Comparison of the sensory components of the SIAM with the other imagery modality variables has resulted in variable evidence relating to substantiation of the convergent and discriminant validity of the measure. Findings in relation to the VMIQ-II better represent the expected predictions than those reported for the SQMI. The possibility of a greater conceptual association of sport imagery and movement imagery, when contrasted with the comparison of sport and general imagery, provides an initial explanation of this trend.

As was the case with the dimensional comparisons, the GTVIC was the measure with which the SIAM demonstrated the strongest modality correlations. Specific modality analyses provided a supportive result through the finding that the GTVIC, a measure of visual imagery, correlated most strongly with the visual dimension of the SIAM ($r = .43$). Correlations between GTVIC and the SIAM kinaesthetic and tactile subscales of approximately, $r = .40$, represent negative evidence in relation to the discriminant capacity of the measure. Similar correlational research has also resulted in unexpected modality associations. Kihlstrom et al. (1991) described a pattern of correlations for the GTVIC and individual modality subscales of the SQMI with only minimal differences in the values between the visual control test and the visual, kinaesthetic, and tactile subscales of the SQMI. Overall, such results may better reflect Richardson's (1994) suggestion that the GTVIC is a measure in need of re-design and psychometric development, rather than evidence of the inadequacy of the SIAM subscales to appropriately examine the sensorial aspects of sport imagery.

Findings in relation to the modality comparisons of the SIAM and the VMIQ-II provided basic evidence in support of visual and kinaesthetic structure of the former measure. In the case of the SIAM visual subscale, the VMIQ-II visual subscale (r = -.33) correlated higher than the kinaesthetic subscale (r = -.29). Additionally, the SIAM kinaesthetic subscale correlated higher with the VMIQ-II kinaesthetic subscale (r = -.31) than it did with the visual subscale (r = -.25). Previous research in the area of movement imagery assessment has shown that only limited differences seem to exist between the values of the correlations between modalities. Campos, Lopez, and Perez (1998) found that the VMIQ (primarily a visual measure) and a haptic version (kinaesthetic and tactile sensations associated with movement execution) of the questionnaire correlated at the level of, r = .60. Hall and Martin (1997) reported that the correlation between the VMIQ and the visual subscale of the MIQ was, r = .65, whereas a lower value of, r = .49 was found with the kinaesthetic subscale. Hall et al. (1985) in their developmental analyses of the MIQ found a correlation between the two subscales of r = 58. Interestingly, Hall et al. suggested that this level of moderate association infers that the modalities "are related, but separate measures" (p. 115), whereas, Munzert and Hackfort (1999) discussing the same finding stated that "one may assume that different characteristics are actually measured" (p.54). The key purpose of the preceding quotes is not to be excessively critical of the MIQ, but to highlight the inherent confusion in interpreting modality comparisons. The values of the modality relationships cited from the previous research exemplify the difficulties involved in developing an imagery tool that can substantiate the specific levels of correlation typically expected in convergent and discriminant analyses (Richardson, 1994). As a set of values it seems unclear as to whether correlations above, $r = .50$, represent similarity or distinction. The results of the SIAM and VMIQ-II modality comparisons represent, firstly, a reasonable reflection that the visual and kinaesthetic modalities are marginally different from each other, and secondly, that each of the measures examines the visual and kinaesthetic senses as they relate specifically to sport and movement imagery.

Existing research clearly indicated that the SQMI was the primary multi-modal imagery measure purposefully examined to determine the convergent and discriminant characteristics of its modality subscales (Hiscock, 1978; Kihlstrom et al. 1991; Richardson, 1988b; White et al., 1974). For this reason, the analyses of its association with the SIAM modality subscales represented an important component in the generation of evidence of the construct validity of the SIAM. Correlations between the SIAM modality subscales and the SQMI modality subscales were small but in the appropriate direction. The predicted pattern of associations, in which same modality correlations (e.g., visual/visual; auditory/auditory) would be the largest of the SQMI correlations data set was observed for only the visual and gustatory SIAM modality subscales. Analyses in relation to the visual sense showed that the correlation between the SIAM visual subscale and the SQMI visual subscale ($r = -.26$) was minimally stronger than the association of the SIAM visual subscale with the non-visual SQMI subscales ($r = -.25$ - kinaesthetic to $r = -.17$ - olfactory). Weaker correlations were found between the SIAM gustatory subscale and SQMI subscales but the pattern was as predicted ($r = -.21$ - gustatory to $r = -.12$ - tactile). No clear pattern could be interpreted from the analyses of the other SIAM modality subscales and SQMI subscales.

Examination of the correlation matrices of previous SQMI subscale comparisons provided little assistance in explaining the variability in the level of association between modalities (Kihlstrom et al., 1991; Richardson, 1988b). Kihlstrom et al. (1991) reported correlations between the SQMI modalities in which expected associations between senses, such as olfactory and gustatory or kinaesthetic and tactile, were similar in value to unlikely associations such as olfactory and tactile or kinaesthetic and auditory. Correlational data presented by Richardson (1988b) for a modified version of the SQMI and a parallel modality matching task indicated that for relationships other than the visual and olfactory senses did not suggest modality specificity. A number of methodological issues detailed in the following section of this discussion, confound the conclusions drawn regarding the modality associations between the SIAM and the SQMI. At this point, the findings suggest that, aside from the visual modality, the other individual senses do not consistently represent distinct characteristics of a multimodal representation of imagery ability.

The majority of applied reviews of the use of imagery in sport support the association of emotions within the generation of images (Perry & Morris, 1995; Martens, 1987; Murphy & Jowdy, 1992; Suinn, 1993; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). Based on this suggestion emotion represented a key variable incorporated in the design of the SIAM. Analysis of the correlations for the SIAM emotion subscale with each of the other imagery variables indicated no clear trends in relation to either dimension or modality. As only minimal previous research exists that addresses the issue of emotion in the context of imagery ability assessment, the present findings represent preliminary data in relation to this characteristic. The individual correlations provide a basis for describing how sport oriented emotional imagery relates to specific sensory and dimensional characteristics.

As very few imagery assessment instruments exist that attempt to examine emotional characteristics, or include emotional or affective items as variables, the capacity to make detailed comparison of the current data with those of other researchers is limited. Richardson (1994) reviewed versions of the Abbreviated Imagination Inventory (AII; Barber & Wilson, 1979) and the Absorption Scale (AS; Tellegen & Atkinson, 1974). Several items from each measure relate to mood or emotions. Sheehan, McConkey, and Law (1978) reported correlations of the AS with the SQMI and GTVIC respectively of $r = -.40$ and $r = .26$, but specific data related to the association between the emotional variables and either dimensions or modalities were not available. Similarly, Richardson (1983b) found the AII correlated moderately with the SQMI total, but provided no individual modality relationship details. The results for the comparison of the SIAM emotion subscale and the non-SIAM dimensional variables reveal no clear pattern of relationships. For example, vividness of movement imagery appeared to have a stronger association ($r = -.36$) than control ($r = .34$) with this variable. This was not the typical pattern observed for the other SIAM subscales, but comparable with the Sheehan et al. (1978) finding that emotion may be more closely associated with vividness than control. Emotion may well function differently from other dimensions and modalities in the context of imagery abilities but as yet the current results or reviewed research do not support the categorisation of emotion as a either a dimension or modality.

The most useful research example relevant to the present study is the examination of the Guy Emotive Imaging Scale (GEIS; Guy & McCarter, 1978). Guy and McCarter designed the measure to assess the vividness of emotional imagery and is based on the response structure of the SQMI. The emotional variables examined include enjoyment, surprise, interest, distress, fear, and anger. Examination of the correlation coefficients between the GEIS and SQMI indicated no clear pattern in the relationship of sensory and emotive imagery. The highest correlation was between the GEIS total and the organic subscale of the SQMI (r = .66) and the lowest was with the SQMI auditory subscale (r = .26). The authors made several interesting conclusions about their findings. Firstly, their interpretation of the association between the organic modality and the GEIS was that the high value was plausible due to the: "emphasis on feeling bodily sensation in the organic modality and in all the emotive modalities" (p. 1272). They also suggested that the subjective representation of sensations such as fatigue or exhaustion is aligned with the generation of emotive imagery. Interestingly, the SIAM emotion subscale correlated higher with the VMIQ-II kinaesthetic subscale than it did with the VMIQ-II visual subscale, offering basic support for a possible body feeling factor associating these imagery variables. Secondly, the overall correlation between the SQMI and GEIS of, r = .50, prompted the ambiguous conclusion, as has been the case with many of the modality or dimensional relationships discussed in this chapter, that although there is some similarity between sensory imagery and emotive imagery the two measures are tapping different phenomena. The small values of the correlations between the SIAM emotion subscale and the individual modality subscales of the SQMI, certainly suggest that emotionally-oriented sport images and general sensory images represent contrasting cognitive processes.

The correlational results presented for the SIAM emotion subscale provide limited support for a possible link with the organic type sensations such as kinaesthesia or touch. Although the highest individual modality correlation was with the VMIQ-II kinaesthetic subscale, the nature of the items assessing that variable are not explicitly representative of organic states such as fatigue. Additionally, the small correlations with the SQMI organic, kinaesthetic, and tactile subscales tend to suggest emotion as examined within the SIAM is different from the perception of bodily state. The emotion variable of the SIAM is more oriented to psychological state than feelings associated with the organic characteristics of imagery. Generally, the convergent and discriminant evidence examined in relation the SIAM emotional subscale indicates that the variable is associated with movement imagery abilities, but is difficult to clearly describe in terms of a dimensional or modal relationship.

Relationship of the SIAM and Non-Imagery Variables

A key component in testing for discriminant validity of the SIAM was the correlation of the SIAM subscales with verbal and objective performance measures of cognitive functioning. The measures used in this study were the spatial and similarities subtests of the Multidimensional Aptitude Battery (MAB; Jackson, 1984). Substantial research has demonstrated that self-reported imagery does not closely relate to either verbal ability or spatial ability (e.g., Ernest, 1977; Hiscock, 1978; Richardson, 1977; Rossi & Fingeret, 1977; Sheehan et al., 1983). In the case of spatial ability, Hall (1998) classified tests of this cognitive operation as objective measures of imagery ability. Sheehan et al. (1983) were adamant that this type of classification is inappropriate. They proposed that this the categorisation of spatial ability tests has occurred firstly, because there is a belief that cognitive manipulations are reliant on imaging, and secondly that there appears to have been a need in psychology to find an objective performance tool as an adjunct to subjective questionnaires.

Examination of the correlations for the SIAM subscales and the MAB-similarities subtest revealed a clear difference between the measures. Individual correlations were typically very small, and for several subscales, small and negative. Previous research findings provide support for the present results. Rossi and Fingeret (1977) reported a near zero correlation of $r = .01$ between the SQMI and the verbal section of the Scholastic Aptitude Test. McKelvie and Rohrberg (1978) found that scores on the VVIQ did not relate to performance on the verbal reasoning section of the Differential Aptitude Test (DAT). Results of research examining the IDQ and other self-report measures of imagery ability support the distinction between imaginal and verbal processing. Hiscock (1978) reported no significant correlations between the IDQ verbal scale and the GTVIC and visual and auditory subscales of the SQMI. In contrast, correlations for the IDQ imagery scale and the other self-report variables were all significant and moderate in value, except the SQMI auditory, which was significant but small. Rarely was any evidence related to movement imagery and verbal processes reported in the reviewed literature. Campos and Perez (1988) found that the VMIQ significantly correlated with the IDQ imagery scale, but not the verbal scale. The findings of the present SIAM study in conjunction with the existing research examining imagery and verbal processing represent strong evidence for the discrimination between self-reported imagery abilities and other forms of cognitive functioning.

Results of correlations between the SIAM subscales and the MAB spatial subtest represent strong evidence of the independence of spatial ability and mental imagery ability as cognitive processes. Individual correlations between the SIAM subscales and MAB spatial subtest were all very small and included positive and negative values. These findings are typical of the previous research investigating the relationship between the measures labelled objective tests of imagery ability (spatial ability) and subjective self-report imagery questionnaires (Durndell & Wetherick, 1976; Ernest, 1977; Hatakeyama, 1981; Hiscock, 1978; McKelvie & Rohrberg, 1978). Durndell and Wetherick (1976) compared participants' scores on the SQMI and GTVIC with their scores on two spatial tests, the Minnesota Paper Form Board (MPFB) and the Flags test. They concluded that the two types of imagery assessment methods are not examining the same construct. The researchers also suggested that in studies where positive correlations are reported they are normally not of sufficient value to: "justify interchanging self-reports of imagery with scores on spatial tests' (p. 1050). Additional research compared the VVIQ (McKelvie & Rohrberg, 1978), and both scales of the IDQ (Hiscock, 1978), with another popular spatial ability measure, the space relations section of the DAT. In both studies, the results were consistent with the proposition that measures of visuospatial performance are unrelated to scores derived from subjective imagery questionnaires.

Comparisons of the SIAM and the MAB subtests provided valuable evidence of the discriminant validity of the former measure. None of the SIAM subscales were shown to have any substantial association with the two indicators of cognitive performance. More specifically, the current results demonstrate that sport imagery ability, irrespective of dimension or modality, is a cognitive process that is distinct from the skills examined by a measure of verbal ability and a spatial ability test. The importance of the comparison of the SIAM subscales (particularly control) and spatial ability measure is its contribution toward the classification of subjective and objective imagery measures as instruments examining independent constructs. Moran (1993) presented a succinct analysis of the comparison of the self-report and objective tasks' imagery methodologies. The key conclusion drawn by Moran and supported by the present study was that subjective measures may examine generation skills whereas the emphasis of objective tests is in the assessment of the ability to transform an image.

In summary, the present findings clearly support important aspects of the existing theory and research in the field of imagery ability assessment. Specifically, the results showed that sport imagery ability is different from both general and movement imagery abilities. Results related to dimensions indicate that moderate associations exist between dimensions of the same characteristics of the different measures. Unfortunately, I also found a similar pattern of relationships between dimensions representing different characteristics. A marginally clearer set of results exist in relation to the modalities assessed. Correlations between the SIAM and the VMIQ-II highlighted that the visual and kinaesthetic modalities are processed differently in terms of imagery abilities. The visual sense was also the modality most highly correlated with the dimensional attributes examined. No distinct pattern of associations was found for the emotion subscale of the SIAM with respect to dimensions or modalities. Thus, the results provide only basic support for the convergent validity of the SIAM but strong support for the discriminant validity of the measure. The discriminant evidence examined in this study clearly indicated that imagery is distinct from the other forms of cognitive functioning examined. Of interest is the lack of relationship between the spatial ability measure and the self-report measures, a finding that provides support for the independence of subjective and objective imagery ability assessment techniques.

Finally, the Triple Code Model (ISM) of imagery (Ahsen, 1984) postulates a framework of image representation for which the present findings provide support. The model comprises the following components: the image itself (I), the somatic response (S), and the meaning of the image (M). In terms of the SIAM, the nature of the relationships between the dimensions and the visual modality represent the creation of the image, the (I) component. Secondly, the differentiation of the visual sense from the other modalities, in association with the moderate level of correlation between the non-visual modalities, tends to support a component such as the somatic response. Finally, although only examined by the SIAM, the imagery characteristic of emotion appears relatively independent, a finding that provides tentative support for the final component of image meaning. Generating evidence in support of imagery models is a complex task but the SIAM represents an instrument more capable than existing measures of facilitating the collection of data to substantively test the ISM framework.

Methodological Issues

Within the methodological issues section I consider the effects of particular measurement and assessment characteristics of this study on the results. The equivocality of a number of the correlations between the SIAM subscales and related variables of the SQMI, GTVIC, and VMIQ-II suggested the possible influence of the following general areas of methodological concern. These are: (a) the effects of the design or psychometric quality of the measures selected for the study; (b) issues related to the experimenter or the mode of administration, such as the selection of measures or the nature of the testing environment; and (c) the existence and subsequent impact of any person-related, or more specifically, participant-related characteristics.

Instrument-Related Issues

Previous reviews of imagery assessment methodologies identified a number of instrument-related problems relevant to the present research (Anderson, 1981; Kaufmann, 1981; Richardson, 1994). Of particular importance are the issues of content, response procedures, and the continued presence of certain psychometric inadequacies in the self-report format of imagery abilities. This section details the exploration of each issue with respect to the measures most representative of the problem, and discusses the influence the issue on the SIAM.

Examination of the images rated within the SQMI and GTVIC revealed content that is of limited relevance in the assessment of the imagery abilities of athletes. Anderson (1981a) described the SQMI items as "emotionally innocuous, unrelated stimuli (e.g., the setting sun, a car honking, the feel of sand)" (p. 157). McKelvie (1992) and Richardson (1972) discussed concerns over the content of the GTVIC and recommended the development of alternatives to the basic image of the car or the involvement of multiple modalities. More important, Anderson (1981a) suggested that the comparison of the scores derived from these measures with the ratings of images created on the basis of specific outcomes would indicate little relatedness. The content orientation of the SIAM items, developed in relation to the outcomes of sport involvement, would lead to a greater degree of relevance to the athlete samples than the content of either the SQMI and GTVIC. The small to moderate correlations between the similar dimension and modality variables highlight the possible effect of diverse between measure content. Content of the VMIQ-II is more representative of the physical activity domain, as indicated by larger correlations with the relevant SIAM subscales, than those found for the SQMI.

Difficulties associated with the interpretation of the ratings of the response scales used in imagery questionnaires represent on-going problems in this field of research (Anderson, 1981; Kaufmann, 1981; Moran, 1993; Richardson, 1994). The SQMI and the VMIQ-II both used response scales (7 and 5-point, respectively) identified previously as potentially affected by the problems of standardisation of the quality of participants' imaginal responses and response set biases. The first problem is that there is "not really any way of knowing whether subjects are applying the same standard in making there ratings" (Anderson, 1981a, p. 157). Do rating anchors such as *perfectly clear and as vivid as the actual experience* or *vague and dim* mean similar things to the good or the poor imager? The same problem may also exist for the SIAM response scales. Anderson (1981) suggested that ensuring careful explanation of the anchors or scale points, both by the administrator and within the measure, partially alleviates the problem. The written instructions and administration protocol used within the current study were aimed at maximising the level of understanding of the items of the SIAM.

The second problem concerns response set biases such as social desirability and acquiescence (Moran, 1993). The initial version of the SIAM was only minimally correlated with the Marlowe-Crowne Social Desirability Scale, which suggested it was unaffected by social desirability. This result does not necessarily mean that the revised SIAM, or the other imagery measures used in this study were free from the bias of social desirability, but the consensus from previous research is that strong contamination of imagery measures by this type of response bias is unlikely (Richardson, 1994). Moran (1993) defined the second potential bias of acquiescence as "the tendency to apply the same rating to each vividness item, regardless of its content" (p. 165). Moran suggested that the reverse scoring technique is a method of limiting the influence of acquiescence. The recent revision of the MIQ (Hall & Martin, 1997) included a reversal of the traditional imagery response format of low score indicating greater imagery ability, to a format of high score representing higher imagery ability. The developers suggested that the original method could create confusion in interpretation and reporting, and therefore if that was the case, quite possibly lead to misinterpretation in completion of the scale. Randomisation of items is the method of minimising acquiescence preferred by Richardson (1994). The randomised version of the SQMI used in this study. The revision of the SIAM also involved the randomisation procedure. The implementation of this strategy should have limited the effects of the acquiescence. Conclusions with respect to the influence of response set biases within the current study are that the administration protocol followed the correct procedures to limit any bias effects, and that researchers involved in large-scale imagery-based assessment studies must acknowledge the possible influences of these response pattern concerns.

The final instrument-related issue warranting discussion concerns the consistent reoccurrence of a number of psychometric peculiarities associated with the assessment of imagery ability (Hiscock, 1978; Kihlstrom et al., 1991). Of substantial importance to the current research is the acknowledgment that no clear framework appears to exist in the generation of convergent and discriminant evidence of imagery ability measures (Kendall & Korgeski, 1979; Moran, 1993; Richardson, 1994). Studies in which several self-report measures and spatial ability measures are intercorrelated appear regularly in the literature, however, the reported evidence has not necessarily resulted in confident conclusions in the confirmation of either convergent or discriminant validity. Richardson (1994) discussed the additional problem of the difficulty in identification of theoretically relevant objective assessment procedures, such as physiological measures or visual memory tests, that consistently provide strong support of the convergent validity of existing imagery measures. Munzert & Hackfort (1999) suggested that imagery ability measures lack the level of specificity required to facilitate strong correlations with associated cognitive tasks. Kaufmann (1981), in his critique of imagery questionnaires, suggested that this assessment approach will regularly generate confusing evidence on the basis that "mental images are an epiphenomena, without any functional significance" (p. 60). In a later article, Kaufmann (1983) did present procedures that imagery researchers should adopt in establishing the validity of their measures. He concluded, however, that validation studies of imagery questionnaires demonstrate little adherence to stringent methodology. Redressing this type of intense negativity toward imagery ability assessment using questionnaire procedures presents researchers with a difficult task.

The design characteristics of the multidimensional, multimodal SIAM reflected an alignment to key elements of Kosslyn's (1983) assessment approach. The method represented an attempt to facilitate knowledge regarding individual differences in imagery ability and its application could assist in resolving on-going validation problems. Kosslyn (1985) proposed the appraisal of imagery ability as a collection of skills that individuals vary in their capacities to perform rather than an overall ability that infers the "person is either "good" or "bad" at imagery (p.169). Achieving consensus on which abilities most accurately represent the imagery construct should assist in the determination of tasks suitable for the examination of convergent and discriminant evidence. The multimodal, multidimensional approach adopted for the evaluation of relationships occurring within the current study constituted an initial effort to address the concern related to the assessment of imagery ability as a single variable.

Additional measure-related psychometric problems are the level of skew and limited range of imagery ability scores. Fundamental to these particular concerns is the conceptual emphasis within the field that the majority of individuals have the capacity to generate an image (e.g., Sheehan et al., 1983; Sheikh, Sheikh, & Moleski, 1994). The methodological quandary of this situation is that self-report imagery tasks in the questionnaires tend to be relatively easy to complete by most participants resulting in skewed scores restricted in their variance (Chara & Hamm, 1989; Kihlstrom et al., 1991; Richardson, 1994). The tasks typically request respondents to image objects and scenes that are familiar to them, which biases responses to the higher end of the rating scale. In terms of the correlational design of the present research, limited variability in participants' test scores constrain the values of the associations between imagery variables (Hiscock, 1978; Kihlstrom et al., 1991). Examination of the low to moderate correlations reported here supports the proposition that this problem influenced the results.

The typical suggestion by imagery assessment researchers to resolve this issue is to include items that tap a broader range of difficulty (Kihlstrom et al., 1991; Richardson, 1994). The highly subjective nature of the imagery process complicates the concept of item difficulty in relation to the development of imagery measures. As there still remains a degree of uncertainty in determining the qualities of an individual's images, prescribing a difficulty level in the creation of items also remains somewhat problematic. A primary goal in the generation of items and scenes for the SIAM was to create a measure that demonstrated an adequate level of discrimination between individuals. Developers of the other measures used in this study would also have attempted to achieve a similar outcome.

The regular acknowledgment of the problems of skew and limited variance in imagery ability assessment by researchers is unfortunately not matched by suggestions to resolve these psychometric concerns (e.g., Hiscock, 1978; Kihlstrom et al., 1991; Sheehan, 1972). The key focal point here is to consider possible modifications appropriate for the on-going development of the SIAM, rather than the direct examination of suggested changes to the GTVIC, SQMI, or VMIQ-II. Streiner and Norman (1995) discussed the ceiling effect of skew on health measurement scales. Their suggestion to counteract this bias represents a possible solution to the problem for imagery ability response scales. Specifically, the average level of an ability does not necessarily need to be represented as the middle value of a scale. Streiner and Norman described a scale in which the lower end represented a typical ability level and the upper rating scale points differentiate among varying degrees of higher abilities. On a 7-point scale this design approach would provide the item with five points above the average rather than three. For example, a further revision of the SIAM vividness subscale could incorporate a 7-point Likert type scale. The scale could include the following ratings: 1- *no image at all*; 2 - *basic image present with basic detail*; 3 - *moderate image with some detail*; 4 - *clear image of recognisable detail*; 5 - *high level of clarity with distinct detail*; 6 - *very clear image with nearly all details apparent*; and 7 - *perfectly clear lifelike image*.

Modifying the scene descriptions of the SIAM is a second approach warranting exploration to increase item difficulty within the measure. Examination of existing research revealed no direct guidance for this type of amendment, but Hale (1994) discussed the importance of using detailed imagery scripts as an applied principle in sport imagery training. Richardson (1994) described the development of scripts based on Lang's (1979a) stimulus and response proposition methodology and inferred that variations in propositional intensity could influence individual differences in imagery ability. Alteration of the image characteristics of the SIAM scene scripts to represent stimulus and response propositions could create a greater challenge to the respondents. The increased propositional requirements for the generation of images related to a particular scene may result in greater measure difficulty and a subsequent improvement in discrimination between imagery ability levels. For example, the introduction of additional visual or auditory characteristics of the image of spectators in the SIAM successful competition scene. The imagery script requirements could also contain possible response propositions (e.g., physiological reaction, affective state) associated with competition anxiety reactions such as increased heart rate or reduced attention.

Greater attention to the instrument-related problems of self-report imagery ability measures is a core aspect in the analysis of the evidence of their reliability and validity. Test constructors should remain vigilant in the examination and review of test content to ensure that the measures remain relevant to their audiences over time (Munzert & Hackfort, 1999). Manipulation of both measure content and overall design plays an important role during the development or modification of instruments, to address the influence of the on-going psychometric concerns, which appear to have remained relatively unresolved in the field of imagery ability assessment.

Experimenter and Administration Related Issues

The second general methodological issue relates to concerns associated with experimenter behaviours and the administration of tests. Specific aspects of the study identified in relation to this issue include selection of measures, experimenter instructions, demand characteristics, and the testing environment. Large sample battery testing of the type conducted in the present study is a logistic necessity in the evaluation of psychological measures but is susceptible to testing-related problems.

I directed considerable effort toward ensuring suitable measures were selected as the convergent and discriminant variables for the present study. The SQMI and GTVIC were selected because of their significant research usage and substantial psychometric evaluation. Irrespective of the problems discussed earlier, few other general imagery ability measures matched their status as assessment instruments within the field. The subtests of the MAB provided psychometrically adequate group-based assessment devices of alternative cognitive processes. Additionally, the selection and use of the MAB spatial ability measure facilitated the comparison of a measure of imagery ability representative of the objective category with measures classified as subjective (Hall, 1998). Overall, my observations during data collection lead to the conclusion that the participants completed the selected measures without any apparent difficulty.

Selection of the VMIQ-II represented a possible weakness in the methodology of the present research. I used the revised version of the VMIQ instead of the original version because of its direct attention to the assessment of the kinaesthetic modality in addition to the visual modality. The revised version of the measure included 18 of the original 24 movements rated in exactly the same manner (visual imagery), with the addition of the rating of the feel of the imagined movement. The revised version appeared adequate in terms of both face and content validity, but unfortunately, no reliability data was available. A possible avenue for methodological criticism concerns the decision to use the measure without psychometric information. Moran (1993) suggested that imagery ability assessment in sport psychology is broadly affected by the use of measures prior to psychometric evaluation and cited the Sport Imagery Questionnaire (Martens, 1982) as an example. I evaluated the internal consistency of the VMIQ-II and found very high Cronbach's alphas for the visual (r = .95) and kinaesthetic (r = .93) subscales. Overall, I acknowledge the lack of reliability information for the VMIQ-II as a measurement selection issue, however, the decision to use this questionnaire, with its additional subscale, improved the opportunities for important construct comparisons (e.g., movement vs. sport: visual vs. kinaesthetic) within the study.

An important procedural issue in imagery ability research is ensuring that participants understand the experimental task requirements (Ahsen, 1990; Hall et al., 1994; Sheehan, 1987). Few of the participants in the current study would have previously completed these types of questionnaires, so the experience of reporting on their imagery may have constituted a novel activity. Richardson (1994) referred regularly to the problems of people misunderstanding instructions, or failing to adhere to instructions during imagery ability assessment. Both the written and verbal instructions provided for the participants in the present study emphasised the importance of clarity and comprehension. All participants were given substantial opportunity to ask questions and complete practice items. The possibility exists that instruction oriented problems, such as the subjective quality of the imagery experience, the inherent ambiguity within imagery response scales, and the difficulty in checking the accuracy of understanding of the procedures employed to control the imagery tasks, affected the findings.

A final point in relation to instructions concerns the issue of subjective and objective assessment of imagery ability. Most detailed discussions of imagery ability assessment in sport psychology (e.g., Hall, 1998; Moran, 1993; Perry & Morris, 1995) refer to measures of both types. In reviewing instructions presented in the current study, participants were asked to use imagery for each of the subjective measures, however, for the measurement of spatial ability the standard instructions were followed, which do not contain any direction to image. My concern involves the possible effect this lack of direction, to incorporate imaginal strategies, had on the subsequent comparison of the tests classified as subjective and objective. McDaniel (1988) suggested that individuals can complete spatial visualisation tasks using nonimaginal strategies. If reviewers of imagery assessment continue to classify spatial ability tests in the context of imagery abilities, then researchers should encourage respondents to complete the measures using imagery, rather than an unspecified cognitive performance technique (Hall, 1998). Monitoring the effects of this procedure on resultant test performances could provide additional useful insights into the differentiation of the two styles of assessment, or lead to the appropriate classification of measures.

The examination of convergent and discriminant validity necessitates the administration of multiple measures of similar constructs and tests capable of generating discriminant evidence. Researchers need to ensure that demand expectations of participants' involvement in the study do not affect the manner in which they complete the measures (Ahsen, 1990). In developing the presentation format for the current research I considered the influence of several possible effects related to demand characteristics.

Firstly, participants completed the testing program over two approximately equal sessions to reduce the chance of experiencing fatigue. Whitley (1996) highlighted the continued need for awareness of this problem in psychological research involving batteries of tests. Secondly, the administration order of tests of similar abilities or context may influence the completion of subsequent measures by participants (Whitley, 1996). The presentation sequence of measurement within each test session of the current study was general imagery, cognitive ability, and sport or movement imagery. The primary goal of this format was to reduce the possibility of a practice effect in relation to imagery skills. A secondary emphasis was to minimise any associated positive or negative motivational influences, resulting from strong or weak performance on the cognitive abilities' tests, on the completion of the subsequent imagery ability measures. Combining tests that incorporate correct or incorrect answers with subjective imagery measures, which involve the interpretation of a cognitive experience, creates the possibility of participants modifying their later responses to compensate for poor performance or to maintain a perceived high standard (Kaufmann, 1981). Finally, the order of test administration and the splitting of testing into two sessions attempted to ensure that tests I had predicted to correlate highly were not juxtaposed, which could have increased the probability of a artificial increase in their association. After reviewing the testing format, I concluded the administration procedures adequately controlled these types of methodological concerns.

Features of the environment constitute a major source of methodological concern in large sample group-based psychological testing (American Psychological Association, 1985; Whitley, 1996). The sampling requirements and consequential testing arrangements of the present research allow for the possibility that restricted control over the environmental settings influenced the results. Testing, for the majority of the participants, took place in lecture theatres and classrooms in the company of their peers. Ideally, imagery activities should take place in comfortable, quiet environments that are free of distractions (e.g., Perry & Morris, 1995; Sheikh et al., 1994; Weinberg & Gould, 1999). Tower (1981) described this aspect of imagery measurement as a situational context, differing in emphasis from the context effect discussed earlier by Whitley (1996). Every effort was made by myself to establish appropriate conditions for the participants, and on most occasions they were effectively facilitated. Nevertheless, in testing groups of up to 30 participants in less than perfect conditions, some individuals may have experienced difficulty in generating their images. The alternatives of individual testing or small group-based assessment in a more controlled setting were not feasible with such a large number of participants.

Participant Related Issues

The final general methodological issue concerns participant characteristics relevant to their involvement in psychological testing situations. Specifically, person-related factors including reactivity to testing, interest in tests or testing, age, and verbal skills may have influenced participants' responses to the administered questionnaires.

Whitley (1996) described two common sources of reactivity: evaluation apprehension and novelty effects. Participants in the present study may have felt a degree of nervousness about the evaluation of their cognitive behaviour. Individuals often experience apprehension as a general consequence of their participation in psychological research. Additionally, I targeted individuals for this study on the basis of their sporting involvement, so some participants may have felt concerned that their performance on these measures could reflect on their status as athletes. Richardson (1994) reinforced the importance of minimising anxiety in testing and stated that: 'imagery ratings should be undertaken when those taking part are relatively relaxed" (p. 16). The issue of novelty effects pertains to two areas. Firstly, few of the participants had previously been involved in research, and thus, the testing activities of the study represented novel experiences. Secondly, the limited use of imagery ability testing in sport psychology, and the unusual procedure of reporting on the characteristics of the imagery experience represent specific aspects of this research that participants could perceive as novel. Ascertaining the impact of these methodological concerns on the findings is difficult. An awareness of their existence is important as a primer to stimulate the implementation of control strategies, such as reinforcing anonymity or pretest discussions of imagery.

The use of convenience collections of participants such as university course undergraduates or elite junior sporting groups, irrespective of the voluntary nature of their involvement, may result in some people completing the measures who are uninterested in psychological testing research (Richardson, 1994). Individuals may also vary in their level of interest concerning specific measures. Athletes may demonstrate an interest preference for the SIAM, because of the perceived meaningfulness of its sport orientation, rather than for the general imagery measures or the cognitive ability measures. From both the perspective of the testing process and that of the subject matter of the tests, level of interest can generate differences "between" and "within" participants in the manner in which they approach completion of the measures (Kaufmann, 1981).

Issues regularly discussed in the research methodology literature concerning self-report measures (e.g., Kaplan & Saccuzzo, 1997; Whitley, 1996) include participant age and verbal abilities. Only seven younger athletes, aged between 12 and 14 years, participated in the present study. All of this subsample were elite junior gymnasts. This age range is typical of individuals competing at the elite level of this sport, so it was appropriate to include them. I examined the original version of the SIAM for verbal comprehensibility on a sample of 15 year-old high school students. I did not implement this procedure for the other measures used in the study. I carefully monitored the gymnastics group (and other younger school-based subsamples) during testing to ensure that I adequately addressed any language-based concerns. This group appeared to complete the measures without any observable difficulty. Generally, the issues of participant age and verbal ability did not appear to substantially influence these findings. Researchers and practitioners must consider these issues in the imagery ability testing of young elite or sub-elite athlete groups, such as gymnasts and divers.

In summary, these findings highlight a number of important methodological issues related to the assessment of imagery abilities in sport. The key problematic areas of methodology revealed in the examination of convergent and discriminant evidence for the SIAM were measure-related, administration-related, and participant-related. Each of the subjective imagery ability measures used requires attention to both content and response format. The revision of existing assessment methodologies will aid in the identification of new imagery-related tasks suitable for use as objective representations of the imagery experience. Researchers and practitioners need to remain procedurally diligent in the administration of imagery ability measures, both as individual tests and as variables within batteries of instruments. Participants' behaviours related to test completion necessitate careful consideration if the results of imagery ability assessments are to be evaluated as accurate descriptors of the imaginal processes. The typical methodological concerns of imagery ability assessment do affect the SIAM and have influenced the present data (e.g., skew, acquiescence). Nevertheless, the thorough design structure of this new measure, relative to other tests of imagery ability, in combination with the present study's attention to procedural rigor, produced valuable evidence toward resolving the measurement related difficulties in the field of imagery research.

Implications for Research

This section presents possible courses of future research arising from the outcomes of the present findings. The two key areas identified are: modifications to the SIAM and the enhancement of the measurement of imagery ability in sport. Additionally, I discuss the contributions that continued use of the SIAM can provide toward furthering the development, or substantiation of models or theories of imagery within sport psychology. The final research approach examined relates to those studies in which imagery ability constitutes a dependent or independent variable associated with imagery training, cognitive skills, physical performance, sporting ability, or specific class of sport.

Measuring Imagery Ability in Sport

Review of the current results, particularly in relation to the methodological concerns outlined earlier, indicated that the SIAM may benefit from additional development. The first of the modification possibilities is the expansion of the scene scripts to include greater propositional detail. Minor enhancement of the current format with additional stimulus and response references could assist in reducing the level of skew of certain subscales. Secondly, a change from the 100- point analogue response scale to Likert-type, with a non-centralised average point, could also aid in generating measure variance. The final modification is the possible addition of items reflecting meaning aspects of the sport imagery experience. For example, '*How strong a meaning did the image generated have for you?*' With the anchors of *no meaning at all* and *very powerful meaning*. Such a change could prove to be supportive of the triple code theory of imagery (Ahsen, 1984). These sorts of variations to the SIAM will necessitate additional reliability and factor structure studies to assess to psychometric qualities of a revised version of the measure.

The present study compared the SIAM with several other well known tests of general and movement imagery ability. As yet, no study has examined the relationship between a sport imagery ability measure and an instrument designed to examine imagery use in sport. Studies pursuing this line of investigation should incorporate the recently developed measure of imagery use, the Sport Imagery Questionnaire (Hall et al., 1998). Future correlational research could involve the use of the SIAM, and an alternative set of self-report imagery ability measures recommended by sport psychologists (e.g., Hall, 1998; Morris, 1997) such as the Sport Imagery Questionnaire (Vealey & Walter, 1993), and Movement Imagery Questionnaire-Revised (Hall & Martin, 1997). The equivocality of the present findings reinforces the need for additional examination of convergent and discriminant evidence pertaining to the characteristics of athletes' imagery experiences. Other measure-oriented investigations could undertake the examination of a subjective imagery ability measure and a test of spatial ability (Moran, 1993), such as the Mental

Rotations Test (Vandenberg & Kuse, 1978), with the incorporation of specific instructions to use imagery. This type of study may prove valuable in resolving the quandary of identifying an accurate objective cognitive indicator of imagery ability. Richardson (1994) suggested other comparative studies should involve the correlation of behavioural (e.g., memory or learning) or physiological (e.g., salivation or skin temperature) measures as potential indicators of imaginal processing with imagery ability test scores.

Testing Theories and Models

The availability of a instrument to examine sport imagery ability assists research designed to test models or theories of imagery functioning. Martin, Moritz, and Hall (1998) recently presented an applied model of imagery use in sport. A key element of this model is the assessment of imagery ability. The authors, although associated with the development of the MIQ and MIQ-R, acknowledged the substantial difference between movement imagery and sport imagery. Their recommendation for future research is the development and validation of new measures that examine imagery ability in the sporting context, such as the SIAM. A second model, for which the use of the SIAM may assist in substantiating, is the triple code model of imagery (Ahsen, 1984). Factor structure analysis of the SIAM subscales could serve to confirm the proposed components of image, somatic, and meaning. Specific theories also require continued investigation to test for support of their conceptualisations of the imagery processes. A theory for which the basic design of the SIAM could provide a strong initial analytical framework, is the bioinformational theory (Lang, 1997). As discussed earlier, the incorporation of propositional statements within modified SIAM scenes provides an expanded set of stimuli, which could facilitate respondent imagery. The modal and dimensional subscale scores would indicate the effectiveness of specific stimulus and response statements in enhancing imagery. Model and theory development are integral areas of sport imagery research (Murphy, 1994) and the accurate assessment of imagery ability could make a substantial contribution.

Future research related to imagery ability assessment represents a significant opportunity for the streams of general and sport psychology to collaborate in the examination of the imagery experience. Similar theoretical and psychometric questions remain unanswered in both fields. Programs aimed at clarifying and enhancing the psychometric properties of imagery ability measures, such as the SIAM, require on-going support from researchers and theorists from each area. The development of a quality test will enable researchers and practitioners to intricately examine the role imagery ability plays in athletic performance.

Implications for Practice

The implications for practice section discusses how the current findings may influence the assessment of imagery ability in the applied setting. Review of the present results in conjunction with an examination of the test content of imagery ability measures used in this study indicate that the SIAM is an appropriate device for use in sport psychology practice. Coaches and practitioners involved in sport imagery training are encouraged to assess the imagery abilities of participating athletes (e.g., Green, 1994; Janssen & Sheikh, 1994). Quantifying the specific image generation and manipulation characteristics allows the training facilitator to: (a) establish initial imagery ability status (Weinberg & Gould, 1999); (b) identify deficits and strengths in skills as a treatment focus (Munzert & Hackfort, 1999; Vealey & Greenleaf, 1998); (c) encourage the acquisition and improvement of imagery skills (Wann, 1997); and (d) monitor changes in imagery ability as an indicator of program efficacy (Morris, 1997).

Discussions of the psychometric quality of imagery ability measures used in sport psychology have not yet provided substantial support for any particular instrument over any other (Hall, 1998; Moran, 1993; Perry & Morris, 1995). The applied literature of the last decade continues to list measures such as the SQMI, GTVIC, VMIQ, SIQ (Martens, 1982), and MIQ within the set of instruments available for the evaluation of imagery abilities (e.g., Cox, 1998; Green, 1995; Janssen & Sheikh, 1994, Morris, 1997; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). Each of these self-report tests and questionnaires has certain design and psychometric merits. Moran (1993), however, is adamant that a lack of validity data is a serious problem. The present findings represent a genuine contribution toward the resolution of this concern, particularly in the applied context.

The SQMI, GTVIC, and VMIQ-II are not recommended as devices for use in developing a sport imagery training program. The general and movement imagery orientations of theses measures do not reflect the type of the imagery these programs are attempting to facilitate. Spatial ability tests, representing the objective assessment approach, also fail to evaluate satisfactorily the cognitive elements linked with sport images (Hall, 1998).

Substantial conceptual alignment exists between the specific design elements of the SIAM and the imagery ability characteristics recommended for examination during the assessment phase of sport imagery training programs (Perry & Morris, 1995; Vealey & Greenleaf, 1998). Perry and Morris (1995) recommended a multi-modal multi-dimensional strategy for determining the qualities of the imagery used by athletes. Vealey and Greenleaf (1998) highlighted the benefits of including the emotion experienced within the evaluation of imagery abilities. The present study has demonstrated that the SIAM is suitable for group administration. Perry and Morris (1995) suggested that important elements of training programs incorporating group imagery sessions are the allowance for a wide variation in abilities and the construction of activities that acknowledge a gradation in skill levels. Finally, the subscale format of the SIAM provides a multi-faceted framework of imagery abilities rather than representation as a single construct (Kosslyn, 1983, 1985). At the applied level, this facilitates discussion of results with athletes, so that they understand their unique abilities and can target specific areas to practice (Vealey & Greenleaf, 1998).

Conclusion

Results of the present study have provided a detailed insight into the conceptual and methodological characteristics of imagery ability assessment in sport psychology. Sport imagery is empirically different from other specific areas of imagery, such as general and movement imagery. The examination of the modal and dimensional relationships did indicate, however, that each imagery type has more in common with other imaginal processes rather than alternative cognitive constructs, such a verbal reasoning or spatial ability. Findings demonstrated that the SIAM would benefit from further development. Modifications to the measure should address psychometric shortcomings and establish a measurement framework from which to explore current theoretical perspectives of imagery functioning. The following study in this thesis, investigating concurrent validity, complements the current research by generating additional evidence to substantiate the construct validity of the SIAM. Even in its current form, the SIAM is an instrument capable of supporting the examination of sport imagery ability in both the research and applied contexts.

CHAPTER 6: EXAMINATION OF THE CONCURRENT VALIDITY OF THE SPORT IMAGERY ABILITY MEASURE (SIAM)

Introduction

The primary aim of this study was to examine the relationship between the SIAM and information derived from the qualitative analysis of the verbal reports of the sport-oriented images of athletes. Qualitative methods are being incorporated more frequently within sport psychology research, because the intricacy and intimacy of the data they generate is often unavailable or hidden when self-report style questionnaires are used (Morrow, Jackson, Disch, & Mood, 2000). Although little use has been made of the qualitative research paradigm within imagery investigations, it represents an enlightening methodology when effectively applied (e.g., Anderson & Borkovec, 1980; Drake, 1996; Kazdin, 1975, 1976; Moran & MacIntyre, 1998; Munroe et al., 2000; White & Hardy, 1998). Cote (1996) suggested that the increasing popularity of qualitative research in sport psychology is inadequately demonstrated in the application of these procedures by "researchers interested in mental imagery and human movement" (p. 74). Cote also suggested that quantitative questionnaire methodologies, rather than qualitative procedures, remained dominant in the investigation of imagery program effectiveness and the assessment of imagery abilities.

The procedure of asking athletes to describe their imagery experiences appeared to constitute an activity that would clearly represent and reveal characteristics of the individual's imagery processes (Anderson, 1981a, 1981b). Katz (1983) indicated that developing tasks that are suitable for the validation of imagery tests is a key conceptual difficulty in imagery ability assessment. Qualitative analysis of participants' reported images seemed to be an appropriate alternative method of gathering more direct data, representative of the dimensional and modal elements of sport-oriented images.

Investigations from general and sport psychology have utilised qualitative methodologies, involving the analysis of both interview and verbal response material that deal with the imaginal processes. Qualitatively-oriented studies from general psychology have typically addressed the assessment of therapeutic approaches involving imagery treatments (Anderson & Borkovec, 1980; Kazdin, 1975). More recently, Drake (1996) content analysed interviews with teachers in relation to the imagery characteristics associated with the guided imagery procedure. The work of Annett (1986, 1988) represents research that crosses the fields of general and sport psychology. Annett analysed the verbal reports of individuals, while they were imagining the performance of simple motor tasks. Previous research that incorporated qualitative techniques to examine imagery behaviours in sport psychology has investigated imagery use (Munroe et al., 2000; White & Hardy, 1998), imagery perspective (Collins, Smith, & Hale, 1998), kinaesthetic imagery processes (Moran & MacIntyre, 1998), and mental factors (including imagery) associated with elite athlete performance (Orlick & Partington, 1988).

Anderson (1981a; 1981b) outlined a qualitative procedure of imagery assessment involving the content analysis of verbal reports that describe imaginal activities. Anderson considered two theoretical perspectives of imagery processing in the development of his analysis technique: firstly, the propositional interpretation of imaginal processing put forward by Pylyshyn (1973) and Lang (1977) and, secondly, Neisser's (1976) conceptualisation of imagery, as it relates to the nature of cognition and perception. The procedure involves categorising of the kind of information contained within imaginal reports and then quantifying the amount of each defined category. Examination of the imagery descriptions provided by the participants in the present research incorporated both these dimensions in the analysis process.

The specific methodology underlying the examination of the imagery information constituted a critical area in the design of the present study. Protocol analysis procedures that incorporate the use of verbal data represent an area of increasing interest in the examination of the cognitive processes in psychological research (Ericsson & Simon, 1993). The theoretical and analytical perspectives proposed by Ericsson and Simon (1980, 1993), regarding verbal 'thinking-aloud' protocols as sources of data, provided a foundation for the qualitative approach undertaken in the present research. Ericsson and Simon (1993) described two forms of verbal reports that appropriately reflect characteristics of cognitive processes such as imagery, which are concurrent verbalisation and retrospective verbalisation. Firstly, concurrent verbalisation (CV) is a procedure involving "talk aloud" or "think aloud" reports where the participants verbalise directly information currently entering attention. The second type, retrospective verbalisation (RV), is a report provided by the participant after a temporal separation from the initial occurrence of the cognitive process. Anderson (1981a) noted that all verbal reports are retrospective to some degree as participants are describing what they were cognitively processing prior to the verbalisation.

Ericsson and Simon (1993) contended that CV is the preferable methodology for examining mental operations because "cognitive processes are not modified by these verbal reports, and that task-directed cognitive processes determine what information is heeded and verbalised" (p.16). They also claimed that the CV procedure is not reliant on short- or long-term memory (as required in RV). The participant is describing information readily available to them and their verbal report of the cognitive process of interest is not affected by additional cognitive functioning. Previous imagery-oriented research incorporating the CV technique has examined covert modelling as therapy (Kazdin, 1975, 1976, 1979), verbal explanation of a serial motor task (Annett, 1988), and imagery processing of speech anxious individuals during exposure to phobic images (Anderson & Borkovec, 1980).

Following consideration of the procedural review of Ericsson and Simon, I selected the CV type of report as the method of generating data for the present study.

Anderson (1981a) described several problems associated with the use of verbal reports of imagery generated through techniques such as concurrent verbalisation. He prefaced the examination of issues affecting the quality of verbal reports, firstly, by proposing that investigations of the imaginal processes should not rely solely on this type of data and, secondly, by presenting a description of what the ideal verbal report of imagery would constitute. Anderson stated that such a report would "provide a perfectly accurate and comprehensive account of the content of imaginal activity. Nothing would be omitted, added, or distorted" (p. 167). The conclusion Anderson drew suggested that such a report is unobtainable and would be impossible to evaluate as perfect, because "the investigator can never know for sure what has been omitted and what may have been added" (p. 167).

Anderson's (1981a) review of the content analysis approach to imagery assessment outlined four key problems in the use of CV as data. Firstly, the CV procedure might cause individuals to consider their imagery content in an extended manner, which in turn may affect their actual imagery processing. Secondly, the interaction of the memory processes may cause participants to add or forget information related to the original imagery task. Thirdly, particular individuals could modify their verbal reports through selective reporting or censoring of the their responses. Finally, investigators need to take account of both the verbal abilities of participants and the "ineffableness" (p. 169) of aspects of imagery, that is, the difficulty in selecting or identifying suitable words that describe characteristics of the imaginal experience. Analysis of the present data required consideration of this set of issues.

The present study endeavoured to establish the criterion-related validity of the SIAM by examining the concurrent validity of the measure. Kaplan and Saccuzzo (1989) stated that: “Studies of concurrent validity assess the simultaneous relationship between the test and the criterion” (p.121). A criterion is a variable that adequately represents the specific attribute of interest to the researcher (Kerlinger, 1986). For the present research, I used the concurrent verbalisation procedure to generate verbal reports of the athletes’ sport-oriented imagery. The criterion represented the evidence gathered from the examination of the concurrent verbalisation transcripts of the imagery tasks undertaken by the participants.

There were two aims of this study. The first aim was to ascertain the association between the modality and dimensional SIAM subscale scores and the corresponding verbal report data, as an indication of the measure's representativeness of the images described by the participants. The second aim was to examine pertinent information regarding the sensory and dimensional characteristics of sport-specific images derived from the analysis of the concurrent verbalisation transcripts.

Method

Participants

I recruited participants from the ranks of the Victorian Water Polo Association. The sample comprised a combination of players from the male and female junior elite squads and members of two premier division Melbourne male and female teams. The Water Polo Association of Victoria approved access to junior participants and provided contact details for elite squad coaches. Both coaches were also engaged in the coaching of the two senior teams involved in the study. I subsequently approached the senior district level players they coached at training sessions about involvement in the study.

During the testing period, 39 participants completed the concurrent verbalisation session, but four players from this group did not complete the questionnaire session. Two of the verbal reports were not included because of poor sound quality in certain sections of the recording. Final composition of the sample was 26 junior players and 7 senior players, with a mean age of 17.91 (SD = 4.58) years and range of 14 to 41 years. Gender distribution of the group was 19 males and 14 females. Individuals reported competing at the state (n = 24) and national levels (n = 9).

Measures

Personal Details Information Sheet. Each participant completed an information sheet that asked for details regarding gender, age, main sporting interests, and highest level of participation (e.g., national, local). The sheet also included a participant code number and the date of the test session.

Revised Sport Imagery Ability Measure (SIAM). As described in the previous chapter, the revised SIAM was the self-report instrument I used to assess sport imagery ability. The revised SIAM is presented in Appendix G.

Water Polo Imagery Concurrent Verbalisation (CV) Activity. I developed this activity specifically for the purposes of the present study. The activity examined the verbatim self-reported imagery of water polo players in response to four specific water polo manoeuvre scenes they had been required to read through. The concurrent verbalisation procedure required participants to 'talk aloud' in as much detail as they could what they were actually imaging, while they processed the task.

I based the specific tasks of the CV activity on manoeuvres described in the Coaching Manual of the Victorian Water Polo Association (Cameron & Coggan, 1994) and consulted with the Victoria University water polo coach regarding there appropriateness. The four manoeuvres selected were shooting, passing, chase and steal, and defensive block. Each manoeuvre scene described specific positional and environmental conditions representative of a game situation.

Three experienced water polo players independently piloted draft versions of the CV imagery task. Each pilot session involved the player reading and responding to the scenes, as if they were in the experimental situation. The pilot participants' then provided feedback on the clarity of instructions, task difficulty, appropriateness of scenes, and suitability of the measure as a device to invoke images specific to water polo. I reviewed the pilot participants' responses and modified the manoeuvre scene descriptors and administration procedures accordingly. Examples of the type of modifications that were made based on the pilot sessions, include: (a) the addition of a warm-up task; (b) increased specificity in the introduction in relation to the imagery characteristics participants could consider; (c) greater detail regarding player movement and location within scenes; and (d) the addition of modality prompts, such as sounds and tactile sensations, within the scene descriptions. Three drafts preceded the final version of the CV activity.

Appendix L contains the final version of the activity, including the instructions and the four scene descriptions. The introduction requested participants to consider the following imagery characteristics (a) the lifelikeness of the imagery, (b) image clarity, (c) control of the image, (d) the senses they experienced during imagery, (e) their emotions or feelings during the imagery. This version included a warm-up CV task in which participants imagined themselves in their favourite room at home. The activity required participants to read through the first manoeuvre scene and then when comfortable attempt to imagine themselves completing that manoeuvre. Participants 'concurrently verbalised' (talked aloud) the images as they were experiencing them. After a break of approximately 20-seconds, the participants read the second task and subsequently undertook the same concurrent verbalisation process. I repeated this sequence until all scenes were imaged and described. I recorded all responses on cassette tape. I transcribed the audiotapes of the concurrent verbalisations audiotape verbatim. Each transcript was then content analysed for material indicative of each subscale of the SIAM independently. Scores for each aspect of imagery were percentages of transcripts that reflected that imagery modality or dimension.

Procedure

Depending on the participant group, I engaged in slightly different procedures to facilitate testing sessions. In the case of the junior players, I contacted the coach responsible for the specific gender squad, informed them of the reasons for the study, procedural requirements, and participants' obligations. I then attended training sessions, spoke to players as a group about the research, and distributed information sheets and consent forms. After additional consultation with both coaches, they facilitated an opportunity for me to approach senior level players from the district teams they coached. In this case, I contacted players individually at the commencement or completion of a training session. Interested players were provided with a research information sheet and consent form. Each consenting participant or parent/guardian (in the case of underage participants) completed the informed consent form explaining the procedures, the use of results, and the participant's right to withdraw at any time. I then compiled a schedule for the testing of players during training sessions and had the coach approve the framework. Junior players completed the Water Polo Imagery Concurrent Verbalisation Activity and SIAM as a component of a training session. Senior players completed the measures at the completion of a training session. Generally, each test activity took approximately 20 minutes to complete.

All participants completed the individual CV imagery activity under the same conditions of testing. I presented the tasks to participants in a quiet poolside room that aided effective one-to-one communication. I reintroduced myself to the players, made them feel as comfortable as possible, and established a basic rapport. I asked non-specific questions relating to the players' water-polo experience, team involvement, or personal interests, as a general framework to open communication. I then asked if they understood what imagery was and if they could imagine themselves in a fantasy sporting situation, such as playing full forward in an AFL grand final or competing at the Olympics. When this interaction was completed, I asked the players to read through an introductory paragraph detailing the concurrent verbalisation procedure and the specific components of imagery they could consider within their responses. This imagery familiarisation step ensured that, irrespective of the players' previous experience in the use of imagery, I would provide them with basic information pertaining to the characteristics considered useful within tasks or measures assessing imagery ability (Perry & Morris, 1995). I then asked the players if they understood the activity and if they had any questions relating to the task. I ensured that the participants understood that I was interested in their imagery of the water polo scenes and not how well they remembered the detail of the scene descriptor. The descriptor was to function as a guide upon which to base their imagery. When they were ready to continue, I asked the players to read through a warm-up scene in which they were required to imagine themselves relaxing at home in their favourite room. When the players had finished reading the descriptor, I asked them to inform me and I responded by saying 'start imaging now' and started the tape recorder simultaneously. The players then 'talked aloud' and described, in as much detail as they could, what they were actually imaging. When the players had finished imaging I stopped the tape. After the warm-up activity, I once again asked if the players if clearly understood the requirements of the task. Once I answered questions, I then presented the water-polo based imaging tasks. I followed the same procedure as for the warm-up activity. Specifically, players commenced the assessed section of the activity by reading through the first water polo manoeuvre scene. They then informed me when they had finished reading and I then asked them to "start describing their image aloud". I once again started the tape recorder simultaneously. I gave players a break of approximately 60 seconds between scene presentations. I repeated this procedure for the three subsequent scenes. After completing the fourth scene, I asked the players if they had any questions, thanked them for participating, and reminded them that at some time in the next few weeks they would be required to complete a different style of imagery measure.

Following the conclusion of the concurrent verbalisation sessions, players completed the self-report imagery questionnaires. The SIAM test session followed the CV imagery activity, so that the detailed dimension and modality language referred to in the questionnaire did not influence or prompt participants' CV responses regarding the imagery characteristics they experienced. Participants completed the SIAM either individually or in small groups of up to five players. Time differences of between two and 24 days separated the CV activity and the SIAM testing, with the average interval being approximately 7 days. The variations in the time between sessions and test group sizes was a result of player availability at training sessions and the coaches' requirements of players at a given training session. Presentation and completion requirements for the revised SIAM were the same as those described in previous procedure sections.

I debriefed and thanked all participants at the end of their final testing session. In the debriefing, I asked participants about the experience of completing the SIAM and its relation to the concurrent verbalisation procedure. I also provided a more detailed explanation of all measures, the specific nature of the research, and the relationship of this research to sport imagery training. I then offered an additional opportunity to ask questions, and provided the details for individual participants to find out at a later date how they performed on the Water Polo Imagery Concurrent Verbalisation Activity and the SIAM.

Treatment of Data and Analyses

The primary goal of the data analysis was the examination of the concurrent validity of the revised SIAM. This involved the comparison of dimension and modality scores with independent indicators of the generation of imagery in a sporting context, as an evaluation of concurrent validity. This evaluation involved the following data treatment, analyses, and statistical procedures:

1. The transcription of tape recordings and the review of written transcripts using content analysis that emphasised keywords and phrases that represent the imagery modalities and dimensions assessed in the SIAM. Transcription resulted in 46-pages of single spaced written material. The maximum size of a participant transcript was 2.5 pages and the minimum was 0.75 of a page.
2. The qualitative analysis conducted followed the basic approaches as outlined by Anderson (1981a) and Miles and Huberman (1994). Firstly, as stated earlier, Anderson's proposed method for the assessment of the characteristics of imaginal activity involved the determination of the amount and kind of descriptive detail the concurrent verbalisations of the water polo imagery tasks contained. Secondly, the procedures of relevance to examining concurrent verbalisations proposed by Miles and Huberman involved the initial reduction of data by the coding of relevant transcript material into selected categories. Words and phrases from the transcript material from two players were analysed and coded in terms of descriptions of the players' physical actions, environmental interactions, and affective states. These player responses were then categorised in terms of image modality or dimension. Table 6.1 displays a selection of the coded data derived from the transcripts. Specifically, with reference to the visual modality, a code of 'player vision' was used to categorise words such as 'see' or 'watch' and phrases such as 'looking around' or 'I can see a goal's been scored'. I assigned this material to the visual modality category. In reference to the kinaesthetic modality, I assigned words or phrases coded as specific or body movements to the kinaesthetic modality category. Table 6.1 shows additional examples. The final display of data involved developing

a matrix in which participants formed the rows and each of the coded modality and dimension variables represented the columns. Cell data reflected the total amount of detail in millimetres of transcript, for each kind of categorised modality- and dimension-related words and phrases, contained within each concurrent verbalisation task.

Following the procedures of data reduction and data coding, the derived matrix was analysed to determine the total amount of modality- and dimension-related words and phrases used by each participant. A percentage of the total transcript (also initially assessed in millimetres) for each participant expressed the amount of CV transcript material related to a particular modality or dimension. For example, a participant total transcript of 3,056 mm, in which 1,723 mm referred to the visual sense, resulted in a score of 56.38 per cent visual sense modality. This score was determined for each modality and dimension categorised within the transcript. I used these scores to highlight the level of involvement of particular modalities and dimensions in sport-related imaging.

3. The computation of inter-rater reliability coefficients associated with the transcript analysis methodology. The CV analysis procedure was discussed and refined by investigators familiar with the procedure in relation to sport imagery and data associated with the continuity of their analyses presented. This procedure involved the categorising of transcript material in relation to modal and dimensional content as described in the previous section. The inter-rater reliability was determined by the comparison of the percentage categorisations of two raters for each imagery characteristic for 10 randomly selected participants. The procedure of categorisation of transcript material was reviewed and the inter-rater reliability of the two raters was determined for a second set of 10 randomly selected participants.

4. The computation of descriptive statistics including means and standard deviations for males and females for each modality or dimension variable of the SIAM represented in the CV transcripts.
5. The comparison of concurrent verbalisation transcript scores for categorised modalities and dimensions with SIAM subscale scores for similar imagery ability characteristics. If the SIAM is measuring imagery ability on the dimensions and modalities assessed, then I the CV scores would reflect the dimensions and modalities corresponding to the similar SIAM imagery ability score. For example, the percentage of visual references in the transcripts should correlate strongly with the visual subscale score of the SIAM, and the auditory reference percentage should correlate highly with the auditory subscale score, and so on. I decided that the strength of these modality and dimension correlations constituted the assessment of the concurrent validity of the SIAM.

Results

This section first describes information and data pertaining to qualitative outcomes and scores. The next section presents comparative statistics associated with the completion of both types of imagery ability assessment technique.

Initially, the results summarise the imagery characteristics identified in the qualitative analysis of the CV transcripts. This section presents details of the inter-rater reliability results in relation to the qualitative analysis procedures. Next, this section presents the descriptive statistics for the athlete imagery ability characteristics identified within the responses from each assessment technique. Finally, the section details data representative of evidence of the concurrent validity of the SIAM, through the presentation of correlations that demonstrate the level of association between the SIAM subscales and CV transcripts for specific imagery characteristics.

CV Transcripts Language Units representing Imagery Characteristics

Table 6.1 presents examples of the words or phrases identified within the CV transcripts and their associated representation as imagery modalities or dimensions.

Table 6.1

Examples of Language Units Representative of Imagery Ability Characteristics

Transcript Material-Meaning Units		Qualitative Categories
Word or Phrase	Action/Behaviour	Imagery Characteristic
Pushing against them	Body movement	kinaesthetic
Jump up and catch	Body movement	kinaesthetic
Splashing everywhere	Environment interaction	tactile
Throw as hard as I can	Body movement	kinaesthetic
See the goalie sitting there	Player vision	visual
Do a bounce shot	Specific movement	kinaesthetic
And you're looking around	Player vision	visual
Get the pass off	Specific movement	kinaesthetic
Swimming down into attack	Body movement	kinaesthetic
Feel the ball	Body process	tactile
Turn around quickly	Body movement	kinaesthetic
Hurts to change direction	Body movement	kinaesthetic
Head in water	Environment interaction	tactile
You can feel it	Body process	tactile
Knock it out	Player action	kinaesthetic
Everyone's jumpy, everyone's fidgety	Affective state	emotion
You're tired	Somatic state/Organic	emotion
I hope that it doesn't come near me	Affective state	emotion
Go for the ball	Player action	kinaesthetic
Stop the ball	Player action	kinaesthetic
I hear the player calling	Player response	auditory
Steal the ball	Specific movement	kinaesthetic

Cote, Salmela, Baria, and Russell (1993) emphasised the importance of creating meaning units from transcript elements that adequately represent the information contained within the qualitative material. Meaning units were defined by Tesch (1990) as a "segment of text that is comprehensible by itself and contains one idea, episode, or piece of information' (p. 116).

Transcript material presented in Table 6.1 was typical of the language used by participants to describe their water polo images. Identifying the action and behavioural elements of the CV material (e.g., body movement, affective/somatic state, environmental interaction, court position) was a coding technique used to assist the transcript analysers in the allocation of words and phrases to the appropriate modality or dimension category.

Analysis of the CV transcript material for the 33 participants resulted in the identification of four modality categories related to the visual, kinaesthetic, tactile, and auditory senses. Language representative of the experience of emotion (affective state) was assigned to a separate category. No text segments within the transcripts represented any of the imagery dimensions or the senses of taste and smell. The extensive nature of the CV material precludes its full inclusion in this thesis. An example of one players concurrent verbalisation responses are presented as Appendix M.

Inter-Rater Reliability

I computed the inter-rater reliability coefficients associated with the transcript analysis methodology for two raters. I conducted a pilot study of the CV analysis procedure that involved two investigators familiar with qualitative research methodology in the area of sport imagery, specifically content analysis and CV transcripts, who each examined three transcripts. Following my discussion of the results of the initial pilot examination with these investigators, consensus was obtained on language elements from the transcripts representative of imagery ability characteristics.

Table 6.2

Inter-Rater Reliabilities for Initial and Final Concurrent Verbalisation Analysis Methodologies

Modality	Method 1 ($N = 10$)	Final Method ($N = 10$)
Visual	0.88	0.97
Kinaesthetic	0.74	0.96
Auditory	0.93	0.96
Tactile	0.92	0.98
Emotion	0.99	0.99

Next, myself and one of the investigators from the pilot study independently examined a set of transcripts for 10 participants and compared the resultant profile of the identified imagery characteristics. Table 6.2 presents the inter-rater reliabilities. Pearson product-moment correlations between the investigators' ratings ranged between, $r = .74$ (kinaesthetic), and, $r = .99$ (emotion). The low value of the inter-rater correlation for the kinaesthetic modality necessitated that the raters extensively discuss and review the CV analysis methodology. The main contention related to language that described an action that could be interpreted as either a visual or kinaesthetic image. For example, the following piece of text was categorised as visual by one rater and kinaesthetic by the other: "I lift my head up, sort of shorten my stroke to prepare to try and fend him off". Following discussion of the interpretative disagreement, the raters decided that text segments of this type better represented the visual sense. The underlying reason for this decision was that, because the consensus interpretation of the preceding text clearly indicated the participant was imaging in the visual sense ("keep my eye on where they are..."), the physical action detailed in the conflicting segment may therefore have been indicative of what was seen rather than what was felt. The raters once again rediscussed and reviewed the transcript analysis methodology, leading to consensus on the necessary changes for the interpretation of the qualitative material.

Each rater then independently examined a second set of transcripts for 10 participants and compared the resultant imagery characteristics' profiles. The final value of the inter-rater reliability Pearson product-moment correlations ranged from, $r = .95$ (kinaesthetic), to, $r = .99$ (emotion). I concluded that this version of the CV analysis methodology was reliable and then analysed the remaining 23 transcripts using this procedure.

Descriptive Statistics for the Concurrent Verbalisation (CV) Data and the Revised SIAM

Table 6.3 presents a summary of the descriptive statistics for percentages of the imagery characteristics represented in the CV material for the total sample, and the male and female subsamples. The sets of percentage scores for the identified imagery characteristics, presented in hierarchical order, were very similar for the three groupings. The visual sense was the highest in each case, followed by the kinaesthetic, auditory, and tactile senses, with the emotion characteristic slightly higher in value than the non-visual senses. Results indicated that the visual sense was the dominant characteristic in the participants' water-polo imagery. Emotional and kinaesthetic imagery percentages indicated that participants consistently incorporated these characteristics within their images. The data revealed only limited representation of the imagery characterising the auditory and tactile senses within the participants' CV of the water-polo imagery tasks. The male subgroup scored higher than the female subgroup for visual imagery percentage. The data demonstrated a reversed pattern for the CV percentages related to kinaesthetic and emotional imagery.

Table 6.3

Means and Standard Deviations for CV Imagery Characteristics Percentages

	Total (N = 33)		Males (n = 19)		Females (n = 14)	
Imagery Characteristic	*M*	*SD*	*M*	*SD*	*M*	*SD*
Visual	62.62	17.47	67.07	18.35	56.58	14.73
Kinaesthetic	15.59	8.05	13.96	7.64	17.80	8.34
Auditory	3.06	2.63	2.47	2.19	3.86	3.03
Tactile	1.83	2.48	1.59	2.85	2.16	1.95
Emotion	16.89	16.46	14.90	16.75	19.60	16.28

Table 6.4 shows the means and standard deviations for the total sample, male subgroup, and female subgroup for the revised Sport Imagery Ability Measure (SIAM) subscales matching the imagery characteristics identified within the CV transcripts. The visual subscale scores were the highest for all three descriptive groupings. The pattern of subscale scores for the water-polo athlete sample was generally similar to that found in the second study described earlier in this thesis. Certain pertinent differences exist in the present sample, however, including the higher values of the visual subscale for the total sample and male subgroup, higher score for the kinaesthetic subscale of the female subgroup, lower score for the kinaesthetic subscale for the male subgroup, and lower scores for the emotion subscale of the total sample and male subgroup. The key difference

between the gender groups, in addition to those described above, is that the female subgroup was higher than males for all subscales other than the visual subscale. The SIAM subscale hierarchical order patterns for the gender groups matches those reported for the CV imagery characteristic percentages.

Table 6.4

Means and Standard Deviations for Revised SIAM Subscale Scores

	Total ($N = 33$)		Males ($n = 19$)		Females ($n = 14$)	
Subscale	*M*	*SD*	*M*	*SD*	*M*	*SD*
Visual	332.64	39.01	343.00	42.18	318.57	30.21
Kinaesthetic	271.03	73.78	245.21	79.75	306.07	47.93
Auditory	255.03	79.64	240.47	86.43	274.79	67.37
Tactile	255.39	76.40	254.37	77.21	256.79	78.17
Emotion	260.30	86.54	244.74	103.53	281.43	52.53

Differences between the scores of the SIAM subscales for the identified imagery characteristics were substantially smaller than those observed between the CV imagery characteristic percentages. Participants indicated higher levels of involvement of the non-visual imagery characteristics within the images generated within the SIAM scenes than within the images generated within the water-polo specific imagery tasks.

Relationship Between CV Imagery Characteristic Percentages and SIAM Subscales

Table 6.5 shows the Pearson product-moment correlations between the CV imagery characteristic percentages and the Revised SIAM subscales for the total sample, male subgroup, and female subgroup.

Table 6.5

Correlation Between CV Imagery Characteristic Percentages and Corresponding Revised SIAM Subscale Scores

Imagery Characteristic	Total ($N = 33$)	Males ($n = 19$)	Females ($n = 14$)
Visual	0.04	-0.16	0.17
Kinaesthetic	0.13	-0.03	0.17
Auditory	0.29	0.11	0.46
Tactile	-0.20	-0.31	-0.01
Emotion	0.19	0.10	0.35

The results indicated very small, non-significant correlations between the associated imagery characteristics for all three participant groupings. The pattern of associations between the measures highlighted higher correlations for the female subgroup for each of the imagery characteristics examined. The correlation values followed no clear pattern indicating minimal similarity in the imagery assessment techniques. Only the emotion and auditory imagery characteristics for the female subgroup approached significance. Several correlations were in the negative direction, an unusual result for measures attempting to assess similar constructs.

Discussion

In the discussion section, issues emerging from the qualitative and quantitative analyses of both verbal and self-report response information associated with sport imagery are considered. The primary purpose of the present study was to evaluate additional evidence toward the construct validity of the SIAM. Concurrent validity data was derived through the comparison of the imagery characteristics analyses of athletes' concurrent verbalisations (CV) of sport-based imagery tasks and their corresponding scores from the related subscales of the SIAM. A secondary purpose concerned the efficacy of the qualitative analyses of verbal reports as a procedure for the identification and description of athletes' imagery abilities in relation to modality and dimensional components. The evaluation of the validity of assessment devices of imagery abilities in relation to sport, has rarely incorporated the use of this type of technique. The first section of the discussion presents general conclusions in relation to the specific measurement methodologies used, highlighting the characteristics of sport imagery ability assessed within each procedure, and the relationships between the identified components. Subsequent sections outline the relationships of the findings to existing theory and research, methodological concerns, implications for future research, and implications for practice.

General Conclusions

The descriptive data derived from the analyses of the CV indicated that the visual sense is the dominant modality in which the athletes described their imagery. The transcripts also revealed the regular involvement of kinaesthetic imagery, but in substantially smaller quantities than visual imagery. The senses of audition and touch represented only small percentages of the content of the CV and the transcripts contained no descriptions of olfactory or gustatory images. The emotional experiences associated with the sport imagery tasks constituted the second highest value for the total sample CV percentages. The amount of emotional imagery was similar to that reported for kinaesthetic imagery, indicating consistent, but not dominant, involvement.

Content analyses revealed that the participants described their imagery purely in terms of modality and affective components. The raters examination of the transcripts did not identify text segments associated with dimensional characteristics, such as vividness, control, ease, speed, and duration. It would appear that the natural tendency in the description of an image is in relation to sensation, rather than generation. The instructions provided to participants before the CV tasks did make reference to dimensional attributes that could be incorporated within their imagery descriptions, but this did not appear to influence their responses. This finding suggests that the language elements associated with the modal characteristics of sport imagery are more immediately available or contextually preferable than words representative of the dimensional components. Simply, respondents describe what they see or feel, not how vivid it is or how easily it is generated.

Several interesting similarities and differences arose between the pattern of scores for the sensory and the emotional components represented within the CV data, and the corresponding SIAM subscales. Participants reported the visual sense was the preferred modality used to represent imagery in relation to sport-oriented situations in both the measures. The kinaesthetic modality represented the second highest value within the identified senses for both assessment techniques. The auditory and tactile modalities were lower in value than both the visual and kinaesthetic senses within the SIAM subscale scores, indicating less involvement, but the difference were not as marked as those reported between the identified senses within the CV task. Emotional imagery scores for both the SIAM and the CV task were indicative of relative importance within the participants' imagery. Scores within both techniques were substantially lower than for visual imagery but of similar value to kinaesthetic imagery scores. This set of results represents evidence confirming the dominance of the visual sense and the emphasis of both kinaesthetic imagery and emotional imagery within sport-oriented images irrespective of the format of the assessment methodology. Other senses, however, constitute lower involvement within athletes' imagery. The method of assessment does seem to affect the level at which respondents report their involvement of the other senses, with the rating scale approach prompting responses in the moderate range (e.g., audition and tactile), whereas the CV technique generated scores representative of only minimal involvement.

A primary task of the present study was to examine the relationship between the identified CV imagery characteristics and the SIAM scores. The results revealed no significant correlations between the CV percentages and the corresponding SIAM subscales. Correlations for the total sample comparisons were positive, but smaller than $r = .30$, except for the tactile sense, which was small and in the negative direction. The low value and directional variation of the correlations suggested that rating scales (SIAM) and the CV tasks require different imagery skills, and possibly cognitive skills to complete, and thus, result in different levels of imagery modality representation. The negligible value of the correlation for visual modality is surprising as the descriptive results clearly highlighted the dominance of this sense in the generation of images within both assessment techniques. The pattern of correlations observed for the other identified characteristics was also inconsistent in relation to the levels of involvement reported within the descriptive statistics.

These correlational findings provided support for the possibility that participant responses reflect the influence of the measurement technique rather than an accurate indication of similarity between imagery abilities as determined within each of the assessment methodologies. I based this suggestion firstly, on anecdotal commentary from the participants that they found the CV activity, a specialised and slightly intrusive investigation of imagery skills, more difficult to complete than the SIAM. It appeared that participants needed to concentrate on the description of the task as much as the actual generation of imagery. This may limit the depth of the reports to the primary characteristics of the imagery, the senses, and not create the cognitive processing space to detail less familiar image components, such as vividness or control. Secondly, completing of the CV activity before the SIAM, particularly with participants that had very limited or no prior formal experience in the area of sport imagery, may have impacted on scores for both measures. Irrespective of efforts to explain the CV task requirements, participants may have used part or all of the activity to establish a level of familiarity with the nature of imagery processing and procedure of verbal reporting. In contrast, the SIAM is more direct and specific in its design, as to how it presents the imagery task requirements and facilitates the reporting of responses. Overall, it appears that novel task requirements and complex cognitive processing associated with the verbal reporting of imagery, limited CV task imagery responses, whereas, possible reduced demand characteristics associated the subsequent completion of the SIAM could have resulted in more confident image generation and assessment.

Findings related to both the descriptive and correlational data indicated several differences concerning gender and imagery processing. It should be noted that the examination of gender differences in relation to sport imagery ability was not a key goal of this thesis. Nevertheless, in working toward the formulation of reasons for the limited association found between the assessment methodologies, I considered gender as a possible intervening variable. The descriptive data for both the CV activity and the SIAM subscale scores indicate a pattern where the scores for the males were higher for the visual sense and for the females they were higher for all the non-visual characteristics identified and rated. In addition, the correlational data highlight a stronger association between the measurement techniques for the females than the males. These findings could be due to differences in gender-based cognitive factors associated with the description and evaluation of imagery as much as variation in imagery abilities. Differences in the reporting of non-visual characteristics in the CV activity suggest that the females may have displayed greater verbal skills to describe the lesser utilised modalities and their emotional imagery.

Variations in the rating scale pattern could have resulted from the females being confident in the generation of their images and subsequently capable of creating the non-visual characteristics within their imagery.

Overall, the results indicated that only a limited relationship exists between the two methods of examining the sport-oriented imagery characteristics of athletes. It seems that the CV activity generates information regarding the content of imagery rather than data pertaining to modal or dimensional abilities. The examination of abilities represents the primary design function of the SIAM, thus, the small correlations between the measures are possibly a result of this difference in reporting imagery behaviour observed in the verbal and self-report responses. The CV technique did not facilitate the description of ability characteristics such as vividness or control, but did generate information regarding the sensorial content of sport imagery. In comparing the pattern of modal representation within both the CV and SIAM data the results indicated the dominance of the visual and kinaesthetic senses within sport imagery.

Relationships to Research and Theory

This section of the discussion presents an analysis of the findings in relation to existing research and theory. The results are examined in terms of the content of sport-oriented images and their association with imagery ability, the relationship between qualitative and quantitative imagery methodologies as evidence contributing toward the validation of the SIAM, and a review of pertinent models, conceptualisations, and theories that support the current data set.

The verbal report examination system described by Anderson (1981a, 1981b) represented the underlying basis of the content analysis methodology used in this study. Anderson designed the system to examine the amount and kinds of information an individual might report when describing their imagery. Material contained within the current CV transcripts of this group of athletes allowed for analysis using this procedure, with the resultant data representative of the type of sport-oriented imagery content suggested within the sport psychology literature (e.g., Perry & Morris, 1995; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999).

Anderson and Borkovec (1980) incorporated a verbal protocol methodology, similar to the present study's CV approach, in which participants described aloud their imagery of anxiety-arousing scenes. The pertinent content issue, related to the Anderson and Borkovec study, was in the area of category development. Initially, they created a large number of categories (24 categories) to code the imagery responses. Anderson and Borkovec concluded following a procedural review that this number inhibited the capacity to facilitate the types of comparisons outlined within the research. They subsequently reduced the number of categories to 10. In relation to the content of the present data, the relevant remaining categories included visual processing (e.g., objects, properties of people), sense organ adjustment, bodily states, and emotion. Unfortunately, although the research specified amount as an analysis criterion, Anderson and Borkovec presented no specific quantity details in relation to this variable. The main points warranting discussion here are, firstly, that the subscale format of the SIAM provided a basic framework facilitating categorical comparison of the CV material in a manner observed in similar research (e.g., Moran & MacIntyre, 1998: Munroe et al., 2000). Secondly, the adoption of existing content analysis and verbal protocol methodologies in the present study successfully enabled the examination of data that depicted both the amount and kind of imagery information contained in the CV transcripts.

Evidence derived from the content analysis data has provided additional information leading to an enhanced understanding of the nature of sensory involvement within mental imagery. Existing qualitative research from both general and sport psychology has generated similar findings in relation to the modal elements reported by individuals in describing their images (e.g., Annett, 1988; Drake, 1996; Moran & MacIntyre, 1998; Munroe et al., 2000; White & Hardy, 1998). Drake (1996) analysed interview material related to the use of guided imagery by teachers. The six participants reported that their imagery was mainly visual, with only minimal discussion of the senses of smell, sound, touch, and taste. Drake made no reference at all, in this detailed non-sport study, to the use of kinaesthetic imagery by the participants. Annett (1988), in discussing the results of the analysis of participants CV of a motor imagery task, concluded that their imagery was 'predominantly visual' (p. 261), however, a minority of the group did experience tactile and kinaesthetic imagery. These types of findings support the argument that within any type of verbal report of imagery, what emerges depends very much on the context of the behaviours examined. For example, a musician imaging playing an instrument is more likely to report auditory imagery, and to a lesser extent visual imagery, rather than kinaesthetic or olfactory imagery.

Recent qualitative research examining a range of characteristics of the imagery processes of athletes provides important evidence regarding sensory involvement (Moran & MacIntyre, 1998; Munroe et al., 2000; White & Hardy, 1998). White and Hardy (1998) examined imagery use and did not directly generate data regarding content by sense modality. A review of the article highlighted references within the athletes' commentary, describing visual, kinaesthetic, and aural imagery. Munroe et al. (2000) also investigated the imagery use of 14 elite athletes. The first outcome of this study of relevance to the present findings relates to the analysis of the participants' descriptions of imagery content derived from interview material. Munroe et al. reported that the identified frequencies of kinaesthetic and visual imagery use were comparable, and both these proportions were substantially greater than the reported amounts of auditory and olfactory imagery use.

Finally, Moran and MacIntyre (1998) presented data derived from interviews with 12 elite level canoe-slalomists that quantified the modal imagery citations of the sample. The findings indicated that 100% of the group referred to the visual sense, 75% to the kinaesthetic sense, 67% to the auditory sense, 16% to the tactile sense, and 8% to the olfactory sense. Overall, the findings of these studies complement the results of the current research. The smaller representation of the kinaesthetic sense within the CV transcripts constitutes the only area of discrepancy. This may be due in part to the different sporting backgrounds of the athletes involved within each of the studies (e.g., water-polo versus canoe-slalomists) and subsequent variation in the emphasis on the kinaesthetic sense within performance of the skill. The level of reported involvement of the minor senses in sport imagery could also represent a variable that will fluctuate between different samples of athletes. Overall, the current results, and the findings of previous research, indicate that athletes typically incorporate the visual and kinaesthetic senses, with a lesser involvement of other senses such as audition, olfaction, gustation, and touch (Hall, 2001; Moran & MacIntyre, 1998; Munroe et al., 2000).

Details pertaining to the dimensional characteristics of sport imagery were not interpretable from the CV transcripts. Previous qualitative research has also inconsistently identified components, such as vividness or control, from the analysis of verbal reports of imagery behaviours (Anderson & Borkovec, 1980; Munroe et al., 2000; White & Hardy, 1998). The derived information related to dimensional processing typically constituted only minor elements of the transcript material or the analysis involved speculative interpretation, rather than a verifiable investigative methodology. Anderson (1981a) described coding guidelines that purposefully ignored the dimensional elements. Anderson stated that "Evaluative statements about the quality of the imagery experience as a whole are not coded because they are not part of the content" (p. 176). Drake (1996) identified and categorised interview statements into meaning units that referred to dimensional elements examining concreteness/detail, realism/vividness, and degree of control. The results of Drake's analysis did not indicate the quantity of these dimensional characteristics within the transcripts.

Review of the interview material related to athletes' imagery, contained within the studies of Orlick and Partington (1988) and White and Hardy (1998), indicated only basic references to dimensional characteristics, such as clarity and control. Munroe et al. (2000) found that only one athlete reported an imagery content reference related to control and that references to imagery vividness occurred rarely and were limited to three athletes out of a group of 14 participants. Hall (2001) provided pertinent commentary related to the Munroe et al. study that highlights the limited emphasis on dimensional components by stating that "athletes commented very little on the controllability of their images, suggesting that this was not a major concern" (p. 537), in relation to what athletes image.

Contrasting the interview-based approach of the preceding qualitative studies with the CV technique incorporated within the present research indicated that the former provided more opportunity for the description of dimensional characteristics within responses. The examination and evaluation of image quality appear to require greater involvement by the researcher through the use of direct questioning, specific instructions, or an overall dimensional evaluation of a complete imagery response, rather than segment analysis. Verbal reports of sport imagery produced though the CV procedure appear to focus on what is occurring within the image rather than the qualities of the images generated. The interview methodology allows an increased opportunity for the interviewee to reflect on characteristics not occurring during actual imagery, especially if such commentary is encouraged within the instructions, questions, probes, or follow-up queries by the researcher.

Emotion is a content component assessed within the current qualitative analysis that has previously been identified as a key characteristic in similar imagery research (Anderson & Borkovec, 1980; Drake, 1996; Munroe et al. 2000). Anderson and Borkovec (1980) were adamant after reviewing their classification procedure that the emotion category be retained, because it constituted a critical, regularly occurring variable. Drake (1996) described a feeling component that upon initial review suggested the representation of emotion. She also reported that this imagery component was important to all participants. Drake then defined this characteristic as an "inner knowing" (p. 34) where the accompanying emotions were peace, satisfaction, and serenity. She contrasted this interpretation with the conclusion that the retrospective nature of the imagery interview activity limited the range of emotions the participants experienced or could articulate. Emotion did not warrant an independent content category within the imagery use study described by Munroe et al. (2000). Closer examination revealed that characteristics, associated with the Motivational General-Arousal (MG-A) and Mastery (MG-M) elements of the Paivio (1985) and Martin et al. (1998) model of imagery use, appear to represent emotional imagery. Participants regularly reported imagery associated with excitement, anxiety control, confidence, and positive feelings. Review of script material presented by Munroe et al. (2000) identified text segments, such as "being excited" and "wasting emotional energy", similar terminology to that categorised as emotional imagery in the current study. The conclusion I have drawn here is that athletes will incorporate emotions within their images and that the involvement of emotions warrants investigation within any method of imagery ability assessment.

The fundamental reason for the qualitative analysis of the imagery of this athlete group was to generate criterion evidence to examine the concurrent validity of the SIAM. Unfortunately, limited previous imagery research, in either general or sport psychology, was available that compared qualitative data with self-report scores. Anderson and Borkovec (1980) reported a significant correlation of, $r = .30$, between the amount of response detail contained within verbal reports of imagery and subjective fear ratings. They found no significant correlations between response detail and subjective ratings of imagery vividness and detail. Moran and MacIntyre (1998) used converging methods to support the modal distribution of sport-oriented imagery. Participants rated the use and importance of the senses incorporated within their earlier descriptions of their imagery. Both sets of results corroborated the qualitative pattern in which the kinaesthetic and visual senses were dominant and subsequently rated the highest of the identified modalities with respect to both ease of involvement and importance of involvement. Participants rated touch, taste, smell, and audition as much harder to sense and not important in the context of canoe-slaloming. The impact of this set of findings on the current correlational data is equivocal. Ideally, correlations of moderate value between the CV data and the SIAM subscale scores would represent valuable evidence of the construct validity of the latter measure. The minimal levels of association observed, and the lack of strong correlational data generated within prior research, confirms that alternative imagery assessment methods tap a variety of generational and ability attributes. It appears that the CV technique represents a measure of imagery content rather than a measure of imagery ability, which may have contributed to the low levels of observed association with the SIAM. Both techniques do generate useful information regarding sport imagery and a program of refinement rather than reconstruction of both techniques would appear warranted. The field of imagery assessment, however, will benefit substantially from the information generated in the current comparison of these distinctive imagery measures.

Analysis of the results highlighted gender differences within the descriptive results for both the CV task and the SIAM subscale scores and in the correlation data relating the

CV data and the SIAM scores. Many reviews of imagery research indicate that overall males and females vary only minimally in their imaging abilities (e.g., Hall, 2001; A. Richardson, 1994; J. Richardson, 1999). The present findings indicated a pattern in which males both described (CV) and rated their visual imagery (SIAM) higher than females, and the female sample described and rated their non-visual sensory and emotional imagery as higher than those of the males. The differences in the visual sense may reflect the preference of males for generating images with a higher level of involvement of the modality in which they feel most familiar. In contrast, the females might have the type of language skills that portray greater evocation and arousal of kinaesthetic and emotional responses (Paivio & Harshman, 1983). Females might also feel confident that their images warrant higher rating scores on the matching SIAM subscales. Ashton and White (1980) proposed that females apply lenient decision criteria in rating their imagery experiences. This type of proposal represents a possible basis for the higher SIAM scores in the non-visual characteristics. The gender differences obtained indicate an area of possible on-going investigation. John Richardson (1999) has argued, however, that gender effects have often arisen within imagery research as a result of using small or unrepresentative samples of male and female participants. The small sample size used in the present study represents a possible cause of the observed gender differences.

Several of the existing models and theories associated with the conceptualisation of sport imagery can function as explanations for the present findings. The results also support several of the existing theories and models of imagery. Firstly, the Martin et al. (1999) model of mental imagery use in sport includes a component acknowledging the influence of the athlete's imagery ability. This component of their model has only referred to visual and kinaesthetic imagery as ability indicators. Data generated within the current study recognises the dominance of these two senses. It would seem, however, because I identified additional sensory references in the current results (e.g., auditory, tactile), and that Martin et al. accept that additional imagery characteristics warrant assessment, that the model could be expanded to recognise involvement of the other senses and emotions as additional indicators of imagery ability.

Secondly, the descriptive qualities of the imagery responses derived through the CV procedure complement elements of Lang's (1977, 1979) bioinformational theory. The development of imagery scripts for both qualitative and rating scale measures of imagery ability requires additional attention to the incorporation of stimulus and response proposition characteristics. The imagery instructions and scenes used in the CV and SIAM scripts appeared to play an important role in arousing the recorded responses. Investigation of the bioinformational theory could be enhanced through a direct focus on stimulus and response properties within both script creation and the analysis of verbal reports.

Finally, the present findings are interpretable within the context of the triple code or ISM model of imagery (Ahsen, 1984). The transcript and rating scale evidence of the generation of images by all participants confirms the image (I) element of the model. Sensory and emotion text segments and their corresponding SIAM subscale scores indicate that the images could have had an associated psychophysiological response (e.g., fatigue, elation), described as the somatic element of the model (S). The third element of the model is the meaning (M) of the image, and a speculative interpretation could imply that both the moderate degree of involvement of emotional imagery and the variation in emotional contexts within the transcript material constitute a unique level of image meaning for these participants. Overall, certain findings representative of sport imagery ability generated in this study are tentatively interpretable in the context of each of the imagery use, bioinformational, and ISM conceptualisations.

Methodological Issues

During the current study, a number of methodological issues have become apparent that could possibly have affected the findings. The specific issues considered relate to the verbal protocol process, participant characteristics, and procedural or measurement-related concerns.

Based on the amount of transcript material, it appeared that the CV activity did serve as a suitable method of generating verbal imagery reports for most participants. Lang (1979a) suggested that the strongest response data is usually derived from participants with good verbal abilities. Those athletes that experienced difficulty with the current CV task may have lacked particular skills that enable the verbal reporting of their imagery. Anderson (1981a) indicated that the completeness of verbal reports is affected by problems in finding s words to describe both imaginal processing (e.g., control or vividness) and certain affective or sensorial aspects of an imaginal activity. A possible methodological flaw of the current study was the lack of control for participants' general verbal skills or their capacities to accurately label the image characteristics that best describe sport imagery. Additionally, Anderson suggested that the effectiveness of verbal protocol procedures based on word count analyses may diminish simply because "some people talk more than others" (p. 170). This problem was countered by representing each imagery category as a percentage of the total words in their transcript.

The second area of concern in relation to the CV activity relates to the novel nature of the task for the majority of participants. Ericsson and Oliver (1987) commented that it is often difficult to ascertain the impact of the non-imaginal cognitive processing actions (e.g., memory recall) on imagery verbalisation. The participants had to think about how they were completing the task in addition to creating a requested image. Task difficulty for this sample could have increased, due to their inexperience with the verbal reporting protocol and their perception of the formality and frivolousness of the image evocation process. An alternative sample may have been more comfortable with the task of describing such a personal event and capable of appropriately detailing their imagery experience.

The two key methodological issues in relation to the participants are age and sporting background. Firstly, due to sample availability the participant group included mainly senior high school students. As discussed previously, involving this older adolescent sample may have exacerbated problems with the imagery tasks at the verbal skills level. In general, younger participants may experience difficulty in understanding task instructions, be reluctant to confide in the experimenter of their problems, or be uninterested in pursuing the task with the precision and positiveness that enhance quality data collection. Secondly, the athletes were representative of only one sport and typically performing at similar elite competition levels. Moran and MacIntyre (1998) also acknowledged this type of concern within their qualitative sport imagery study involving canoe-slalomists, suggesting that research of this type could be improved by including athletes from other sports. The use of data derived only from water polo players in the present study could have lead to a restricted range of responses recorded and subsequently affected both the descriptive and correlational data. Following reconsideration of the CV data collection procedure, I believe that several of the participants did find the task difficult and appeared to rush their responses and limit the detail they included in their verbal reports. In addition, because of the restriction to a single sport many of the younger athletes did know each other and may have discussed the novel nature of the procedure, or felt uncomfortable when their turn to undertake the imagery task was acknowledged by their peers.

Procedural and measure-related methodological issues represent the final area requiring discussion. The main procedural issue centres on the small sample size used to generate the data. Although samples of 30 participants or less are common in qualitative research (e.g., Drake, 1996; Moran & MacIntyre, 1998), because the emphasis of the study was in measure comparison, a larger sample size may have lead to less psychometric restriction of the findings. Secondly, the relative timing of the assessment activities could have resulted in the restriction of responses (Anderson, 1981a). Presenting the novel and more involved CV activity before the SIAM may have placed task-related pressure on the respondents and thus, caused them to under perform. The reason for presenting the SIAM after the CV was to avoid any possible confounding effect from participants familiarising themselves with imagery processes through the completion of the highly detailed self-report questionnaire. This approach may also have affected the SIAM scores through a possible confidence effect. I believe that participants may have lacked confidence in their ability to complete the CV task particularly with their limited experience with both the verbal reporting procedure and the detailing of specific aspects of their sport images (as outlined in the participant information sheet). Comments by the athletes' that they felt the questionnaire format was easier to complete than the CV task support the possibility of a confidence effect. The minor gain in understanding of the technique of imagery assessment acquired through completion of the CV task may have lead to increased confidence in reporting their imagery abilities in the less intrusive response format of the SIAM.

Measure specific concerns became evident during the research. The differences in design and response demands of the two assessment techniques (CV task and SIAM) may have contributed to the limited level of association observed between the imagery variables. In reviewing the approaches, it appears that the CV technique does not measure imagery ability but represents a report of the modal content of sport imagery. Modification of CV approach is required to ensure that participants' reports reflect imagery ability skills, and to limit the effect of the contrasting cognitive operations (e.g., self-report vs. concurrent verbalisation). The modified CV measure should incorporate similar imagery scenes to the SIAM and include participant instructions that provide guidance in relation to verbally reporting imagery ability characteristics. These changes may lead to improvements in the CV technique so that it represents a suitable measure for use in the evaluation of the criterion validity of the SIAM. It was also psychometrically hazardous to compare a reliable measure (SIAM) with a measure of unknown reliability (CV activity). I assumed that the use of an innovative direct assessment method would generate useful data for use to test the criterion validity of the SIAM. Irrespective of the limited level of association between the measures, reinforcing that in the measurement of mental imagery many unknowns still exist, it remains vital to continue to gather imagery information directly from the imager. John Richardson (1985) emphasised this point of view and stated that "from a logical point of view subjects' reports do not represent an indirect or inferential source of knowledge but constitute the best possible evidence for the occurrence of mental imagery" (p. 109).

The final measure concern relates to the content analysis system. As an outcome of the examination of the substantial number of themes and categories formulated in other studies of imagery using verbatim reports (e.g., Anderson, 1981a; Munroe et al., 2000), I considered that different options for summarising the data may have enhanced the findings. For example, the inclusion of an experimenter-defined rating of control and vividness would have provided additional comparison data. Text segments representing visual images could have been categorised on the basis of vividness in addition to modality. Text segments indicating between modality switching may have also been evaluated in relation to control of imagery. The options for modification of the content analysis system are numerous. In retrospect, however, the selected method was possibly too basic but did function in a predictable and accurate manner in relation to modal content.

Implications for Research

In this section, I discuss the implications for future research emerging from the present findings. General themes for possible areas of investigation are measurement techniques, participant preparedness, and theory development.

As an outcome of this study, support has arisen for the continued emphasis on imagery script quality at the instructional and content levels (Munzert & Hackfort, 1999; Murphy, 1990; Suinn, 1997, Weinberg & Gould, 1999). Imagery scripts serve as both mediation and provocation instruments in the creation of sport images. Substantial research attention is necessary in determining the effects of varying instructions and aspects of content, such as propositions or context, on the observed levels of imagery response. Variability in response characteristics could reflect not only differences in imagery ability, but also the quality of the stimulus material. The limited level of association between the CV task and the SIAM highlights the important role of scripts and instructions in facilitating expected style of response. The scripts and instructions developed for the CV procedure generated responses that revealed information regarding imagery content rather than the specific characteristics of imagery ability. This finding demonstrates that studies directed toward the evaluation of scripts and instructions in relation to response characteristics represent an important area of future research.

The specific assessment techniques, the content analysis of CV material and the SIAM, both warrant continued development through appropriate research. No instrument or procedure is currently available that is both fully effective and comprehensive in its analysis of imagery ability in sport (Martin et al., 1999). The SIAM is at a more advanced stage in its validation schedule, and constitutes a more practical approach with large samples, than the CV procedure. The findings and conclusions drawn in this study, however, do highlight that refinement and additional psychometric evaluations of the SIAM are required. Additionally, the content analysis approach generated direct evidence that the participants were imaging the presented script accurately in terms of content. Murphy (1990) has stressed the importance of manipulation checks that determine whether athletes are correctly completing imagery tasks. The CV procedure could serve as an evaluation of the accuracy of the imagery athletes are asked to generate, as either a component of research activities or in applied imagery training. Review and analysis of the CV technique, using a similar study design with a larger sample to establish its psychometric attributes, thus, is warranted.

Substantial support exists for the on-going combination of qualitative and quantitative methods in the investigation of imagery ability (Anderson, 1981a; Moran & MacIntyre, 1998; Munzert & Hackfort, 1999). This research was unique in its approach, but I hope that it serves as a stimulus for other studies that can benefit from the conceptual and procedural information generated from the findings. Cote (1996) recommended qualitative methodology for sport imagery research, because of the intricate detail it can produce to assist in understanding a complex concept. Drake (1996) concluded that various combinations of quantitative and qualitative data require contemplation "to get as full a picture of imagery as possible" (p. 158).

Future researchers must be conscious of certain participant characteristics. The composition of new samples should include athletes of a variety of ages (not too young) that represent a broad range of sporting backgrounds. Although imagination is used across the athletic spectrum, in the context of viable imagery ability research, the compatibility of assessment technique and participant background must be ensured. Additionally, there is support for the introduction of imagery skills pre-training for participants in relation to imagery ability assessment (Anderson, 1981; Lang, 1979; Munzert & Hackfort, 1999). Researchers could undertake specific studies that determine the effect of additional imagery knowledge on subsequent SIAM scores relative to no-training controls.

The SIAM and CV procedure can continue to serve as agents in the generation of data toward model and theory development. Firstly, the construct of imagery use represents the most actively researched field in relation to sport imagery. The Martin et al. (1999) model will remain an important focus in the development of the SIAM, with the resultant data serving to support and expand the imagery ability component. Additionally, the Munroe et al. (2000) qualitative framework of imagery use allows for future information derived from both the SIAM and CV procedures to support the 'what' and 'why' functions. Both these measures provide direct evidence of the content of athletes' imagery. The triple code model (Ahsen, 1984) also represents an important direction for research involving the SIAM. Refinement of scripts in the manner purported in the bioinformational theory (Lang, 1975, 1979) could serve to facilitate responses that allow for model testing via confirmatory factor analysis. Several items pertaining to the meaning element of imagery may require construction within the rating scale format of the SIAM, to more accurately operationalise an evaluation of the ISM model.

Implications for Practice

The current findings provide valuable information regarding sport imagery that can assist in sport psychology practice, particularly in relation to imagery training and evaluation. Practitioners can feel confident that the SIAM represents an assessment technique that genuinely ascertains diverse information pertaining to athletes' imagery ability skills. The SIAM is a reliable measure that athletes appear to experience minimal difficulty in completing. It also has an expanding assemblage of validity evidence. The CV procedure represents a more intricate approach, suitable for individual counselling, that can produce detailed and personalised reflections of the imagery experience. Both methods can serve as acceptable diagnostic devices, before commencing imagery training and later in determining the effectiveness of programs.

White and Hardy (1998) made several suggestions for sport psychology consultation relevant to the current study. Firstly, practitioners need an awareness and understanding of the athlete's imagery experience. The consultant can achieve this through the analysis of athletes' imagery accounts of the involvement of sensory and dimensional components and the examination of detail related to the sporting situation and background experience. Secondly, the attainment of a detailed report of the imagery experience can assist the psychologist in providing advice and support in relation to creative and individualised applied uses of imagery. Munroe et al. (2000) also supported this imagery content focus in the provision of sport psychology services. They suggested that the information derived from the analysis of imagery data might serve "as an educational tool to teach athletes the richness of their imagery content" (p. 134). Practitioners can also use assessment information derived from the SIAM as a check that athletes are involving the key components of imagery within their training.

Conclusion

The final study of this thesis, in which I compared scores from the SIAM with an independent indicator of participants' imagery generation, resulted in weak evidence in support of the concurrent validity of the measure. This finding does not simply suggest that the SIAM is not a valid measure of sport imagery ability, but more that the complexity of the imagery construct represents a substantial challenge to those researchers wishing to quantify its associated attributes (Drake, 1996). Earlier studies in this thesis clearly demonstrated the reliability of the SIAM, and generally supported the validity of the measure. Richardson (1988a), in discussing the assessment of imagery abilities, stressed that the "practical difficulties of getting a reliable and valid estimate are great indeed" (p. 104). The primary difficulty in the present study was the development of a procedure with which to validate the SIAM. Katz (1983) has previously highlighted that the matching of an imagery test to a validating task represents a substantial problem. He suggested the concern centres upon the assumption that the individual's imagery will remain the same irrespective of the "image-evoking context" (p. 43). As discussed earlier the CV task did not constitute a good match in the validation of the SIAM. This procedure generated information regarding imagery content, or what is being imagined, whereas, the SIAM evaluates ability, or how effective the imagery is on a number of relevant criteria. The assumption that participants would include effectiveness information in their verbal reports (even with guidance included in the task instructions) was incorrect, and highlights the difficulty of selecting or developing similar tasks with which to evaluate imagery measures. It would also appear that a degree of interference occurred with the imagery associated with the CV activity, primarily generated from the non-imagery cognitive processing associated with understanding the task itself. Both these factors may have affected the quality and type of imagery represented in the CV transcripts, and lead to the limited level of association observed between the two measures.

In constructing and evaluating the SIAM, I have attempted to follow an accepted and standardised set of psychometric procedures to substantiate the reliability and validity of the measure. The equivocality of the current results serves to reinforce the on-going need for balanced refinements and revisions to the SIAM, that are detailed in the final chapter. Additionally, the qualitative data reinforced existing representations of the modal characteristics of sport-oriented imagery (e.g., Perry & Morris, 1995; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). The SIAM examines all the senses represented in the CV transcripts, so it seems appropriate that I suggest that the qualitative data supports the continued inclusion of the modal characteristics currently examined within the measure. The qualitative data also serves to provide an insight into those characteristics that occur in mental imagery, that the more practical and systematic approach of the self-report questionnaire needs to evaluate (J. Richardson, 1985). Cote (1996) in reviewing the contribution of the qualitative style of imagery research concluded that the "depth of understanding of information expressed in the participants' own words provides a holistic understanding of imagery and unifies the dimensions crucial to the practice and study of mental imagery" (p. 74). Although, I agree with Cote's acknowledgement of the substantial value of the imager's own description of the process, I do not agree that it adequately allows for the representation of accepted dimensional content (e.g., vividness, control). Munroe et al. (2000) provided a pertinent opinion in relation to understanding and knowledge of what athletes image. They suggested that greater detail will arise from the use of a variety of sources. The SIAM represents a valuable source of information regarding the characteristics associated with athletes' ability to image. The measure is worthy of continued use by itself or in conjunction with other qualitative or quantitative assessment techniques, and is capable of generating information that will make a significant contribution to the knowledge base in the area of mental imagery.

CHAPTER 7: GENERAL DISCUSSION

Introduction

This discussion integrates the findings of the four studies that form this thesis, with particular emphasis on the psychometric evaluation of the Sport Imagery Ability Measure (SIAM). Initial research constituted the development and logical analysis of this new multi-modal, multi-dimensional questionnaire, designed to assess sport-oriented imagery abilities. Subsequent quantitative and qualitative studies generated evidence toward determining the measure's reliability and construct validity. Investigations involved both large and small samples of elite and non-elite athletes drawn from a diverse range of sport backgrounds. In addition, I discuss relevant theoretical and procedural issues pertaining to the conceptualisation and assessment of imagery in both cognitive and sport psychology. The discussion also outlines the possible contributions of the SIAM as a research instrument for the ongoing examination of sport imagery. Finally, I give consideration to the role of the SIAM as an applied tool, available to practitioners involved in the delivery of imagery training programs for performance enhancement.

Overall, this chapter summarises the important outcomes of each study that best reflect the value of the SIAM in furthering the knowledge base concerning imagery in sport. Specific content includes sections discussing the summary of major findings, status of the assessment of imagery ability in sport, definition of the imagery experience with respect to sport, interpretation of results in relation to imagery models and theories, future research directions incorporating the SIAM, applied use of the SIAM, and final comment.

Summary of Findings

Development and Reliability of the Original SIAM

The original SIAM is a 72-item self-report measure that uses six sport-related scenes to examine the dimensions of vividness, control, duration, ease, and speed of image generation; the visual, auditory, olfactory, gustatory, tactile, and kinaesthetic senses; and the sensation of emotion. Logical analyses included domain representative measure development, comprehensibility, face, and content validation. Test construction initially involved the development of an item pool. Items were generated through the examination of relevant imagery theories, analysis of research work in the field of imagery ability, and the review and analysis of existing measures of imagery ability used in the area of sport psychology. I reviewed the measure for comprehensibility, as part of the initial construction process, by asking five secondary school students to complete the SIAM. Six researchers and practitioners in sport psychology, familiar with the use of imagery ability measures, served as sources to face and content validate the SIAM. Each expert examined the draft measure and completed a set of review questions on an attached proforma. Following the examination of the experts' responses, I made relevant changes to this version of the SIAM. The types of modifications suggested by the experts included simplification of language used in the instructions, scenes, and responses scales, re-wording certain scale anchors, and ensuring consistency in formatting the analogue response scales.

The first large-scale data collection phase in the evaluation of the SIAM involved 474 participants of both genders completing the redrafted version the measure. School, university, and club athletes were included in the sample. The internal consistency scores (Cronbach's alpha) for each of the 12 subscales indicated adequate reliability with values ranging from .63 (ease) to .8 (olfactory). To test the temporal stability of the SIAM, 47 university students completed the measure a second time after a 4-week interval. Results revealed moderate but significant subscale test-retest correlations, varying from .44 (speed) to .83 (gustatory). The SIAM did not demonstrate any bias in relation to social desirability, as none of the subscales correlated meaningfully with the Shortened Marlowe-Crowne Social Desirability Scale. An exploratory factor analysis on the specific items did not resolve to a clear structure. Factor analysis on the subscale totals showed a clear two factor structure with non-visual sense modalities as one factor and dimensions plus vision as the other. The emotion subscale did not load above .5 on either factor.

Revision of the SIAM

Following the review of the results of the first study, moderate reliability data for certain subscales indicated that the SIAM required modification. Specifically, revisions involved the reduction in the number of scored scenes from six to four (72 to 48 items), the inclusion of the fitness scene from the original questionnaire as a domain-based practice scene, and the randomisation of the order of response scales within each scene.

The revised version of the SIAM was then examined for reliability and validity. In this study, involving 633 participants of both genders, the revised SIAM showed an improvement in internal consistency, even though I reduced the numbers of items per subscale from six to four. The Cronbach alpha values indicated good to very good internal consistency with coefficients ranging from .66 (speed subscale) to .87 (gustatory subscale). The auditory subscale was the only subscale for which the internal consistency value was markedly lower than for the original. Test-retest reliability correlations, determined over a 4-week interval ($N = 58$), showed a small increase when compared with the results reported for the original measure. The test-retest reliability results revealed moderate to very good correlations for the specific subscales, varying from .41 (auditory) to .76 (gustatory). Overall, increases were greater in value than the decreases, and the greatest positive changes were observed in subscales typically associated with imagery in sport (e.g., visual, emotion). These findings suggest that the revisions to the original measure contributed to improved reliability.

Confirmatory Factor Analysis

The aim of this analysis of SIAM responses for the 633 participants from Study 2 was to examine the factor structure of the revised SIAM through the use of structural equation modelling and present a confirmatory model of the key characteristics of mental imagery in relation to sport. I investigated the fit data for a number of alternative models. This approach is consistent with current best practice in the construct validation of measures in sport psychology (Marsh, 1998). Models based on individual items did not result in a good fit, so I decided to examine models derived from subscale scores. The two-factor model that emerged from the EFA in Study 1 did not reflect strong indexes of fit. All of the other models produced fit statistics that were comparable and broadly acceptable, based on current interpretations (e.g., Conroy et al., 2000; Cramer, 2000). The third model (M3), involving three factors (auditory sense grouped with the other single organ senses of taste and smell, visual/dimensions, bodily feeling), had slightly lower AGFI levels, but each of the other comparison fit indices was above or close to the .90 levels. Based on the evaluation of the fit data and a logical review of the model structure, I decided that the three-factor model (M3) had the greatest conceptual coherence of the three models examined, as a representation of sport imagery ability. The model combines variables in the context of latent factors that represent generation and manipulation of images, somatic responses, and the senses controlled by a single organ, e.g., hearing. This type of factor structure seems to reflect key elements of current theoretical interpretations of imagery functioning, such as the triple code theory (Ahsen, 1984).

Criterion Validity

The aim of this analysis from Study 2 was to examine whether the revised SIAM distinguishes between elite and non-elite athletes, as a test of criterion validity. I grouped the national and state level athletes as elite, and grouped the district, local, and school athletes as non-elite. The results of the set of independent samples *t* tests indicated significant differences between the groups for the vividness, control, visual, kinaesthetic, and emotion subscales. Resultant effect sizes for differences between the athlete groups were all in the small range. The difficulty in establishing a clear distinction between elite and non-elite athletes (in a mixed sport sample) may have limited the effect sizes. Overall, athletes participating at a higher competition level reported that they are better able to generate and manipulate the visual, kinaesthetic, and emotional characteristics of the images related to their sport. Again, this is consistent with expectations, as these are the dominant elements of experience in most sport contexts.

Convergent and Discriminant Validity

The purpose of Study 3 was to determine the convergent and discriminant characteristics of the revised SIAM. Convergent and discriminant validity evidence was generated by comparing the SIAM with tests examining (a) self-reported general imagery, including vividness and control; (b) movement imagery; (c) objective imagery ability; and (d) non-imagery cognitive functioning. Individual subscale scores of the SIAM were correlated with subscale and total scores of the following measures: Shortened Form of the Questionnaire on Mental Imagery (SQMI); Vividness of Movement Imagery Questionnaire-II (VMIQ); Gordon Test of Visual Imagery Control (GTVIC); and Multidimensional Aptitude Battery (MAB - Spatial Ability and Verbal Comprehension). Participants ($N = 436$) from high schools, university physical education courses, and elite sports groups completed the six measures over two sessions. Small to Moderate correlations (.27 to .48) were found for the SIAM control, vividness, visual, and kinaesthetic subscales with a number of the related dimension and modality variables of the other imagery measures, providing support for the convergent validity of these subscales of the SIAM. Very low to small correlations (.01 to .20) were typically reported between the SIAM subscales and (a) the cognitive ability measures and (b) unrelated dimension and modality variables of the other imagery measures, supporting the discriminant validity of the SIAM.

In spite of the small correlations found between SIAM subscales and the various imagery measures, the findings were generally representative of the predicted pattern of relationships. The most interpretable relationships were those between the visual and kinaesthetic subscales of the SIAM and the VMIQ-II subscales, between the GTVIC and the control subscale of the SIAM, and between the vividness and control subscales of the SIAM and the total score of the VMIQ-II. These findings suggest that, generally, the visual and kinaesthetic modalities are the most appropriate to assess athletes in relation to their sport imagery ability.

As found in previous studies, little distinguishes the dimensions of vividness and control in defining imagery ability (Richardson, 1994). Variations in the assessment methodologies of the measures and the specific nature of the language of the SQMI items were considered to be factors that may have limited the size of the correlations found between corresponding subscales of the different measures. Results indicated negligible relationships between measures of cognitive ability and imagery ability, supporting the discrimination of imagery from such cognitive processes as spatial ability and verbal reasoning.

Generally, the pattern of the correlations suggests that the SIAM subscales are assessing characteristics of imagery ability that are related to similar dimensions and modalities examined within general and movement imagery measures, especially given problems in test construction and focus of other measures. The SIAM subscales appear to operate in a distinct manner within athletic populations, due to the relevance of generating images in a sport-related context, rather than in relation to objects, places, movements, and other experiences included in general and movement imagery questionnaires. Meaningfulness of the content, and experience of the content that was used to develop the sport-oriented scenes of the SIAM represents a possible factor for the lower than expected levels of convergence observed between the SIAM subscales and the similar modal or dimensional variables assessed in the other imagery measures. Athletes may have been able to relate to, and consequently generate, images of content with which they are more familiar.

Concurrent Validity

As an integral component in the validation process of the revised SIAM, I compared the measure's subscale scores with data derived from a qualitative analysis of the sport imagery characteristics of athletes. Participants were 33 state-level junior and senior water polo players and coaches that included 19 males and 14 females (M = 17.91 years). Each athlete was required to read through and familiarise themselves with a common water polo performance situation and use the procedure of concurrent verbalisation (CV) to describe their imagery relating to involvement in this type of situation. I repeated this procedure with four different water polo scenarios. These athletes also completed the SIAM.

Descriptive statistics were reported for the visual, kinaesthetic, tactile, and auditory modalities, and experience of emotion for the CV task, and corresponding SIAM subscales. The results showed that the visual sense was the dominant modality for both CV and the SIAM. Similar distributions of scores existed for the other identified senses and emotion within both the CV task and the SIAM subscales. Small to very small, non-significant correlations were found between the two measures for all modalities for the total sample.

As suggested within the sport psychology literature, the visual sense is the dominant modality in which athletes both describe and rate their imagery (e.g., Gould & Damarjian, 1996; Vealey & Greenleaf, 1998). Evidence of several senses within the CV transcripts reinforces the perception of sport imagery as a multi-modal activity. Participants, who were not prompted to respond in any specific way in their CV tended to describe their images primarily in terms of the sensory and affective components, rather than providing descriptions that included dimensional qualities, such as clarity or control. It is valuable to assess these dimensional qualities, which are important within sport imagery training, because dimensional abilities enable athletes to create and manipulate their images. Overall, the examination of concurrent evidence provided only limited support for the validity of the SIAM. This was due in part to the substantial differences in the self-report methodology and the concurrent verbalisation task. The SIAM is concerned with the evaluation of imagery abilities, whereas, the verbal reports provided information regarding the content of the athletes' images, rather than descriptions relating the effectiveness of generation. Self-confidence and cognitive processing demands may have affected the quality and detail of the verbal reports provided by some participants.

These four studies examined evidence in support of the reliability and validity of the SIAM. Currently, the latest version of the measure represents a reliable instrument with a coherent factor structure and an increasing collection of evidence regarding its validity. Few existing imagery ability measures provide psychometric details associated with validity. For this reason, determining the tasks that appropriately represent independent indicators of the imaginal experience remains as difficult a challenge as the development of the SIAM itself. Overall, the current validity evidence indicates that the measure warrants continued refinement, but is at a level of development that makes acceptable its use in research and as an applied tool for trained sport psychologists.

The SIAM in Relation to Conceptualisations of Imagery in Sport

Outcomes associated with the exploration of evidence of the validity of the SIAM from all four studies have contributed toward supporting and advancing existing definitions, theories, and models of imagery. In addition, because this research has enhanced knowledge and understanding of the sport imagery construct, a balanced overview and summary of the relevant conceptualisations associated with athletic performance is possible.

Definitions

A number of excellent definitions of imagery are available that refer to characteristics of imagery that are observable and interpretable from the responses to the SIAM. Rather than represent entire definitions, the important components that are reinforced by the thesis data are detailed. Specific elements of seven imagery descriptions considered within sport psychology, that characterise the SIAM findings, include: (a) a psychological activity that evokes the physical characteristics of an object, person, or place (Denis, 1985); (b) images can be passive, active, and dynamic (Paivio, 1986); (c) images are quasi-sensory and quasi-perceptual representations occurring in the absence of the genuine stimulus under the control of the imager (Richardson, 1969); (d) images are capable of blending thoughts and emotions with experience beyond simple stimulus/response propositions (Simons, 2000); (e) imagery is more than visual, it is also tactile, auditory, muscular, and emotional (Suinn, 1976); (f) imagery is re-creating or creating experiences (Vealey & Greenleaf, 1998); and (g) imagery is a form of simulation involving the recall of information from memory and shaping it into meaningful representations (Weinberg & Gould, 1999).

The definition generated earlier in this thesis, as an amalgam of existing descriptions, remains relevant and appears supported by the findings. It is hoped that future researchers can modify the following definition in an effort to improve its accuracy and clarity as a description of sport imagery. Imagery in the context of sport may be considered as the creation or recreation of an experience stimulated from memorial information, involving quasi-sensorial, quasi-perceptual, and quasi-affective characteristics, that is under the volitional control of the imager, and may occur in the absence of the real stimulus antecedents normally associated with the experience.

Conjecture remains as to which term to use for describing the capacity of the individual to develop images. Most measurement researchers discuss imagery as an ability. Other labels discussed in the assessment literature include competence, skill, state, and trait (Ahsen, 1993; Hall, 2001; Munzert & Hackfort, 1999). Hall (2001) suggested that the ability label infers that the capacity to image is stable and unlikely to vary. Hall and Martin (1997) argued that because imagery test scores can be improved with practice it needs to be considered as a skill. Hall (2001) recently concluded, however, that research findings (Rodgers et al., 1991) indicate that imagery in the sport domain be perceived as both an ability and a skill. Ahsen (1993) defined ability as "what can be done with present training and development" (p. 156). In the context of the present SIAM data, the subscale responses did reflect the current status of the participants' capacity to image, trained or untrained, developed or undeveloped. On the basis of this observation, and in consideration of current measurement conventions (e.g., Ahsen, 1997, Hall, 1998), it would seem appropriate to continue to use the term ability to describe the self-reported assessment of the quality of imagery.

Theories and Models

Recent reviews of imagery in sport outline a number of theories that describe and explain the possible operation of imagery in enhancing performance (Hall, 2001; Suinn, 1997; Weinberg & Gould, 1999). The theoretical perspectives discussed in these texts include psychoneuromuscular (Jacobson, 1930, 1932), symbolic learning (Sackett, 1934), dual coding (Paivio, 1971), bioinformational (Lang, 1977), and psychological skills hypothesis (Weinberg & Gould, 1999).

Based on the current SIAM findings, the four studies of this thesis provide only limited support for the preceding theoretical perspectives. For example, facilitation of neuromuscular activity or the cognitive rehearsal of symbolic aspects of physical performance are primary elements of existing theories for which imagery ability scores do not serve as clear indicators. In relation to the bio-informational theory, data generated from the use of the SIAM provided basic evidence to support the imagery effects of stimulus and response propositions. The SIAM uses scenes to facilitate participant imagery that incorporate statements similar to examples of stimulus and response propositions described by Lang (1977) and Hale (1986). For example, in the successful competition scene, general characteristics of the sport imaged serve as stimulus propositions, such as “you pull out a sensational move”. Statements within the text referring to physiological attributes, such as “the feel of any muscles moving” represent response style propositions. I observed in both the descriptive data, and anecdotally, that the different scenes did prompt variations in subscale responses for the participants. For example, the mean successful competition scene scores were higher than the mean slow start scene scores. This finding suggests that those scenes with a higher level of overall stimulus effect for the participant may also lead to higher scores on the physiologically-oriented subscales (e.g., kinaesthetic, tactile, emotion) derived form the basic response-oriented propositions within the SIAM scene scripts. The design framework of the SIAM, specifically the scene format, does present the possibility for specific revisions representative of the bioinformational theory to include greater detail in relation to stimulus and response propositions.

Another key outcome of the current findings relates to models of the imagery process. The two models I consider that the data derived from the use of the SIAM supports are the triple code model (Ahsen, 1984) and the applied model of imagery use in sport (Martin et al., 1999). The authors of each model have identified important areas of imagery functioning that may be better understood when considered in the context of individual differences in sport-oriented imagery abilities. These areas include the differentiation of visual and non-visual imagery and the role of imagery ability in relation to imagery use.

Ahsen (1984) described the elements of his triple code model as image (I), somatic (S), and meaning (M). The factor structure data generated from the SIAM provides partial support for the existence of these components. Firstly, the image element is primarily representative of the visual content. The first factor from both the EFA and CFA suggests that the visual modality mediates the operation of the dimensions. This may constitute the primary substructure of Ahsen's model, the generation of image (dominated by the visual sense). Secondly, the grouping of somatic style sensations and the emotional parameter, as a factor in the proposed CFA model, is indicative of the existence of the somatic component of the triple code model. Although no items of the SIAM relate directly to image meaning, I consider that the experience of emotion item constitutes an indicator of image meaning to the respondent. Developing a CFA model that included emotion as a latent variable was not possible because only one variable of the SIAM represented this characteristic.

The present findings provide basic support for the model of imagery use in sport presented by Martin, Moritz, and Hall (1999). I propose that, because the majority of participants could generate the requested sport-oriented images, many of these individuals may have used imagery in the context of their involvement in sport. No item directly requested information relating to whether the participants had ever used, or currently used, imagery in training or competition. This general indicator of imagery use (capacity to generate requested images) supports the proposition within the Martin et al. model that imagery ability is a key component of imagery use. Athletes participating in the study who may have never attempted to generate images in relation to their sporting involvement may have experienced greater difficulty in completing the SIAM than those who have used imagery in their sport. The tendency for a number of the more familiar elements associated with imagery (e.g., visual, vividness) to be slightly negatively skewed indicates a degree of familiarity within this athlete sample with the process of producing sport-oriented images. The developers of each model are currently encouraging research that contributes toward a clearer understanding of their suggested frameworks. The SIAM is the type of imagery ability assessment device suited to analysing the soundness of the triple code and imagery use in sport models

Status of SIAM in Measuring Imagery Abilities in Sport

The underlying basis for the present thesis concerns the issue, raised by a number of authors, that a lack of quality imagery assessment devices has limited the thorough examination of the imagery abilities of athletes in relation to research and practice (e.g., Gill, 2000; Hardy et al., 1996; Mahoney & Epstein, 1981; Murphy, 1990: Perry & Morris, 1995). For the few measures of sport imagery ability that do exist, such as the Sport Imagery Questionnaire (Martens, 1982), no published validation evidence is available. Furthermore, measures of general and movement imagery ability do not possess sufficient specificity to be highly effective in measuring imagery ability in relation to sport. Moran (1993) stressed that the primary quality issue is that the majority of the imagery ability measures used in sport lack adequate evidence of both reliability and validity. Recent discussions of imagery assessment in sport psychology continue to highlight an on-going need for the development of a sport-oriented, multidimensional measure of imagery ability that possesses strong psychometric properties (Gill, 2000; Martin et al., 1999; Munzert & Hackfort, 1999). The construction of the SIAM constituted a significant attempt to resolve these concerns in relation to imagery ability assessment in sport.

Literature from both general and sport psychology details the psychometric characteristics or guidelines that constitute a minimum level of evidence in evaluating the construct validity of self-report imagery questionnaires (McKelvie, 1994, Moran, 1993, Richardson, 1994). Marsh (1998), in reference to the development of psychological measures for use in sport, outlined a set of processes to follow in instrument construction. The construct validation approach should include logical, correlational, and experimental procedures. In relation to the development of the SIAM, this research incorporated many of Marsh's suggested techniques. Specifically, logical analysis involved: (a) creation of items based on definition and theory; (b) attention to the measure's instructions, item format, and scoring procedures; and (c) consideration of the instrument's characteristics in relation to the age and background of typical respondents. The correlational methods included the within-network evaluations, which "explore the internal structure of a construct" (p. xvi), such as internal consistency, test-retest reliability, social desirability, exploratory factor analysis, and confirmatory factor analysis. Between-network analyses, which "attempt to establish a logical, theoretically consistent pattern of relations between measures of a construct and other constructs" (p. xvi), evaluated evidence of convergent, divergent, and concurrent validity. This was achieved through the comparison of the SIAM with subjective, objective, and qualitative measures of the imagery construct, and through comparison of the SIAM and measures of different cognitive constructs. The evaluation of criterion evidence for the SIAM involved the comparison of the subscale scores of athlete groups participating at different levels of sporting competition. The research in this thesis did not involve experimental techniques in the evaluation of the SIAM. I recognise, however, that this remains a key element in substantiating the construct validity of the measure and will discuss possibilities for experimental investigation in the future research section of this chapter.

McKelvie (1994) presented guidelines for evaluating the psychometric properties of self-report imagery questionnaires. The demanding standards proposed referred to reliability and validity characteristics of measures developed for use in general psychology. Interpretation of the quality of the SIAM against these criteria seems appropriate, because measures such as the SQMI and GTVIC constituted a basis for development of the SIAM, and were used in the evaluation of validity evidence. McKelvie proposed that (a) the lowest acceptable alpha is, $r = .85$, (b) test-retest reliability coefficient be above, $r = .75$, for delayed test-retest, (c) that validity coefficients above, $r = .25$, support consequential relationships, and (d) that social desirability independence comparisons need to be below, $r = .25$. The guidelines proposed by McKelvie also suggested that evidence of group differences is marginal when the effects size d is between .20 and .49. McKelvie did not provide factor structure detail in relation to factor loadings or fit indices. Overall, the evidence in relation to the SIAM is below or at the lower limits of acceptability for a number of the analyses conducted. Many of the measure that McKelvie is likely to be evaluating against theses criteria, however, assess only one or two dimensions, and in many cases only one or two modalities. The multi-dimensional, multi-modal design of the SIAM, and the small number of items per subscale, may affect the capability of the SIAM to reach these standards. Examining the psychometric details outlined in Table 2.1 of this thesis indicate that few of the measures reach all the criteria minimums that McKelvie proposed. Consequently, this comparison does not necessarily suggest that the SIAM lacks psychometric merit, but highlights the developmental status of the measure as a research instrument, and the difficulty of measures of imagery ability to reach the extremely demanding psychometric standards that may be used to evaluate measures of other psychological attributes.

The development protocols of the existing imagery ability measures used in sport psychology (e.g., MIQ, SIQ, VMIQ) do not appear to have incorporated all of the analysis elements of the systematic approach proposed by Marsh (1998). Researchers regularly present reliability and validity data for these measures without reference to guidelines that indicate possible psychometric inadequacies (e.g., Eton et al., 1998; Hall, 1998; Marks & Isaac, 1994). The resultant values of the psychometric analyses reported for the SIAM reinforce the difficulty involved in creating instruments that can provide both a detailed and consistent examination of the multiple characteristics associated with the construct of imagery. This is not a new outcome, as many imagery tests confront this psychometric hurdle. Until a more reliable and fully validated multi-modal, multi-dimensional assessment device is constructed, the SIAM represents an instrument of acceptable psychometric merit, suitable for the examination of imagery abilities in sport.

This research has produced information that details the specific characteristics that warrant consideration when examining the imagery abilities of athletes. The SIAM assesses 12 variables, including the dimensions of vividness, control, duration, speed of generation, and ease of generation, the modalities of vision, kinaethesis, hearing, touch, taste, and smell, and the experience of emotion. Although existing sport psychology literature supports the evaluation of the dimensions of vividness, control, and ease, all of the senses, and emotion, no measure has previously attempted to assess all of these characteristics (Hall, 1998; Perry & Morris, 1995; Munzert & Hackfort, 1999; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999). The present descriptive SIAM data indicated that the athletes evaluated their images at the moderate to strong level for all but the gustatory and olfactory modalities. Reliability data was generally acceptable for all but the speed and ease of generation dimensions and the auditory modality. Factor analyses suggested factors representing generation and manipulation of visual imagery, non-visual imagery, and feeling-oriented imagery. Overall, the evidence provisionally supports the current subscale structure of the SIAM as a credible representation of imagery ability characteristics warranting further evaluation. Possible changes involve the removal of the ease or speed of generation subscale, as they may represent characteristics of imagery ability that are perceived as very similar by athletes, and the inclusion of a subscale to broaden the experience of emotion characteristic that evaluates the strength of the meaning of the image to the individual.

Several authors of articles discussing sport-oriented imagery have described imagery ability as a psychological variable that can distinguish between athletes performing at different competition levels (Hardy et al., 1996; Murphy, 1994; Weinberg & Gould, 1999). Possible trends relating to individual differences in sport imagery ability based on participation level were observed in the SIAM criterion validity results. This data provided broader evidence of the specific characteristics of imagery ability that distinguish elite and non-elite athletes, than findings reported in similar studies (e.g., Eton et al., 1998; Isaac & Marks, 1994). Athletes participating at a higher level appear better able to generate images related to their sport. Those subscales that discriminated between the groups, the visual, kinaesthetic, vividness, control, and emotion subscales, represent the characteristics of imagery ability most regularly discussed in relation to sport (e.g., Gould & Damarjian, 1996; Vealey & Greenleaf, 1998).

The small effect size for group differences may have resulted from a limited capacity of the criterion variable to accurately discriminate between the participants in regard to sporting ability. Specific distinctions between groups based on hours of involvement in their sport (e.g., training and competition), or accredited achievement levels from within a single sport sample, could increase the degree of differentiation between groups classified as elite and non-elite. Additionally, detecting substantial individual differences in imagery ability between athletes at different performance levels is difficult because of the inherent ability of all people to generate images (Sheikh, Sheikh, & Moleski, 1994). On the basis of the criterion validity evidence, the SIAM is a suitable measure for use in both research and applied settings to substantiate if imagery ability is a contributing psychological variable in differentiating between successful and less successful competitors.

Future Research Involving the SIAM

The set of studies comprising this thesis raises a number of important implications for the on-going examination of imagery abilities in sport psychology. The SIAM represents an instrument that has both conceptual integrity and psychometric merit, and therefore, should prove valuable in clarifying the confusion surrounding just what are the underlying imagery characteristics associated with athletic performance. I will discuss the directions for future research incorporating the SIAM within the following sections: revision and continuing psychometric evaluation of the SIAM; experimental investigations; and theory and model development.

Revision and Psychometric Evaluation of the SIAM

A major aspect in maintaining and improving the quality of any psychological measure is the developer's commitment to the processes of refinement and re-evaluation. I outlined possible modifications to the SIAM within the discussion sections of each study. Following the review of these suggestions, and in consideration of the integrated reliability and validity data set, certain changes to the current version of the SIAM warrant examination.

Firstly, the data reported for a number of the SIAM subscales was highly skewed. This is a problem previously identified in imagery ability assessment research (e.g., Kihlstrom et al., 1991). Modifying the response scale approach from its current sematic differential style to a modified Likert scale constitutes a possible method for limiting the degree of skew and increasing the spread of scores. The Likert scale should incorporate descriptors that are based upon a middle point that represents the expected level of response. In relation to imagery ability, this descriptor should refer to a clear image of recognisable detail, as this appears to be the typical rating that respondents make for the their imagery ability skills for a characteristic such as vividness. Reducing subscale skew values will assist in determining the true level of relationship between the SIAM and both aligned imagery characteristics and non-imagery variables. In addition, this modification should lead to an improvement in the identification of individual differences in imaging abilities.

Following consideration of both the statistical findings and anecdotal reports from respondents, minor revision of the current imagery scenarios may benefit the SIAM. The design of the measure allows for the modification of the scene scripts. Particular script images (e.g., slow start) were more difficult to generate for certain participant groups (e.g., swimmers). In the development of this type of generic-sport measure, we must ensure that the scripts are generic, and therefore capable of completion by athletes from any sporting background. Script refinement related to the bioinformational theory, would necessitate the inclusion of text representative of both stimulus and response propositions. Although the measure currently includes this type of material, greater attention to the manipulation of each proposition type within each scene may aid in generating greater variation in the reported imagery responses.

Another area of possible refinement relates to the removal or addition of subscales. Only two of the current variables appear to replicate information. It remains unresolved as to whether the respondents perceived the speed and ease of generation items differently. Perhaps a solution is the exclusion of one of these subscales. I gave consideration to the usefulness of the continued inclusion of the gustatory and olfactory subscales. In light of the current support for the multi-modal representation of imagery within the applied literature (e.g., Vealey & Greenleaf, 1998; Weinberg & Gould, 1999), I maintain that there is valuable information to be gained from the retention of these subscales. Knowledge of athletes' abilities concerning smell and taste may be of greater salience in sports not examined specifically in this thesis (e.g., shooting, surfing), thus, the availability of a measure to evaluate these characteristics remains essential. Important imagery characteristics not currently examined in the SIAM that represent possible additional subscale variables are imagery perspective and imagery meaning. Both these areas have received substantial attention in the discussion of imagery in sport (e.g., Hale, 1994; Hall, 2001; Munzert & Hackfort, 1999; Murphy, 1990; Murphy & Jowdy, 1992) and may be abilities that discriminate between athletes in relation to their physical performances. The difficulty in terms of assessment is how to develop items that evaluate ability in relation to the imagery associated with perspective or meaning. For example, meaning could be examined by the inclusion of an item requesting the respondent to rate the level of intensity of the image meaning, with anchors such as *no meaning at all* to *meaningful as the actual experience*. Responses would be examining the ability of the individual to associate a meaning with the images they create. This item could also prove useful in resolving the factorial representation of the experience of emotion subscale, as it could be hypothesised that these two variables would load on the same factor. Currently, within the SIAM, the emotion subscale loads with the tactile and kinaesthetic subscales (feeling senses), a structure that warrants only tentative support. A factor that includes both the emotional and meaning characteristics of an image represents a more reasonable proposal in relation to possible hypothesised models of sport imagery abilities. Munzert and Hackfort (1999) and Vealey and Greenleaf (1998) supported the inclusion of perspective items within the evaluation of sport imagery abilities, however, Callery and Morris (1997) do not describe perspective as an imagery ability characteristic. On the basis of on-going interest in the nature of imagery perspective within the sport imagery literature (e.g., Cox, 1998; Hall, 2001; Munzert & Hackfort, 1999) the inclusion of separate subscales assessing internal and external imagery perspectives, as in the Vealey and Greenleaf (1998) version of the SIQ, could represent an important development for the SIAM. The type of questions representing the perspective characteristics would relate to the amount of involvement of internal and external imagery within the generation of the requested image. For example, for the internal perspective the anchors could be, *no image sensation from inside body* to *very strong image sensation from inside body.*

Finally, the on-going refinement of the SIAM requires the examination of a range of individual difference variables. Possible mediators influencing variations between athlete groups in relation to imagery ability include type of sport, level of sporting ability, age, gender, and cultural background. New individual differences research beyond this thesis, examining imagery abilities and level of sporting ability/involvement and cultural background, is currently being analysed or commenced. These types of characteristics are readily assessable with only minor modifications to the present format of the SIAM, such as language of presentation and the addition of alternative demographic questions related to involvement in sport (e.g., hours of training/competition). Researchers interested in the specific influences of athlete characteristics, that they speculate could be the cause or result of differences in imagery abilities, are encouraged to use the SIAM to investigate their proposals.

Experimental Investigations

The SIAM is sufficiently developed and validated to warrant its use within experimental studies of sport imagery. Suinn (1997) and Goginsky and Collins (1996) stressed the importance of examining imagery abilities within any research that incorporates imagery exercises as an experimental component. In addition, limited quality research exists (e.g., Rodgers et al., 1991) that has assessed the effects of an imagery training program on imagery ability. This latter type of study represents a significant area of future research for the SIAM. The measure could serve to indicate changes in imagery ability as an outcome of training, or be used as a variable to place individuals within imagery ability level groupings. The development or selection of an appropriate training regimen represents an important issue, and new research would appear possible in light of the substantial availability of applied literature in relation to the development of these types of programs (e.g., Rushall, 1995; Simons, 2000; Weinberg & Gould, 1999). Goginsky and Collins (1996) provided a valuable outline of the necessary components (e.g., control groups, task specificity) to consider in constructing research that evaluates the effectiveness of imagery interventions in relation to physical performance. The SIAM could serve to control for differences in imagery abilities before treatment, to ensure that performance differences following training are due to the program and not because of pre-program differences in imagery abilities. Demonstrating the efficacy of the SIAM as an imagery ability assessment device necessitates that studies in which it is used are designed to the standards representative of best research practice.

Another possible area of experimental research concerns the examination of subjective reports of imagery ability in relation to psychophysiological variables. Previous studies (e.g., Bakker et al., 1996; Hale, 1982; Hecker & Kaczor, 1988) have assessed changes in imagery ability responses and physiological variables, such as heart rate or muscle innervation, as an outcome of the presentation of imagery scenarios. The SIAM scenes could be used in their current form, and in addition to the normal subscale responses following the imagery task, certain physiological variables (e.g., heart rate, respiration, muscle innervation) of interest can be measured simultaneously. Previous imagery ability measures used in these types of studies were restricted to a small number of imagery characteristics, of a non-sport orientation (e.g., general vividness and control), and in certain instances lacked psychometric detail (e.g., purpose designed scale for the research). The SIAM is an instrument that could substantiate relationships between each of the six self-reported imagery sensations and any related physiological responses.

Theory and Model Development

An additional area of future research involving the SIAM is the testing of existing sport and non-sport models or theories of imagery. Two non-sport theoretical explanations of the imagery phenomenon that SIAM data may particularly assist in resolving are the bioinformational theory (Lang, 1977) and the triple code model (Ahsen, 1984). The model of imagery use in sport proposed by Martin et al. (1999) includes imagery ability as a key element within its structure. The developers of each model are currently encouraging research that contributes toward a clearer understanding of their suggested frameworks. The SIAM is an imagery ability assessment device suited to generating data that facilitates the explanation of the imagery process as represented by these conceptualisations. In addition, the development of a viable hierarchical structure, of the primary components of imagery ability in relation to sport, remains an important goal of research in this field of sport psychology.

Future research use of the SIAM could serve to advance the interpretation of the imagery process, as it pertains to the bioinformational theory, beyond that of previous studies in sport psychology (e.g., Bakker et al., 1996; Hecker & Kaczor, 1988). The SIAM uses scenes to facilitate participant imagery, which allows for the incorporation of text segments that represent both stimulus and response propositions. Minor modification to the existing SIAM scripts, emphasising specific propositional biases, could test the various assertions of the bioinformational theory. For example, it would be possible to include response propositions in the SIAM scripts such as 'feel your heart pounding' or 'your muscles are aching', in addition to the basic stimulus propositions already included in the current scripts such as 'see the equipment' or 'hear the crowd'. The effects of variations in emphasis of each proposition type within the imagery scripts are examinable in terms of the imagery ability parameters of the SIAM. Increases or decreases in dimension or modality score may be the result of the inclusion or removal of statements biased toward either stimulus or response information. Simple psychophysiological measurements, as described earlier, could generate additional information with which to evaluate the bioinformational explanation. For example, heart rate could be monitored as participants generate their images, while completing the SIAM. Heart rate may increase as an outcome of generating the image associated with training activity outlined in the SIAM, and degree of change may be associated with scores indicating vividness or kinaesthetic imagery abilities. Combining detailed subjective and physiological data formulates an important evidence base that may assist in the resolution of this theory.

Further exploration of sport imagery ability, incorporating the SIAM, could serve to assist in testing the triple code model, referred to by Ahsen as ISM (1984). I derived basic support for the image (I) and somatic (S) elements of this imagery processing model from the factor structure data of the SIAM. Future research could be directed toward determining the function of the meaning (M) element within this model, as it applies to sport-oriented images. Modifications to the format of the SIAM, detailed earlier, to include items that relate to the meaning of the image could facilitate the complete examination of the ISM model. The inclusion of more than one item would allow testing of the independence of the meaning characteristic, using confirmatory factor analysis. Firstly, respondents could rate the intensity of the meaning of the image. Secondly, the creation of an item that examines the specificity of the meaning of the image could provide information regarding the ability to generate images of specific significance to the respondent. For example, the response scale could ask participants rate the relevance of their imagery between anchors such as *no specific meaning* to *highly specific meaning.* Sport psychologists (e.g., Murphy, 1990; Murphy & Jowdy, 1992; Weinberg & Gould, 1999) have promoted the investigation of the ISM model in the context of the imagery associated with physical performance. The continued development of the SIAM and its establishment as a valid instrument in the examination of imagery abilities necessitates that it accurately represents accepted conceptualisations of the imagery process.

Martin, Moritz, and Hall (1999) detailed a model of imagery use in sport that incorporates imagery ability as an integral component. Findings derived from SIAM research may serve to explain the role of imagery ability as a moderator variable within their model. Martin et al. (1999) suggested that existing measures, such as the MIQ and VMIQ, lack the necessary sporting orientation required to generate data to specifically examine the effects of imagery ability the other variables of the imagery use model. It is possible that the SIAM may be an appropriate instrument for examining the characteristics of imagery ability associated with the cognitive and motivational function of imagery. Scenes of the SIAM could be manipulated to include text segments that describe "sport-related experiences such as goal achievement (MS imagery) and game strategies (CG imagery)" (Martin et al., 1999, p. 257). This procedure may serve to examine the influence of the situational element on subsequent assessment of both imagery function and ability.

Martin et al. (1999) proposed that researchers design studies that incorporate the SIQ to examine the five imagery types detailed within the model. Initially, a correlational study involving the SIAM and SIQ could demonstrate the level of association between imagery ability characteristics, such as modality and dimension, and the functional elements of athletes' imagery use. Subsequent research could examine the moderating effect of differences in imagery ability (high versus low) in relation to the desired outcomes component of the model (Martin et al., 1999). Overall, the Martin et al. imagery use model represents a sound organisational framework within which the SIAM can contribute valuable data associated with the 'what athletes image' element recently discussed by Hall (2001). The generation of evidence toward the substantiation of this model also constitutes an additional technique in the on-going construct validation of the SIAM.

On the basis of the current SIAM data, future studies could examine a hierarchical model of imagery ability in relation to sport (Figure 7.1). The basic model represents a three-tier framework, with a general factor at level one, second level generation, feeling, and single sense factors, and a third level that details individual dimension and modality characteristics. Confirmatory factor analysis could be used to test variations of this basic structure, particularly with respect to the visual modality and the experience of emotion. Factor labelling and the identification of any additional second order factors are concerns that require specific analyses. Investigations are required to resolve the association of the visual sense with the dimensional components, perhaps as a second order generation factor, and the specific assignment of the non-visual senses and the emotion variable. As with the imagery use model discussed earlier (Martin et al., 1999), this conceptualisation is presented as an initial framework for the on-going analysis of the structure of sport imagery ability.

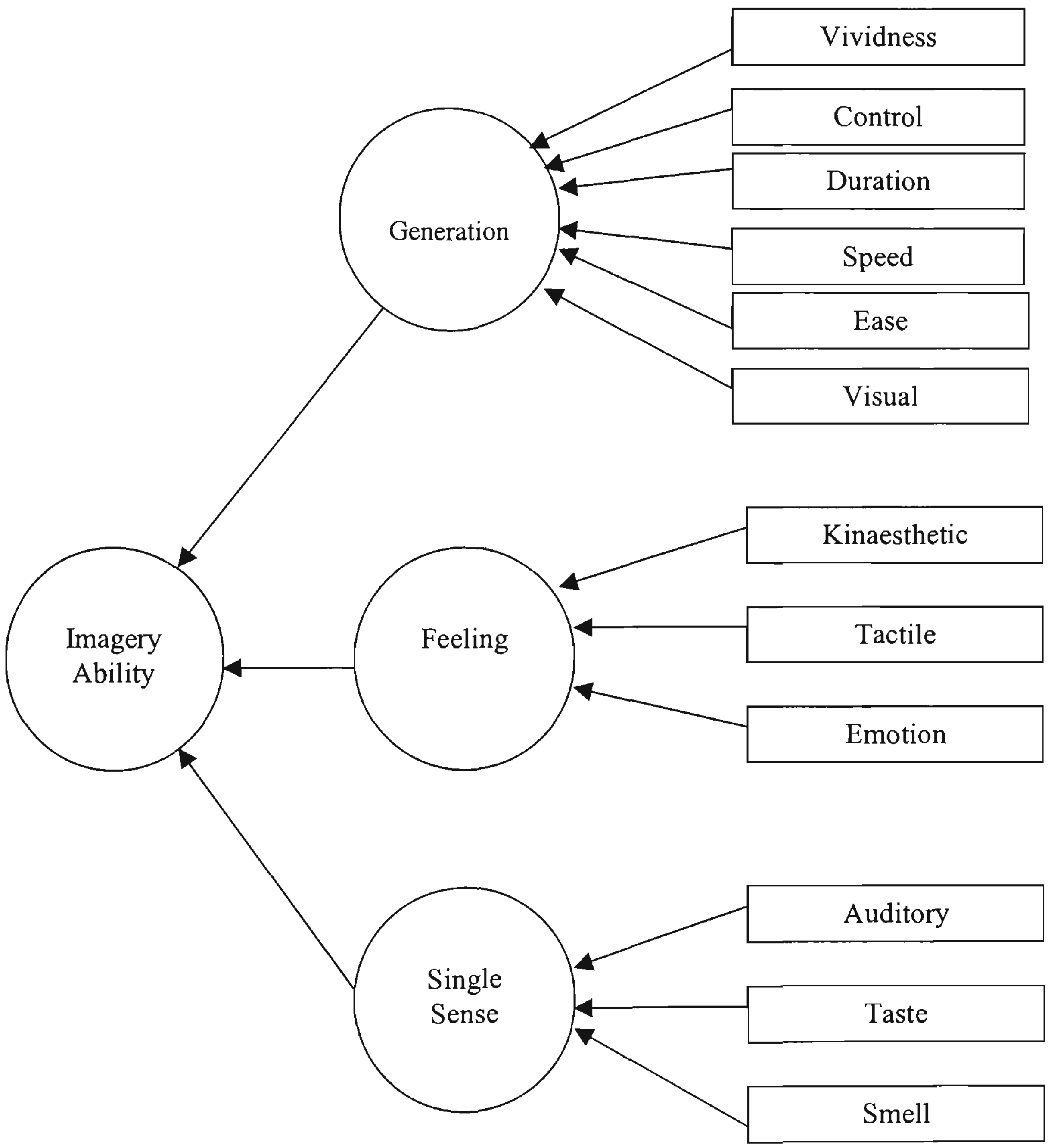

Figure 7.1. Model of imagery ability in relation to sport

The complexity of the imagery phenomenon dictates that attempts to formulate a single comprehensive theory to describe this cognitive process will struggle to succeed

(Drake, 1996; Hall, 2001). I propose that existing theories and models of imagery functioning each contribute valuable knowledge, therefore, the concept of an integrated model appears a valid approach for future construct development (Janssen & Sheikh, 1994; Hall, 2001; Murphy & Jowdy, 1992; Suinn, 1997). It is hoped that the SIAM can serve as a useful device in formulating evidence to support several of the current explanations of imagery operation in the sporting domain.

Applied Use of the SIAM

Imagery represents one of the fundamental techniques used within sport psychology practice (e.g., Suinn, 1997; Simons, 2000). An important reason for the development of the SIAM was as a response to assessment concerns expressed by practitioners working in the area of imagery. Consultants acknowledged that existing measures of imagery ability lacked psychometric precision, were not designed with a sporting context, and did not examine the full range of characteristics associated with athletes image generation (Gill, 2000; Perry & Morris, 1995; Murphy, 1990). The indications from the current research are that the SIAM is an assessment device suitable for use by sport psychologists and coaches involved in the area of developing the imagery skills of athletes. Specifically, this section will review the use of the SIAM in the following roles: (a) as a measure of an athlete's current imagery abilities; (b) as a component in the evaluation of an imagery training program; (c) as a manipulation check in relation to imagery content incorporated within specific imagery exercises; and (d) as an aid in the identification of the key elements of sport imagery which will facilitate practitioners' awareness and understanding of the imagery process.

Assessment of an Athlete's Imagery Abilities

Most recent reviews discussing the use of imagery within sport psychology practice support the assessment of an athlete's imagery ability (e.g., Janssen & Sheikh, 1994; Perry

& Morris, 1995; Vealey & Greenleaf, 1998; Weinberg & Gould, 1999) before commencing any imagery training program. Typically, the literature has indicated that practitioners gather information about both the sensory and dimensional aspects of the athlete's current imagery capacities. Measuring a broad range of imagery characteristics will provide direction concerning which imagery skills and activities to include within the imagery training program. Unfortunately, in those reviews in which an assessment device was provided, typically the Sport Imagery Questionnaire (Martens, 1982), the authors based their selection on an inferred level of content validity and ignored the fact that the instrument lacks any associated psychometric or theoretical support (Gill, 2000). Future research in which imagery ability assessment is used prior to training using imagery programs would benefit from the use of the SIAM as the device to determine any individual differences. The multi-modal, multi-dimensional design allows the practitioner to examine a broad range of imagery characteristics and subsequently focus on those aspects of imagery ability the athlete may require assistance in developing. Alternatively, individualised scripts can be developed using imagery characteristics for which each athlete already reports sound imagery ability.

Evaluation of Imagery Training

Following the commencement of an imagery training program, the SIAM can be incorporated as an evaluation instrument to ascertain the progress of athletes concerning imagery skill development. Priority areas in relation to imagery ability, such as vividness enhancement or kinaesthetic sense development, can be assessed at intervals during the training program, to ensure that the desired changes are occurring. If knowledge of the athlete's imagery abilities is integral to the imagery training program (e.g., Janssen & Sheikh, 1994; Weinberg & Gould, 1999), then the on-going incorporation of evaluation sessions, employing a measure such as the SIAM, can provide valuable feedback in ascertaining the success of the program.

Manipulation Check of Imagery Content

Murphy (1990) reported that imagery research often lacks checks that participants are experiencing their images in the proposed manner. This may also be the case in the applied use of imagery, where it is necessary to ascertain that the reported imagery matches the intended intervention (Murphy, 1994). If practitioners incorporate scripts within their imagery tasks that emphasise particular modal or dimensional qualities, then the SIAM could be used to determine whether that focus is reflected in the client's self-reported ratings of those characteristics.

Identification of Components of Imagery

Recently, in discussing the outcomes of a qualitative analysis of sport imagery, Munroe et al. (2000) suggested that knowledge of 'what' athletes image will serve an educational role for coaches, psychologists, and athletes. The SIAM is also capable of performing this function. Further refinement of the measure, so that it demonstrates a stronger relationship with the qualitative characteristics of sport images will increase the likelihood that the SIAM provides an accurate analysis of the 'what' component. The major advantage of the use of the SIAM is that the facilitation of information pertaining to the characteristics of sport imagery is achieved utilising less involved quantitative methodologies.

The SIAM is a measure of sport imagery ability that is sufficiently advanced in terms of design and evaluation for use in the applied area of sport psychology. The measure can provide the practitioner with information regarding the status of an athlete's imagery abilities, or an indication of the effectiveness of an imagery based training programme. Material derived from the analysis of SIAM scores will allow the practitioner to determine more precisely the imagery components that they may need to concentrate on within their sessions, and develop a clearer understanding of the facets of imagery ability that represent the imagery process in relation to sport. Finally, the SIAM may serve as an evaluation tool that can aid in determining whether a programme is actually focussing on the imagery skills the practitioner is targeting.

Concluding Comments

The set of studies reported in this thesis represent a significant attempt to directly address the concerns identified by researchers in relation to the assessment of imagery ability in sport (e.g., Moran, 1993 Murphy, 1990; Perry & Morris, 1995). In concluding this thesis, I will discuss briefly the three primary issues that encapsulate this research. These are the original purpose of the task, the nature of the task, and the general outcomes of the task.

Firstly, this work reflected the suggestion by Murphy (1990) that there is a lack of quality imagery assessment devices available to sport psychologists. Moran (1993) reinforced this perspective, following his review of existing imagery ability measures used in sport, through the inference that the available instruments are of limited psychometric quality. In concluding his own analysis of the difficult task of assessing individual differences in imagery within general psychology, Alan Richardson (1994), stated that: "It is true that error lies about us everywhere, and that the price of good science is eternal paranoia. Nevertheless, a caution is one thing: pessimism is another" (p. 124). More recently, J. T. E. Richardson (1999) concluded that the subjective self-report methodology remains as one of the premium procedures for analysing imagery as a phenomenal experience. Each of these ideas played an important part in the decision to develop a measure of sport imagery ability. Irrespective of the difficulty in developing measures in this field, the genuine need for a quality instrument and the encouragement from established experts in imagery research that a measure development program needs to be undertaken, prompted the pursuit of the academic challenge to design and evaluate the SIAM.

The task of developing measures in psychology is acknowledged as a problematic one (McKelvie, 1994; Perry & Morris, 1995). Tests examining imagery are perhaps more confounding than most, because they attempt to assess an ability almost all individuals appear to possess, but one that remains confusing in its identification and classification. In relation to the tasks involved in the production of this thesis, Perry and Morris (1995) presented an accurate description of the procedural difficulty of imagery measure development. They stated that:

> The development of a sound psychometric device is not generally considered a glamorous activity by many psychologists. It is a long gruelling process, without the gratification that intervention research brings when performers develop as intended. Still, it is essential to the progress of many fields and imagery is certainly one...... (p. 359).

The program of measure development put in place in the creation of the SIAM followed closely the suggestions of sport psychology experts and psychometric researchers, such as Marsh (1998), Moran (1993), and Murphy (1990). The original design of the questionnaire was based on a detailed analysis of existing imagery literature and measures. The SIAM was then evaluated rigorously and broadly in relation to both its reliability and validity. The resultant evidence leads me to suggest that the SIAM represents a quality measure of acceptable reliability and comprehensible factor structure. More importantly, the SIAM demonstrates an adequate degree of validity supported by a variety of types of evidence, particularly when considered in the context of existing tests of imagery abilities, whose authors have often failed to present sufficient detail regarding validity characteristics. Consequently, the validity of the SIAM will continue to be examined through its involvement in a range of future imagery studies, and I will direct substantial endeavour to continue to refine and improve the measure on the basis of the findings generated from its application in both research and practice.

Finally, I propose that the development of a quality measure of imagery ability in sport will serve two key roles in the future examination of this cognitive attribute in the field of sport psychology. Firstly, data derived from the use of a psychometrically accurate assessment device, based on reputable theory, will contribute valuable information toward an enhanced understanding of how imagery works in relation to involvement in sport. In addition, the advancement of the knowledge base of imagery functioning should assist practitioners to facilitate improved performance outcomes for athletes from the application of imagery strategies. Recently, Hall (2001), a leader in the field of imagery research in sport, concluded that there is no doubt that imagery will remain an important area of future interest within sport and exercise psychology. Measurement of characteristics of imagery will also be increasingly important. The SIAM represents the most thoroughly examined measure of the important area of sport imagery ability, so it has the potential to make a noteworthy contribution to the field.

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APPENDIXES

Appendix A: Sport Imagery Ability Measure (SIAM)

Code:__________________

Date:__________________

Sport Imagery Ability Measure

Age:__________________

Gender:_______________

Main Sporting Interests:____________________________

Introduction

This questionnaire involves creating images of six situations in sport. After you image each scene, you will rate the imagery on twelve scales. For each rating, place a cross on the line at the point you feel best represents the image you produced. Ensure the ***intersection*** of the cross is on the line as shown in the examples below.

Correct |————————X————————————————|

Incorrect |————————————x——————————x——|

An **example** of the style of scene to be created is as follows:

You are at a carnival, holding a bright yellow, brand new tennis ball in your right hand. You are about to throw it at a pyramid of six blue and red painted cans. A hit will send the cans flying and win you a prize. You grip the ball with both hands to help release the tension, raise the ball to your lips and kiss it for luck, noticing its soft new wool texture and rubber smell. You loosen your throwing arm with a shake and, with one more look at the cans, you throw the ball. Down they all go with a loud "crash" and you feel great. Now imagine the scene for yourself.

Below are some possible ratings and what they represent to give you the idea.

1. How **clear** was the image ?

no image |——————X——————————————————————| perfectly clear

This example shows an image was experienced but was unclear

6. How well did you **feel the muscular movements** of the image?

no feeling |——————————————————————X—————| very clear feeling

This example indicates very strong imagery of muscular movements

7. How well did you **hear** the image?

no hearing |——————————————————————————X——| very clear hearing

This example reflects the strongest possible image, like hearing the real sound

12. How strong was your **experience of the emotions** generated by the image?

no emotion |——————————X——————————————————| very clear emotion

This example reflects a degree of emotion which is moderate

Do you have any questions regarding the imagery activity or the way you should respond using the rating scales? Please feel free to ask now.

<u>DO NOT TURN THE PAGE</u> UNTIL YOU ARE ASKED TO DO SO.

Training Session

Think of a drill you do in training that is really tough. Now imagine yourself doing the drill. As you get an picture of yourself performing the skill in practice, try to complete an entire routine or drill. Take notice of where you are, what is all about you, particularly what you see, hear, taste, and smell. How do your muscles feel? Can you feel the equipment and the different surfaces related to your training? Do you get an emotional feeling from this image? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How **clear** was the image?

no image |________________| perfectly clear

2. How well could you **control** the image?

unable to control image |________________| completely able to control image

3. How **easily** was an image created?

image difficult to create |________________| image easy to create

4. How **quickly** was an image created?

image slow to create |________________| image created quickly

5.How **long** was the image held?

image held for a very short time |________________| image held for the whole time

6. How well did you **see** the image?

no seeing |________________| very clear seeing

7. How well did you **hear** the image?

no hearing |________________| very clear hearing

8. How well did you **feel** the muscular movements of the image?

no feeling |________________| very clear feeling

9. How well did you **smell** the image?

no smell |________________| very clear smell

10. How well did you **taste** the image?

no taste |________________| very clear taste

11. How well did you **feel the texture** of objects within the image?

no feeling |________________| very clear feeling

12. How strong was your **experience of the emotions** generated by the image?

no emotion |________________| very strong emotion

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Your "Home" Venue

Imagine that you have just got changed and made your final preparations for a competition at your "home" venue, where you usually practice and compete. You move out into the playing area and loosen up while you look around and tune in to the familiar place. Take notice of what you see, hear, smell, and taste, and the feel of your muscles moving. Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How **clear** was the image?

no image |________________| perfectly clear

2. How well could you **control** the image?

unable to control image |________________| completely able to control image

3. How **easily** was an image created?

image difficult to create |________________| image easy to create

4. How **quickly** was an image created?

image slow to create |________________| image created quickly

5. How **long** was the image held?

image held for a very short time |________________| image held for the whole time

6. How well did you **see** the image?

no seeing |________________| very clear seeing

7. How well did you **hear** the image?

no hearing |________________| very clear hearing

8. How well did you **feel** the muscular movements of the image?

no feeling |________________| very clear feeling

9. How well did you **smell** the image?

no smell |________________| very clear smell

10. How well did you **taste** the image?

no taste |________________| very clear taste

11. How well did you **feel the texture** of objects within the image?

no feeling |________________| very clear feeling

12. How strong was your **experience of the emotions** generated by the image?

no emotion |________________| very strong emotion

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Recreational Activity

Imagine yourself in a recreational physical activity you enjoy that is different to your chosen sport. Get a clear picture of what you are doing, where you are, and who you are with. Take notice of where you are and everything around you. What is it that you see, hear, smell , and taste? What about the feeling of your muscles, and the feel of the equipment and surfaces you may be using. Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How **clear** was the image?

no image ______________________________ perfectly clear

2. How well could you **control** the image?

unable to control image ______________________________ completely able to control image

3. How **easily** was an image created?

image difficult to create ______________________________ image easy to create

4. How **quickly** was an image created?

image slow to create ______________________________ image created quickly

5.How **long** was the image held?

image held for a very short time ______________________________ image held for the whole time

6. How well did you **see** the image?

no seeing ______________________________ very clear seeing

7. How well did you **hear** the image?

no hearing ______________________________ very clear hearing

8. How well did you **feel** the muscular movements of the image?

no feeling ______________________________ very clear feeling

9. How well did you **smell** the image?

no smell ______________________________ very clear smell

10. How well did you **taste** the image?

no taste ______________________________ very clear taste

11. How well did you **feel the texture** of objects within the image?

no feeling ______________________________ very clear feeling

12. How strong was your **experience of the emotions** generated by the image?

no emotion ______________________________ very strong emotion

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

A Slow Start

Imagine that the competition has been under way for a few minutes. You are having difficulty concentrating and have made some errors. You want to get back on track before it shows on the scoreboard. During a break in play, you take several deep breaths and really focus on a spot just in front of you. Now you switch back to the game much more alert and tuned in. What can you see, hear, smell, and taste? Can you get the feeling of your muscles as you make your movements? Feel the texture of any equipment and the playing surfaces. How does this competition image make you feel emotionally? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How **clear** was the image?

no image |__________________________________| perfectly clear

2. How well could you **control** the image?

unable to control image |__________________________________| completely able to control image

3. How **easily** was an image created?

image difficult to create |__________________________________| image easy to create

4. How **quickly** was an image created?

image slow to create |__________________________________| image created quickly

5.How **long** was the image held?

image held for a very short time |__________________________________| image held for the whole time

6. How well did you **see** the image?

no seeing |__________________________________| very clear seeing

7. How well did you **hear** the image?

no hearing |__________________________________| very clear hearing

8. How well did you **feel** the muscular movements of the image?

no feeling |__________________________________| very clear feeling

9. How well did you **smell** the image?

no smell |__________________________________| very clear smell

10. How well did you **taste** the image?

no taste |__________________________________| very clear taste

11. How well did you **feel the texture** of objects within the image?

no feeling |__________________________________| very clear feeling

12. How strong was your **experience of the emotions** generated by the image?

no emotion |__________________________________| very strong emotion

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Fitness Activity

Imagine yourself doing an activity to improve your fitness for your sport. Get a clear picture of what you are doing, where you are, and who you are with. Take notice of what you see, hear, smell, and taste, and the feel of any muscles moving. Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How **clear** was the image?

no image |________________________________| perfectly clear

2. How well could you **control** the image?

unable to control image |________________________________| completely able to control image

3. How **easily** was an image created?

image difficult to create |________________________________| image easy to create

4. How **quickly** was an image created?

image slow to create |________________________________| image created quickly

5.How **long** was the image held?

image held for a very short time |________________________________| image held for the whole time

6. How well did you **see** the image?

no seeing |________________________________| very clear seeing

7. How well did you **hear** the image?

no hearing |________________________________| very clear hearing

8. How well did you **feel** the muscular movements of the image?

no feeling |________________________________| very clear feeling

9. How well did you **smell** the image?

no smell |________________________________| very clear smell

10. How well did you **taste** the image?

no taste |________________________________| very clear taste

11. How well did you **feel the texture** of objects within the image?

no feeling |________________________________| very clear feeling

12. How strong was your **experience of the emotions** generated by the image?

no emotion |________________________________| very strong emotion

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Successful Competition

Imagine you are competing in a specific event or match for your sport. Imagine that you are at the very end of the competition and the result is going to be close. You pull out a sensational move, shot, or effort to win the competition. What can you see, hear, smell, and taste? Can you get the feeling of your muscles as you make your movements? Take into account the feel of any equipment and playing surfaces. How does this competition image make you feel emotionally? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How **clear** was the image?

no image |______________________________| perfectly clear

2. How well could you **control** the image?

unable to control image |______________________________| completely able to control image

3. How **easily** was an image created?

image difficult to create |______________________________| image easy to create

4. How **quickly** was an image created?

image slow to create |______________________________| image created quickly

5. How **long** was the image held?

image held for a very short time |______________________________| image held for the whole time

6. How well did you **see** the image?

no seeing |______________________________| very clear seeing

7. How well did you **hear** the image?

no hearing |______________________________| very clear hearing

8. How well did you **feel** the muscular movements of the image?

no feeling |______________________________| very clear feeling

9. How well did you **smell** the image?

no smell |______________________________| very clear smell

10. How well did you **taste** the image?

no taste |______________________________| very clear taste

11. How well did you **feel the texture** of objects within the image?

no feeling |______________________________| very clear feeling

12. How strong was your **experience of the emotions** generated by the image?

no emotion |______________________________| very strong emotion

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Appendix B: Expert Evaluation Proforma for SIAM

Review of Multi-Modal, Multi-Dimensional Sport Imagery Ability Questionnaire

Thank you for agreeing to review the following questionnaire. The measure is a task oriented, multi-modal, multi-dimensional test designed to assess imagery ability related to sport. The questionnaire is task-oriented in that participants are asked to decide on a specific version of each of six sport-related scenes in one sport that is meaningful to them and then to image each scene. After imaging each scene, participants rate it on the same twelve items about imagery dimensions (5 items), experience of senses (6 items), and experience of emotion (1 item). The items are based around sports related scenes that should be flexible enough to cater for the imagery abilities of a wide variety of individual sporting experiences.

Following the review of existing imagery measures used in sport psychology and the examination of current imagery theory it was determined that each item should be rated on the following aspects:

1. Dimensions: vividness, control, ease of generation, speed of generation, and length of time the image was held.
2. Sense Modalities: visual, auditory, kinaesthetic, olfactory, gustatory, and tactile.
3. Emotion

It would be appreciated if you would take the time to read the administration instructions and then examine the items by actually completing the questionnaire. Please also feel free to write comments on the questionnaire.

Your feedback to the following questions would be extremely useful: Please circle either 'yes' or 'no' and provide further comments if you wish.

1. Were the administration instructions clear ? **Yes No**

Comments

____

____

____

____

2. Were you able to understand the questionnaire instructions ? **Yes No**

Comments

____

____

____

____

3. Were you able to understand the item format ? **Yes No**

Comments

____

____

____

____

4. In your opinion does the questionnaire adequately examine:

vividness	**Yes** **No**		seeing	**Yes**	**No**
control	**Yes** **No**		hearing	**Yes**	**No**
ease	**Yes** **No**		muscle movement	**Yes**	**No**
speed	**Yes** **No**		tasting	**Yes**	**No**
duration	**Yes** **No**		smelling	**Yes**	**No**
emotion	**Yes** **No**		touching	**Yes**	**No**

Comments

5. Were you able to respond effectively on the rating scales as presented ? **Yes** **No**

Comments

6. Please provide any other comments about this questionnaire.

Comments

Thank you very much for your participation and feedback.
Please return this review sheet and the completed questionnaire by the following date

or contact me so that I can collect your return personally.

My Details are: ***Tony Watt 6 Agnes Street Yarraville 3013***
Tel: 9314 8146 Home 9376 1953 Work Fax: 9376 3594

Appendix C: Summary of Expert Reviews

Summary of Expert Reviews

1. Clarity of Administration Instructions

The general consensus regarding administration instructions were that they were clear, precise and of an acceptable comprehension level. Several of the reviewers suggested refinements including:

- Relax the instructions , avoid putting the participants under any unnecessary pressure
- Too great an importance on the placement of the response cross, more pressure
- No real substantiation as to the choice of 60 seconds as the time for reading item text
- The script should be read aloud for each item
- Additional pre-testing on colleagues

2. Comprehension of Questionnaire Instructions

Most reviewers were able to understand the instructions for the questionnaire. Suggested modifications related to this area included:

- Resolution of confusion relating to the intersection of the cross on the response line
- Vocabulary could be simplified a great deal more

3. Comprehension of the item format

Most of the reviewers made comment regarding particular elements of the item format including:

- Anchors could be improved by being more descriptive. Suggested changes to anchors included generated to created, strong sensation to clear hearing or seeing depending on the modality, drop vivid form vividness item, generated to formed, control image as if actually performing to completely able to control image.
- What is the unit of measure for the response line.
- Change from 9.2 cm to 10 cm line length.
- Mark a 50% point on the response line
- Why 60 seconds reading time
- Language relating to modality items is not clear

4. Adequacy of the examination of imagery concepts

All reviewers found the majority of imagery areas could be suitably examined through this measurement style. Areas that should be examined further were:

- Adequacy of concept examination dependent on units of measure
- Speed and duration items are too subjective
- Modality items heavily weighted toward vividness. They do not refer to control, ease, duration, etc. of modalities
- The single-item self-response format may not be adequate to examine these concepts fully
- Scenarios too general to effectively measure modalities

5. Response to Rating Scales

All reviewers reported that they would be able to respond effectively with this type of rating scale. Areas of concern were:

- The need to go back and review images to make judgements, which may lead to the creation of new images while responding
- Degree of uncertainty as to what the ratings are examining
- Really need to have experienced images recently. However this should not be a problem for the majority of participants

6. Additional Comments

- Requires concentration and motivation to complete all 6 images. May be the need for encouragement
- May show ordering effects in the 12 questions over 6 scenes. These could be learning and fatigue effects
- Essentially a vividness questionnaire for modalities with some duration and speed etc. for overall image added on
- Why include fitness and training scenes? What is the rationale for inclusion?
- Any delay between item presentations should be avoided because of loss of concentration
- Potential for overlap, distortion, corruption of images if scenarios are given too closely together

From: "Robert Middleton" <robmid@actionplan.com> Tue 4:08 PM
Subject: More Clients - Idea Constipation
To: "Wende Moss" <wende.moss@vu.edu.au>

More Clients
the Online Marketing Newsletter
for Independent Professionals
from Action Plan Marketing
and Robert Middleton

Sent to over 19,200 subscribers every Tuesday.
Please pass on More Clients to those in your network.
To leave or change address, follow instructions at bottom.

Idea Constipation (Its Causes and Cure)

One of my favorite models that I use in workshops and talks is the "Person With an Idea" model. It's a little diagram with a stick person with several circles orbiting his/her head like planets. Each circle represents an idea. And then I say...

"This is like you, an Independent Professional with a certain number of ideas spinning around inside your head. And if you're like most people, those same ideas tend to circle endlessly. They become your opinions, points of view and beliefs, as well as your creative ideas."

I continue... "To start becoming a successful InfoGuru Marketer, you need to take one of those ideas, get it out of your head and into the world. Put it into an article, a talk or a service. Transform the idea into something useful that can make a contribution to others."

But here's the most important part: "When you get an idea out of your head and into the real world, something amazing happens. You create space inside your head for a new idea to come in. And then you take that idea and put it out there, and yet another idea pops in. And pretty soon you discover that there are an infinite number of ideas just floating around, waiting to pop into your head... all you need to do is get the old ones out first!"

Sadly, I see many Independent Professionals with "idea constipation."

They have a limited number of ideas inside, and they never get them out into the world. They become stagnant. What was a pretty good idea becomes old and tired. A plan that seemed to hold so much potential becomes outdated. A theory, process or model, once brilliant, turns dull and dogmatic.

These unfulfilled ideas kick around inside their heads until they literally sap their vitality, energy and creativity. Their enthusiasm for business wanes. They feel stuck, and they are.

The symptoms of idea constipation are not always obvious, but they are often characterized by a lot of thinking and talking without a whole lot of action. See if this dialogue sounds familiar:

"I've been working on this idea about teams that could turn around the way a company works."

"Sounds interesting. How long have you been working on it?"

"Oh, about a year."

"Great, do you have an article or report on it?"

"Not yet."

"A talk or a presentation?"

"I'm working on one."

"Anything on your web site?"

"Well, I'll probably get around to it when I get my site up, but I'm afraid someone might steal my idea..."

"OK, are you working with any clients on this yet?"

"Well, I'm not quite ready, but..."

When a client approaches me with idea constipation, I offer him an instant "idea laxative." The prescription goes something like this:

"Sounds like an interesting idea. It might work. What I'd like you to do is write an article on this idea by next week. Here's a pretty simple format that you can use. Run it by me and I'll give you some ideas for tuning it up. Then I'll show you how you can get that idea out there, attracting interest and attention for your business right away."

And as if the "burden of Job" is lifted from their shoulders, they start to work on that article. Sometimes it takes more than a week to complete, but when it's done an amazing, tonic-like action takes place.

The client starts to get new, more creative ideas. They become energized. They see a bigger picture. Their web site copy start to flow. Networking becomes more fun. They write with more passion. The struggle and effort of marketing lets go of its iron-tight grip.

Do you have idea constipation?

Quick, don't wait: write something this week and get it into the hands of as many people as possible. I promise it will make you feel more regular, lifting both your spirits and your business.

More on "Idea Constipation" in Marketing Flashes below.

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Dr. Robert's Marketing Action Tonics - They'll cure what ails ya!

This week I have several marketing remedies, one completely free (at the bottom). Check them out. If you're suffering from idea constipation, they're sure to clean out your system in no time flat ;-)

The "Hold Your Feet to the Fire" Marketing Action Program...

...is almost full. We had 12 spaces; four are left. This is the program for you if you want a weekly dose of marketing elixir. I won't just talk to you. You'll create a new marketing action plan each week. Held virtually by bridge line. Details at:

http://www.actionplan.com/actiongroup.html

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For Those With Bad to Severe Marketing Allergy...

... I'm doing a TeleClass this coming Wednesday the 13th (10 a.m Pacific) on "Overcoming Your Resistance to Marketing Yourself and Your Services." If you find it an ordeal to get your marketing off the ground, this 90-minute program is for you. We have about 12 spaces still open.

http://www.actionplan.com/allergy.html

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The NYC Area Marketing Mastery Workshop on September 19 and 20...

... has just five spaces left. We're holding it to a maximum of 50 new participants, plus ten spaces for clients. If you're anywhere on the Eastern Seaboard, we're just an hour or two away. This is a once-in-a-year opportunity to give your marketing a major shot in the arm.

http://www.actionplan.com/wkp/newjersey.html

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And Finally... A Free TeleClass on Book Publishing

The ultimate way to get your ideas out there is through publishing a book. I'm currently working with my colleague, John Eggen, on a project called. "The World's Greatest Business Mentors," designed to get you virtually instant credibility. John is employing his marketing experience with authors such as Mark Victor Hansen ("Chicken Soup for the Soul" series) and Robert Allen ("Nothing Down" and other financial bestsellers) to publish a book co-authored by top business mentors (like you).

John and I will be co-leading a FREE TeleClass on Wednesday, Augst 20 at 10 am Pacific to discuss the book and how you can participate in this high-level marketing program. We'll also explore some of the myths of the book publishing business, and discuss how a book can be the best marketing tool you'll ever use (or a total waste of time and effort if you don't do it right).

You can tune in by signing up here on the Acteva reservation site:

http://www.acteva.com/booking.cfm?bevaid=52661

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Marketing Flashes on "Idea Constipation"

Marketing Constipation strikes us all. The cure is so simple it often doesn't occur to us: Get the idea out of your head and out into the world. Take the leap from thinking and talking into action. But here are some answers to your "what ifs":

* What if my writing skills are poor? They'll get better the more you write, but at first you may do well to hire a writing coach to help you develop your style. Then continue to use an editor and proofreader to hone your ideas. You'll learn from them and become a better writer.

* What if I'm not yet a top expert? You have to start somewhere. The question to ask is: Do I know more about this topic than the average person who is going to read my article? If that's true, then to them you are an expert. You don't need to be a Pulitzer Prize winner.

* What if my ideas aren't original? Very few ideas these days are totally original. What makes your ideas interesting -- and even compelling -- is the particular personal spin you put on your ideas. The more you write, the more interesting spins you'll come up with.

* What if nobody reads my article? Maybe thousands won't read it, but it's not too hard to get an article out there. Put in on your web site; submit it to other web sites; send it to your clients; use it as a follow-up after meeting someone through networking.

* What if I keep getting stuck? Often we stay stuck because we get overwhelmed by thinking about the whole process. Make a simple, step-by-step action plan: Come up with a topic and a title, outline the article, write the opening, write the main points, write the close.

Get feedback. Done!

One more thing.....

See the new online Marketing Professionals Directory...

... for those who want exposure to a targeted group of businesses who are looking for marketing assistance. We'll list a maximum of 5 InfoGuru-oriented businesses in each category. Reserve a space today.

http://www.actionplan.com/marketingpros.html

Until next week, all the best,

Robert Middleton - Action Plan Marketing

Helping Independent Professionals Attract More Clients

* *

http://www.actionplan.com

210 Riverside Drive
Boulder Creek, CA 95006
831-338-7790

mailto:robmid@actionplan.com

* *

CONTACTING ME. I get about 500 emails a day. I get a lot of questions and it's hard to get to them all. However, if you'd like to explore working with me or having me develop a web site for you, please contact me by email and we'll set up a time to talk. Thanks!

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http://www.actionplan.com/tellafriend.html

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Appendix D: Shortened Marlowe-Crowne Social Desirability Scale

Listed below are a number of statements concerning personal attitudes and traits. Read each item and decide whether the statement is true or false as it pertains to you personally.

Circle either true or false beside each question.

1.	It is sometimes hard for me to go on with my work if I am not encouraged .	T	F
2.	I sometimes feel resentful when I don't get my own way.	T	F
3.	On a few occasions, I have given up doing something because I thought too little of my ability.	T	F
4.	There have been times when I felt like rebelling against people in authority even though I knew they were right.	T	F
5.	No matter who I'm talking to, I'm always a good listener.	T	F
6.	There have been occasions when I took advantage of someone.	T	F
7.	I'm always willing to admit it when I make a mistake.	T	F
8.	I sometimes try to get even rather than forgive and forget.	T	F
9.	I am always courteous, even to people who are disagreeable.	T	F
10.	I have never been irked when people expressed ideas very different from my own.	T	F
11.	There have been times when I was quite jealous of the good fortune of others.	T	F
12.	I am sometimes irritated by people who ask favours of me.	T	F
13.	I have never deliberately said something that hurt someone's feelings.	T	F

Appendix E: Examples of information and consent forms

Information for Participants: Study 2

The accurate assessment of imagery ability will assist coaches and sport psychologists in the preparation of future imagery training programs. Participants will be contributing to the development of a precise measure of imagery ability. which will in turn contribute to the understanding of imagery as a component of sport and exercise psychology, and more broadly, health psychology. Imagery can contribute to performance enhancement in sport, but also personal growth and development, enhancement of self-esteem and confidence, recovery from injury, and stress reduction. It is important that we understand how, and under what conditions, imagery is effective, and measuring imagery ability is central to research on these issues.

Imagery is creating an experience in the mind. We are interested as to how you are able to imagine a range of everyday things, particular movements, and your involvement in specific sporting situations. Everyone images things in their own way, so there are no right or wrong answers. All we want you to do is to report on the images you are creating honestly.

Within this study you will be asked to complete the Sport Imagery Ability Measure (SIAM), which is the measure we have been developing. You will also be asked to complete three other well established imagery questionnaires, the Questionnaire on Mental Imagery, Test of Visual Imagery Control, and Vividness of Movement Imagery Questionnaire. Finally, we would like you to complete two short mental abilities measures, the similarities and spatial visualization subtests of the Multidimensional Aptitude Battery.

Your total involvement will take about one and a half hours, made up of two 45 minute sessions in which you will complete three measures. All testing will be undertaken at a location suitably convenient for yourself and at a suitably agreed time. At any point during the test schedule you wish to ask questions, resolve any concerns, or discuss any issues regarding the research please feel free to do so. I also encourage you to feel free to either contact me on 03-9314 8146, or leave me with your contact details so that I can provide you with feedback regarding your results on the various measures. I wish to take this opportunity to thank you for agreeing to be involved as a participant within my research and hope that the experience will prove rewarding to you as a sportsperson working on advancing our understanding of the sport sciences.

Yours Sincerely

(A. P. Watt)

Parent or Guardian Consent Form: Study 2

Nature of the Study

We would like to invite your child to be a part of a study about imagery, that is creating an experience in the mind. We are developing a new measure of imagery ability. It involves your child imagining a number of common scenes in their own sport and then rating their imagery on the same 12 questions for each scene by putting a cross on a line that indicates the amount of that kind of imagery they experienced. In addition to completing this new measure we would like them to complete three other short imagery measures that also examine how they create and control images. Everyone images things in their own way, so there are **no right or wrong answers**. All your child needs to do is to rate their own imagery honestly. Finally, we would like them to complete two short mental abilities measures. The whole testing procedure will take about two hours and will be divided into two one-hour sessions. Results from the study will be kept totally confidential. They are free to withdraw from the study or stop for a while at any time. They are also encouraged to ask questions at any time if they have any queries.

Informed Consent

I__________________________________, acknowledge that:

The nature of the study has been explained to my child.

They have been given the chance to ask questions.

They may ask further questions at any time.

They have been informed that the results will be confidential.

They may stop or withdraw at any time.

and that I am willing for my child ________________________________to participate in the study under these conditions.

Signed:_________________________________ Date:_________________

Witness other than the experimenter:

Signed:_________________________________ Date:_________________

Any queries about your child's participation in this project may be directed to the researcher (Anthony Watt ph. 03-9314 8146). If you have any queries or complaints about the way you or your child has been treated, you may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone no: 03-9688 4710).

Appendix F: Individual Item EFA of the SIAM

	Factor										
	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00
TRAIN1	0.32	-0.21	0.04	-0.27	-0.12	0.21	0.78	-0.09	-0.07	0.26	0.05
TRAIN2	0.35	-0.29	0.05	-0.26	-0.13	0.22	0.67	-0.05	-0.16	0.31	0.06
TRAIN3	0.30	-0.17	0.00	-0.23	-0.20	0.21	0.77	-0.04	0.18	0.22	0.07
TRAIN4	0.26	-0.14	-0.04	-0.18	-0.10	0.16	0.60	-0.03	0.31	0.15	0.01
TRAIN5	0.25	-0.28	-0.02	-0.27	-0.26	0.20	0.63	-0.05	-0.21	0.25	0.03
TRAIN6	0.27	-0.16	0.05	-0.28	-0.14	0.26	0.76	-0.08	-0.02	0.22	0.03
TRAIN7	0.20	-0.21	0.17	-0.17	-0.10	0.15	0.38	-0.08	-0.13	0.46	0.29
TRAIN8	0.24	-0.19	0.04	-0.27	-0.19	0.21	0.43	-0.27	-0.13	0.59	0.20
TRAIN9	0.12	-0.15	0.45	-0.12	-0.12	0.05	0.24	-0.09	-0.05	0.62	0.17
TRAIN10	0.12	-0.12	0.37	-0.08	-0.12	0.05	0.20	-0.11	-0.04	0.64	0.07
TRAIN11	0.22	-0.21	0.18	-0.21	-0.27	0.26	0.40	-0.30	-0.16	0.53	0.30
TRAIN12	0.26	-0.19	0.11	-0.31	-0.23	0.26	0.51	-0.43	-0.11	0.45	0.14
HOMVEN1	0.26	-0.21	0.08	-0.16	-0.33	0.86	0.30	-0.06	-0.06	0.08	0.06
HOMVEN2	0.30	-0.27	0.04	-0.21	-0.28	0.75	0.20	-0.02	-0.24	0.13	0.01
HOMVEN3	0.23	-0.22	0.03	-0.12	-0.28	0.86	0.25	-0.02	0.16	0.07	0.04
HOMVEN4	0.21	-0.22	-0.01	-0.09	-0.28	0.76	0.20	0.04	0.27	0.08	0.03
HOMVEN5	0.30	-0.26	0.03	-0.19	-0.36	0.76	0.14	-0.04	-0.33	0.11	0.13
HOMVEN6	0.29	-0.15	0.07	-0.19	-0.37	0.82	0.30	-0.02	-0.07	0.09	0.12
HOMVEN7	0.23	-0.14	0.17	-0.12	-0.23	0.57	0.14	-0.04	-0.27	0.24	0.29
HOMVEN8	0.25	-0.21	0.08	-0.19	-0.31	0.57	0.16	-0.16	-0.32	0.37	0.33
HOMVEN9	0.17	-0.16	0.48	-0.15	-0.24	0.37	0.13	-0.10	-0.20	0.49	0.27
HOMVEN10	0.15	-0.11	0.56	-0.11	-0.24	0.33	0.06	-0.04	-0.20	0.49	0.28
HOMVEN11	0.27	-0.29	0.24	-0.20	-0.33	0.52	0.13	-0.29	-0.22	0.35	0.35
HOMVEN12	0.28	-0.23	0.11	-0.14	-0.34	0.63	0.18	-0.39	-0.14	0.26	0.24
RECREAT1	0.26	-0.10	0.05	-0.87	-0.19	0.17	0.30	-0.03	-0.04	0.07	-0.02
RECREAT2	0.23	-0.20	0.07	-0.80	-0.25	0.15	0.27	-0.07	-0.11	0.13	-0.16
RECREAT3	0.22	-0.09	0.01	-0.81	-0.18	0.16	0.35	0.01	0.17	0.08	0.00

RECREAT4	0.24	-0.09	0.01	-0.77	-0.19	0.17	0.26	0.08	0.16	0.13	0.01
RECREAT5	0.26	-0.21	0.10	-0.79	-0.25	0.14	0.26	-0.10	-0.20	0.14	-0.02
RECREAT6	0.25	-0.12	0.08	-0.84	-0.21	0.18	0.31	-0.06	-0.03	0.07	0.05
RECREAT7	0.12	-0.14	0.26	-0.57	-0.18	0.11	0.17	-0.20	-0.18	0.22	0.27
RECREAT8	0.18	-0.11	0.24	-0.67	-0.17	0.14	0.17	-0.30	-0.23	0.24	0.27
RECREAT9	0.13	-0.13	0.55	-0.46	-0.18	0.13	0.08	-0.21	-0.16	0.41	0.16
RECREA10	0.07	-0.11	0.56	-0.40	-0.13	0.08	0.01	-0.14	-0.16	0.40	0.16
RECREA11	0.25	-0.15	0.25	-0.65	-0.22	0.16	0.15	-0.36	-0.17	0.21	0.25
RECREA12	0.20	-0.16	0.28	-0.68	-0.21	0.09	0.17	-0.47	-0.09	0.23	0.13
SLOSTAR1	0.22	-0.89	0.11	-0.22	-0.31	0.27	0.30	-0.04	-0.10	0.11	0.17
SLOSTAR2	0.25	-0.89	0.10	-0.14	-0.33	0.27	0.26	-0.02	-0.10	0.13	0.15
SLOSTAR3	0.13	-0.92	0.07	-0.13	-0.28	0.20	0.24	0.00	0.03	0.15	0.16
SLOSTAR4	0.14	-0.86	0.07	-0.12	-0.31	0.19	0.17	0.01	0.07	0.15	0.13
SLOSTAR5	0.21	-0.86	0.12	-0.10	-0.37	0.23	0.19	-0.02	-0.23	0.09	0.19
SLOSTAR6	0.19	-0.89	0.14	-0.13	-0.32	0.25	0.23	-0.01	-0.09	0.14	0.19
SLOSTAR7	0.13	-0.55	0.38	-0.12	-0.22	0.17	0.13	-0.06	-0.08	0.16	0.54
SLOSTAR8	0.23	-0.61	0.23	-0.18	-0.32	0.22	0.13	-0.21	-0.14	0.29	0.55
SLOSTAR9	0.09	-0.42	0.63	-0.10	-0.19	0.12	0.06	-0.04	-0.11	0.26	0.51
SLOSTA10	0.05	-0.36	0.67	-0.13	-0.13	0.09	0.03	-0.03	-0.05	0.26	0.48
SLOSTA11	0.15	-0.63	0.24	-0.16	-0.32	0.22	0.14	-0.22	-0.11	0.24	0.54
SLOSTA12	0.16	-0.74	0.13	-0.19	-0.32	0.20	0.18	-0.37	-0.09	0.17	0.31
FITACT1	0.87	-0.17	0.04	-0.26	-0.21	0.27	0.33	-0.07	-0.02	0.09	0.04
FITACT2	0.86	-0.23	0.10	-0.21	-0.21	0.25	0.32	-0.16	-0.13	0.15	0.00
FITACT3	0.89	-0.18	0.01	-0.24	-0.20	0.23	0.29	-0.05	0.05	0.09	0.06
FITACT4	0.84	-0.16	-0.01	-0.22	-0.21	0.27	0.29	-0.02	0.08	0.08	0.04
FITACT5	0.76	-0.18	0.12	-0.17	-0.21	0.25	0.28	-0.15	-0.25	0.09	0.04
FITACT6	0.86	-0.11	0.12	-0.19	-0.23	0.30	0.34	-0.12	-0.07	0.13	0.05
FITACT7	0.52	-0.17	0.34	-0.27	-0.23	0.23	0.26	-0.26	-0.18	0.18	0.35
FITACT8	0.65	-0.13	0.18	-0.27	-0.24	0.28	0.25	-0.42	-0.21	0.28	0.24
FITACT9	0.32	-0.10	0.66	-0.21	-0.08	0.11	0.12	-0.33	-0.22	0.33	0.23

FITACT10	0.25	-0.09	0.70	-0.18	-0.05	0.12	0.10	-0.33	-0.16	0.31	0.20
FITACT11	0.56	-0.15	0.31	-0.19	-0.20	0.17	0.20	-0.43	-0.11	0.25	0.30
FITACT12	0.53	-0.16	0.28	-0.20	-0.28	0.20	0.21	-0.56	-0.07	0.30	0.22
SUCCOMP1	0.30	-0.39	0.08	-0.29	-0.89	0.38	0.20	-0.07	-0.04	0.12	0.05
SUCCOMP2	0.28	-0.37	0.08	-0.24	-0.85	0.37	0.17	-0.08	-0.16	0.15	0.11
SUCCOMP3	0.24	-0.28	0.02	-0.20	-0.88	0.31	0.13	-0.04	0.08	0.14	0.07
SUCCOMP4	0.19	-0.27	0.01	-0.18	-0.84	0.31	0.15	0.04	0.12	0.13	0.05
SUCCOMP5	0.22	-0.32	0.07	-0.18	-0.80	0.31	0.14	-0.09	-0.18	0.09	0.07
SUCCOMP6	0.23	-0.26	0.10	-0.21	-0.84	0.35	0.20	-0.09	-0.02	0.07	0.04
SUCCOMP7	0.12	-0.24	0.29	-0.16	-0.63	0.22	0.11	-0.18	-0.14	0.20	0.23
SUCCOMP8	0.23	-0.25	0.23	-0.24	-0.65	0.25	0.08	-0.32	-0.17	0.28	0.40
SUCCOMP9	0.10	-0.16	0.76	-0.18	-0.40	0.14	0.00	-0.16	-0.11	0.43	0.31
SUCCOM10	0.09	-0.17	0.74	-0.18	-0.37	0.13	0.02	-0.15	-0.07	0.41	0.28
SUCCOM11	0.21	-0.26	0.34	-0.19	-0.61	0.26	0.10	-0.37	-0.16	0.32	0.40
SUCCOM12	0.17	-0.28	0.17	-0.23	-0.66	0.24	0.11	-0.49	-0.07	0.21	0.18

Appendix G: Revised SIAM

Code:__________________

Date:__________________

Sport Imagery Activities Form

Age:__________________

Gender:_______________

Highest Level of Sports Participation: (Tick appropriate box).

Local/school ☐

District ☐

State ☐

National ☐

Main Sport Interest:____________________________

Second Sport Interest:___________________________

Introduction

This questionnaire involves creating images of four situations in sport. After you image each scene, you will rate the imagery on twelve scales. For each rating, <u>place a cross on the line</u> at the point you feel best represents the image you produced. The left end of the line represents no image or sensation or feeling at all and the right end represents a very clear or strong image or feeling or sensation.
Ensure the ***intersection*** of the cross is on the line as shown in the examples below.

Correct |-----------X---------------------|

Incorrect |-----X--------------------x----|

An **example** of the style of scene to be created is as follows:

You are at a carnival, holding a bright yellow, brand new tennis ball in your right hand. You are about to throw it at a pyramid of six blue and red painted cans. A hit will send the cans flying and win you a prize. You grip the ball with both hands to help release the tension, raise the ball to your lips and kiss it for luck, noticing its soft new wool texture and rubber smell. You loosen your throwing arm with a shake and, with one more look at the cans, you throw the ball. Down they all go with a loud "crash" and you feel great.

Below are some possible ratings and what they represent to give you the idea.

1. How **clear** was the image ?

no image |----X---------------------------| perfectly clear image

This example shows an image was experienced but was quite unclear

6. How well did you **feel the muscular movements** within the image?

no feeling |--------------------------X----| very strong feeling

This example indicates very strong imagery of the feel of muscular movements

7. How well did you **hear** the image?

no hearing |------------------------------X| very clear hearing

This example reflects the strongest possible image, like hearing the real sound

12. How strong was your **experience of the emotions** generated by the image?

no emotion |----------------X---------------| very strong emotion

This example reflects a degree of emotion which is moderate

Do you have any questions regarding the imagery activity or the way you should respond using the rating scales? Please feel free to ask now.

<u>DO NOT TURN THE PAGE</u> UNTIL YOU ARE ASKED TO DO SO.

Please attempt the following practice question. Listen carefully to all the instructions. Note that this question does not count. It is here to help you get used to imaging and rating your experience

Fitness Activity

Imagine yourself doing an activity to improve your fitness for your sport. Get a clear picture of what you are doing, where you are, and who you are with. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you get the sensation of **taste** within the image?

no taste ______________________________ very clear taste

2. How **long** was the image held?

image held for a very short time ______________________________ image held for the whole time

3. How well did you **feel the texture** of objects within the image?

no feeling ______________________________ very clear feeling

4. How **clear** was the image?

no image ______________________________ perfectly clear

5. How well did you **hear** the image?

no hearing ______________________________ very clear hearing

6. How **easily** was an image created?

image difficult to create ______________________________ image easy to create

7. How well did you **see** the image?

no seeing ______________________________ very clear seeing

8. How **quickly** was an image created?

image slow to create ______________________________ image created quickly

9. How strong was your **experience of the emotions** generated by the image?

no emotion ______________________________ very strong emotion

10. How well did you **feel** the muscular movements within the image?

no feeling ______________________________ very strong feeling

11. How well could you **control** the image?

unable to control image ______________________________ completely able to control image

12. How well did you get the sensation of **smell** within the image?

no smell ______________________________ very clear smell

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Your "Home" Venue

Imagine that you have just got changed and made your final preparations for a competition at your "home" venue, where you usually practice and compete. You move out into the playing area and loosen up while you look around and tune in to the familiar place. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **feel the texture** of objects within the image?

no feeling ____________________ very clear feeling

2. How **clear** was the image?

no image ____________________ perfectly clear

3. How well did you get the sensation of **taste** within the image?

no taste ____________________ very clear taste

4. How **long** was the image held?

image held for a very short time ____________________ image held for the whole time

5. How well did you **hear** the image?

no hearing ____________________ very clear hearing

6. How **easily** was an image created?

image difficult to create ____________________ image easy to create

7. How strong was your **experience of the emotions** generated by the image?

no emotion ____________________ very strong emotion

8. How well did you **see** the image?

no seeing ____________________ very clear seeing

9. How well did you **feel** the muscular movements within the image?

no feeling ____________________ very strong feeling

10. How well could you **control** the image?

unable to control image ____________________ completely able to control image

11. How well did you get the sensation of **smell** within the image?

no smell ____________________ very clear smell

12. How **quickly** was an image created?

image slow to create ____________________ image created quickly

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Successful Competition

Imagine you are competing in a specific event or match for your sport. Imagine that you are at the very end of the competition and the result is going to be close. You pull out a sensational move, shot, or effort to win the competition. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **see** the image?

no seeing ____ very clear seeing

2. How **quickly** was an image created?

image slow to create ____ image created quickly

3. How strong was your **experience of the emotions** generated by the image?

no emotion ____ very strong emotion

4. How **clear** was the image?

no image ____ perfectly clear

5. How well did you get the sensation of **taste** within the image?

no taste ____ very clear taste

6. How well could you **control** the image?

unable to control image ____ completely able to control image

7. How well did you get the sensation of **smell** within the image?

no smell ____ very clear smell

8. How **easily** was an image created?

image difficult to create ____ image easy to create

9. How well did you **feel the texture** of objects within the image?

no feeling ____ very clear feeling

10. How **long** was the image held?

image held for a very short time ____ image held for the whole time

11. How well did you **feel** the muscular movements within the image?

no feeling ____ very strong feeling

12. How well did you **hear** the image?

no hearing ____ very clear hearing

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

A Slow Start

Imagine that the competition has been under way for a few minutes. You are having difficulty concentrating and have made some errors. You want to get back on track before it shows on the scoreboard. During a break in play, you take several deep breaths and really focus on a spot just in front of you. Now you switch back to the game much more alert and tuned in. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How strong was your **experience of the emotions** generated by the image?

no emotion ____________________ very strong emotion

2. How **easily** was an image created?

image difficult to create ____________________ image easy to create

3. How well did you **feel the texture** of objects within the image?

no feeling ____________________ very clear feeling

4. How well could you **control** the image?

unable to control image ____________________ completely able to control image

5. How well did you get the sensation of **smell** within the image?

no smell ____________________ very clear smell

6. How **clear** was the image?

no image ____________________ perfectly clear

7. How well did you **hear** the image?

no hearing ____________________ very clear hearing

8. How **quickly** was an image created?

image slow to create ____________________ image created quickly

9. How well did you get the sensation of **taste** within the image?

no taste ____________________ very clear taste

10. How **long** was the image held?

image held for a very short time ____________________ image held for the whole time

11. How well did you **see** the image?

no seeing ____________________ very clear seeing

12. How well did you **feel** the muscular movements within the image?

no feeling ____________________ very strong feeling

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Training Session
Think of a drill you do in training that is really tough. Now imagine yourself doing the drill. As you get a picture of yourself performing the skill in practice, try to complete an entire routine or drill. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **feel** the muscular movements within the image?

no feeling ____________________ very strong feeling

2. How well could you **control** the image?

unable to control image ____________________ completely able to control image

3. How well did you **hear** the image?

no hearing ____________________ very clear hearing

4. How **long** was the image held?

image held for a very short time ____________________ image held for the whole time

5. How well did you get the sensation of **taste** within the image?

no taste ____________________ very clear taste

6. How well did you **see** the image?

no seeing ____________________ very clear seeing

7. How **easily** was an image created?

image difficult to create ____________________ image easy to create

8. How strong was your **experience of the emotions** generated by the image?

no emotion ____________________ very strong emotion

9. How **quickly** was an image created?

image slow to create ____________________ image created quickly

10. How well did you get the sensation of **smell** within the image?

no smell ____________________ very clear smell

11. How **clear** was the image?

no image ____________________ perfectly clear

12. How well did you **feel the texture** of objects within the image?

no feeling ____________________ very clear feeling

Check that you have placed a cross on all 12 lines.
DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Appendix H: Randomized Short Form of the Questionnaire on Mental Imagery

The Randomized Short Betts' Questionnaire Upon Mental Imagery

The aim of this questionnaire is to determine the vividness of your imagery. Each of the items will bring certain images to mind. You are to rate the vividness of each image by reference to the rating scale given below. For example, if your image is "vague and dim" you would give it a rating of 5. Record your answer in the brackets provided after each item. Before you turn to the items on the next page, familiarise yourself with the different categories on the rating scale. A copy of this scale is printed on each page. Please do not turn over a page until you have completed each item, in the order given, on the page you are doing. Do not turn back to check on other items you have done. Try to do each item separately---independent of how you may have done other items.

The image aroused by an item may be:

Perfectly clear and vivid as the actual experience	Rating 1
Very clear and comparable in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3
Not clear or vivid, but recognisable	Rating 4
Vague and dim	Rating 5
So vague and dim as to be hardly discernible	Rating 6
No image present at all, you only "know" that you are thinking of the object	Rating 7

An example of an item on this questionnaire might be one which asked you to consider an image which comes to your 'mind's eye,' of a red apple. If your visual image is "moderately clear and vivid" you would check the rating scale and mark 3 in the brackets as follows:

Item	Rating
Seeing a red apple	(3)

Now turn to the next page when you have understood these instructions and begin.

Imagine	Rating
1. Feeling the warmth of a tepid bath.	( )
2. Seeing, for a relative or friend, the different colours worn in some familiar clothes	( )
3. The sensation of fatigue.	( )
4. Smelling an ill-ventilated room.	( )
5. Seeing, for a relative or friend, the characteristic poses of head, attitudes of body, etc.	( )
6. Tasting granulated white sugar.	( )
7. Performing the act of running upstairs.	( )
8. The sensation of a sore throat.	( )
9. Hearing an ambulance siren.	( )
10. The sensation of drowsiness.	( )
11. Feeling sand.	( )
12. Seeing, for a relative or friend, the exact contour of face, head, shoulders, and body.	( )
13. Feeling linen.	( )
14. Tasting jelly.	( )
15. Hearing the sound of hands clapping in applause.	( )
16. Tasting salt.	( )
17. Smelling the scent of a rose.	( )

The image aroused by an item may be:

Perfectly clear and vivid as the actual experience	Rating 1
Very clear and comparable in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3
Not clear or vivid, but recognisable	Rating 4
Vague and dim	Rating 5
So vague and dim as to be hardly discernible	Rating 6
No image present at all, you only "know" that you are thinking of the object	Rating 7

Imagine	Rating
18. Hearing the mewing of a cat.	( )
19. Smelling fresh paint.	( )
20. Seeing, for a relative or friend , the precise carriage, length of step, etc., in walking.	( )
21. Hearing the sound of a car horn.	( )
22. Performing the act of springing across a gutter.	( )
23. Feeling the prick of a pin.	( )
24. Smelling cooking cabbage.	( )
25. Performing the act of drawing a circle on paper.	( )
26. Smelling roast beef.	( )
27. Performing the act of reaching up to a high shelf.	( )
28. Tasting oranges.	( )
29. The sensation of hunger.	( )
30. Performing the act of kicking something out of the way.	( )
31. Hearing the sound of children singing.	( )
32. Tasting your favourite soup.	( )
33. Feeling fur.	( )
34. Seeing the colour and shine of silverware.	( )
35. The sensation of repletion, as from a full meal.	( )

The image aroused by an item may be:

Perfectly clear and vivid as the actual experience	Rating 1
Very clear and comparable in vividness to the actual experience	Rating 2
Moderately clear and vivid	Rating 3
Not clear or vivid, but recognisable	Rating 4
Vague and dim	Rating 5
So vague and dim as to be hardly discernible	Rating 6
No image present at all, you only "know" that you are thinking of the object	Rating 7

Appendix I: Gordon Test of Visual Imagery Control

Controllability of Visual Imagery Questionnaire

The questions asked on the next page are concerned with the ease with which you can control or manipulate visual images. For some people this task is relatively easy, and for others relatively hard. One participant who could not manipulate his image easily gave this illustration. He visualised a table, one of whose legs suddenly began to collapse. He then tried to visualise another table with four solid legs, but found it impossible. The image of the first table with its collapsing leg persisted. Another participant reported that when he visualised a table the image was rather vague and dim. He could visualise it briefly, but it was difficult to retain by any voluntary effort. In both these illustrations the participants had difficulty in controlling or manipulating their visual imagery. It is perhaps important to emphasise that these expectations are in no way unusual.

Read each question, then try to visualise the scene described. Record your answer by underlining "Yes," "No," or "Unsure," whichever is the most appropriate. Remember that your accurate and honest answer to these questions is most important for the validity of the result. If you have any doubts at all regarding the answer to a question, underline "Unsure." Please be certain that you answer each of the twelve questions.

1. Can you see a car standing on the road in front of a house? Yes No Unsure

2. Can you see it in colour? Yes No Unsure

3. can you now see it in a different colour? Yes No Unsure

4. Can you now see the same car lying upside down? Yes No Unsure

5. Can you now see the same car back on its four wheels again? Yes No Unsure

6. Can you see the car running along the road? Yes No Unsure

7. Can you see it climb up a very steep hill? Yes No Unsure

8. Can you see it climb over the top? Yes No Unsure

9. Can you see it get out of control and crash through a house? Yes No Unsure

10. Can you now see the same car running along the road with a handsome couple inside? Yes No Unsure

11. Can you see the car cross a bridge and fall over the side into the stream below? Yes No Unsure

12. Can you see the car all old and dismantled in a car cemetery? Yes No Unsure

Appendix J: Vividness of Movement Imagery Questionnaire-II

Vividness of Movement Imagery Questionnaire Mark-II

Movement imagery refers to the ability to imagine a movement. The aim of this test is to determine the vividness of your movement imagery. The items of the test are designed to bring certain images to your mind. You are asked to rate the vividness of each item by reference to the 5-point scale.

After each item, write the appropriate number in the box provided. The first box is for a visual image obtained watching somebody else, the second box is for a visual image obtained doing it yourself, and the third box is for an image associated with the feel (kinaesthetic sensation) of the movement. Try to respond to each item separately, independently of how you may have responded to other items.

Firstly, complete all items obtained watching somebody else. Secondly, return to the beginning of the questionnaire and rate the image obtained doing it yourself. Finally, return to the beginning and rate the kinaesthetic or feel image. The three ratings for a given item may not be the same in all cases. While you are imaging you may have your eyes **OPEN** or **CLOSED**.

Rating Scale

The image aroused by each move might be:	
Perfectly clear and vivid as normal	Rating 1
Clear and reasonably vivid	Rating 2
Moderately clear and vivid	Rating 3
Vague and dim	Rating 4
No image present at all, you only "know" that you are thinking of the skill	Rating 5

Think of each of the following moves and classify the image according to the degree of clearness, vividness and feel as shown on the Rating Scale.

Moves	**Watching Somebody Else**	**Watching Yourself**	**Feeling It Yourself**
1. Standing	☐	☐	☐
2. Walking	☐	☐	☐
3. Running	☐	☐	☐
4. Jumping	☐	☐	☐
5. Reaching for something on tiptoe	☐	☐	☐
6. Bending to pick up a coin	☐	☐	☐
7. Falling forwards	☐	☐	☐
8. Balancing on one leg	☐	☐	☐
9. Climbing over a high wall	☐	☐	☐

Rating Scale

The image aroused by each move might be:	
Perfectly clear and vivid as normal	Rating 1
Clear and reasonably vivid	Rating 2
Moderately clear and vivid	Rating 3
Vague and dim	Rating 4
No image present at all, you only "know" that you are thinking of the skill	Rating 5

Think of each of the following moves and classify the image according to the degree of clearness, vividness and feel as shown on the Rating Scale.

Moves	**Watching Somebody Else**	**Watching Yourself**	**Feeling It Yourself**
10 Throwing a stone into water	☐	☐	☐
11. Kicking a ball into the air	☐	☐	☐
12. Catching a ball with two hands	☐	☐	☐
13. Hitting a ball with a bat	☐	☐	☐
14. Running downhill	☐	☐	☐
15. Slipping over backwards	☐	☐	☐
16. Jumping into water	☐	☐	☐
17. Swinging on a rope	☐	☐	☐
18. Jumping off a high wall	☐	☐	☐

Rating Scale

The image aroused by each move might be:	
Perfectly clear and vivid as normal	Rating 1
Clear and reasonably vivid	Rating 2
Moderately clear and vivid	Rating 3
Vague and dim	Rating 4
No image present at all, you only "know" that you are thinking of the skill	Rating 5

Tick the appropriate box:
Did you answer the items

with your eyes Closed ☐ Open ☐ Both ☐

Are you Right Handed ☐ Left Handed ☐ Mixed ☐

Appendix K: Spatial and similarities subtests of MAB

MULTIDIMENSIONAL APTITUDE BATTERY

SPATIAL

The purpose of the next test is to find out how well you can see the differences in figures. Each problem in this test consists of one figure on the left of a vertical line and five figures on the right. You are to decide which of the five figures on the right is the **same** as the figure on the left.

Look at question Y.

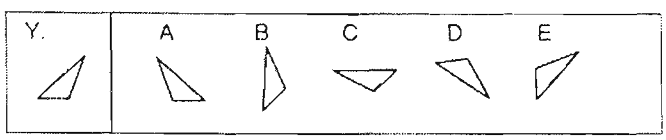
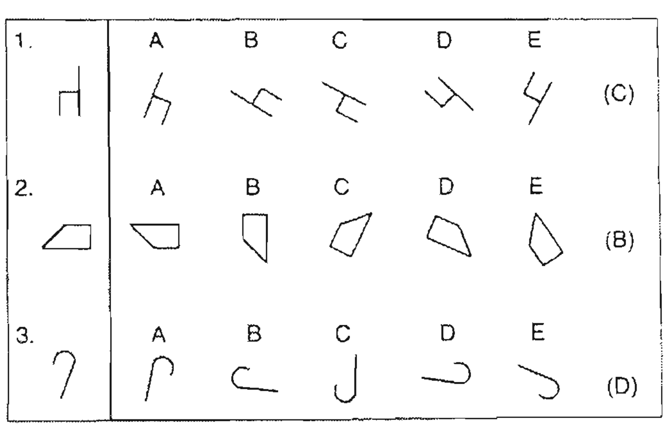


Figure B is the same as the figure on the left, so you would black out the space next to B on your answer sheet. Figure B can be made to look like the figure on the left by turning it into a different position on the page. Figures A, C, D, and E are **not** the same. They cannot be made to look like the figure on the left by turning them on the page. They would have to be **flipped over.**

Practice on the following sample problems. The correct answer is indicated to the right of each problem.

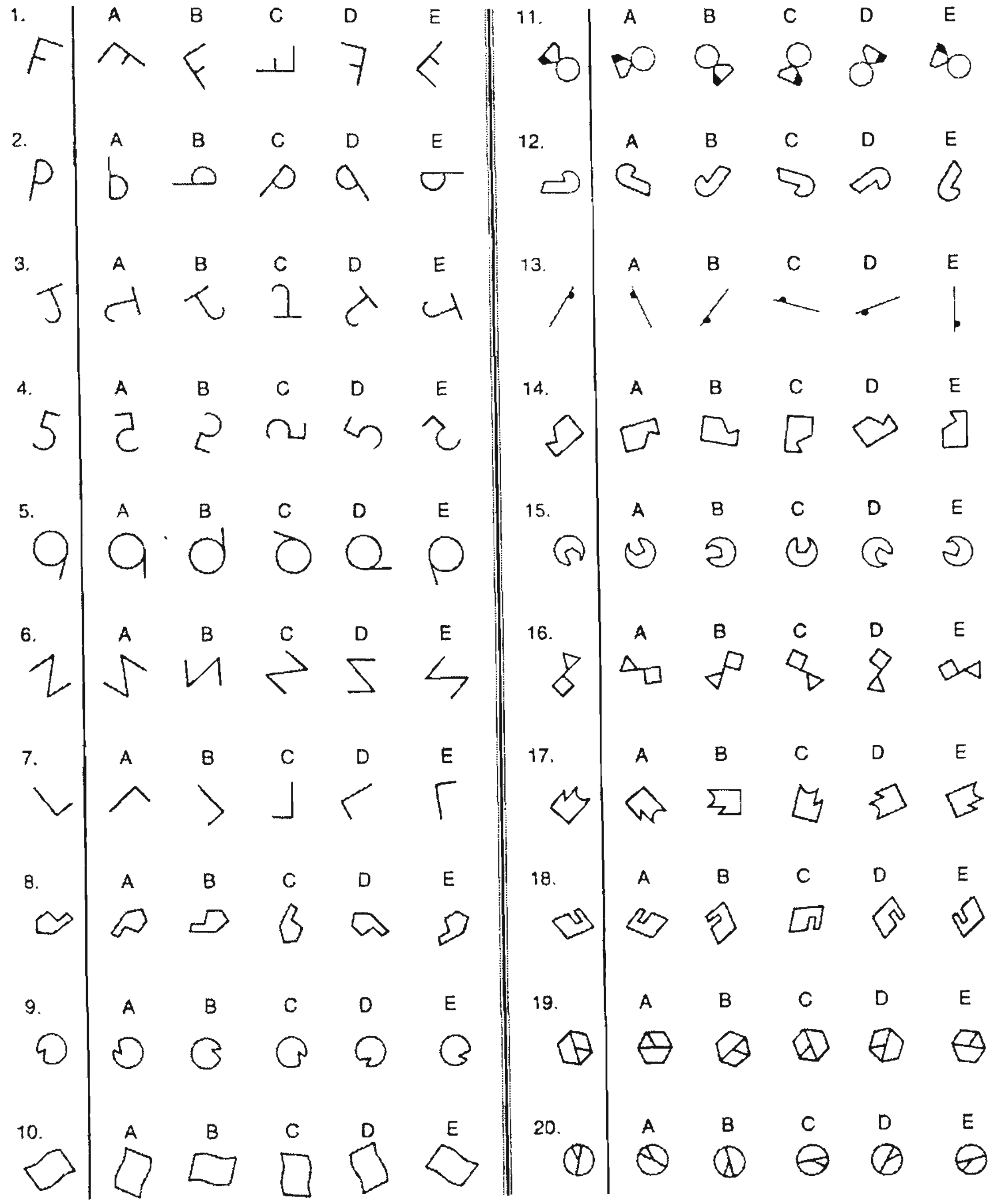


In marking your answers on the answer sheet, be sure that the number of the question you have just read is the same as the number on the answer sheet.

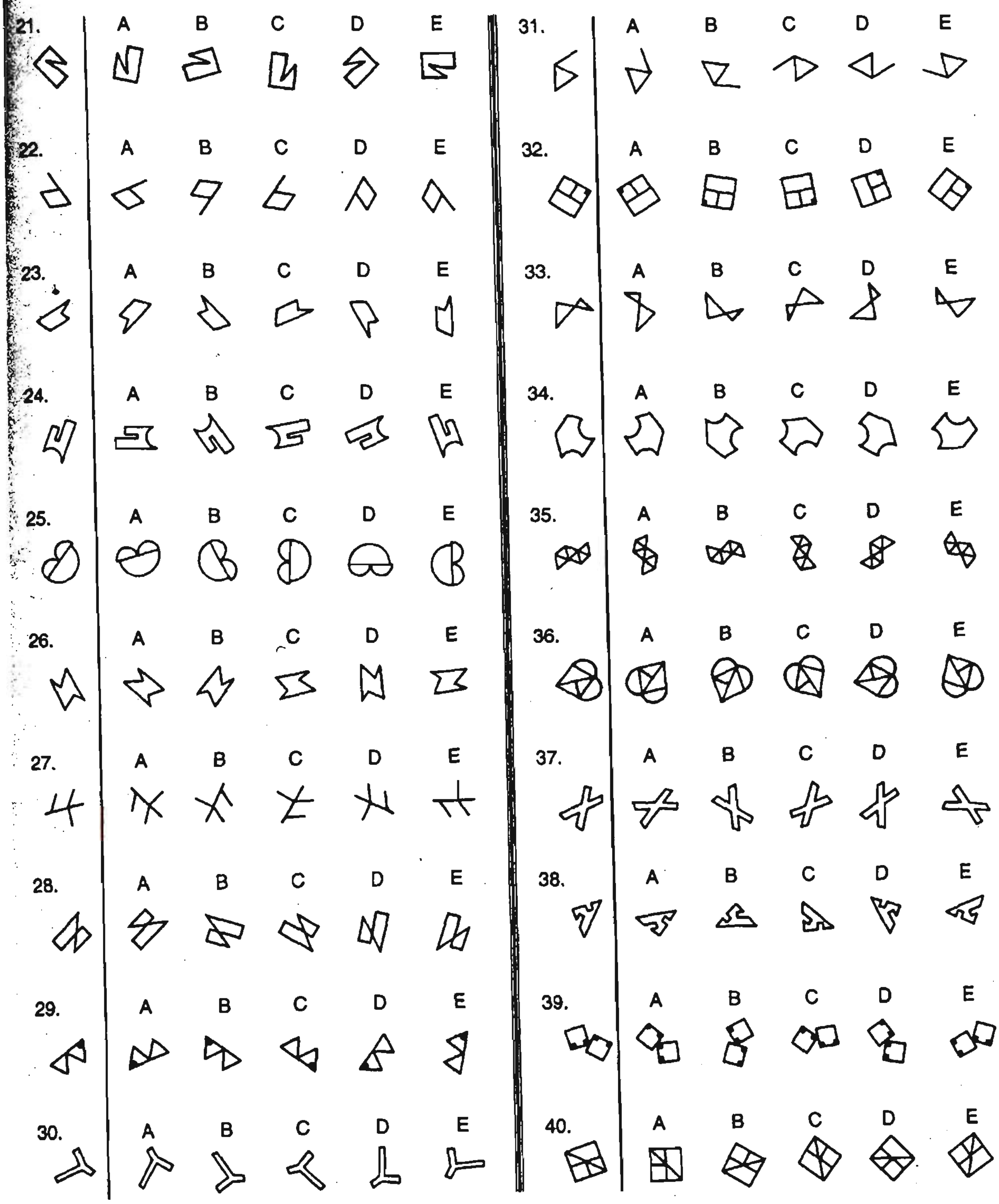
At a signal from the examiner, turn the page and begin with the first question. Continue until time is called. Work quickly.

WAIT FOR THE SIGNAL

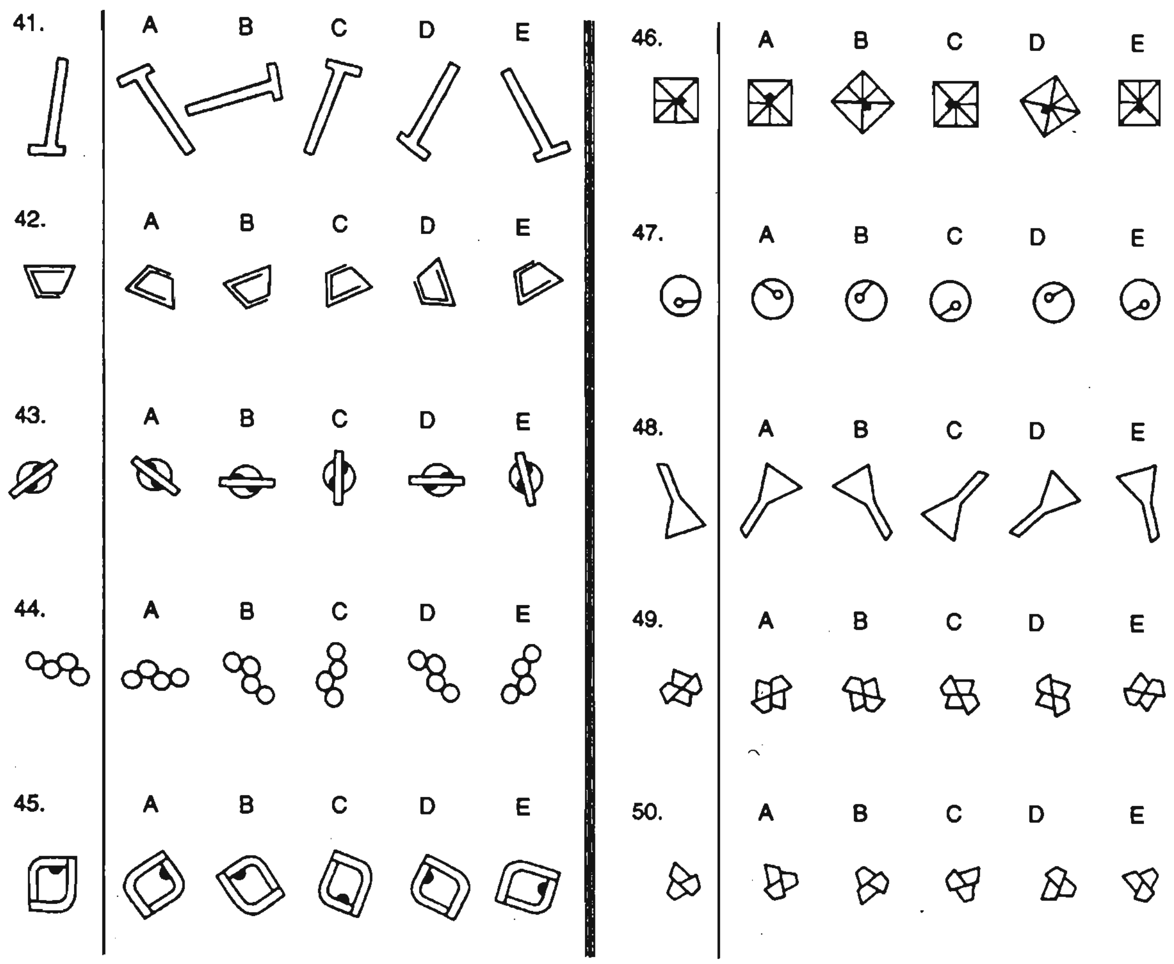
P3


1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
5. A B C D E
6. A B C D E
7. A B C D E
8. A B C D E
9. A B C D E
10. A B C D E
11. A B C D E
12. A B C D E
13. A B C D E
14. A B C D E
15. A B C D E
16. A B C D E
17. A B C D E
18. A B C D E
19. A B C D E
20. A B C D E

P3


21. A B C D E
22. A B C D E
23. A B C D E
24. A B C D E
25. A B C D E
26. A B C D E
27. A B C D E
28. A B C D E
29. A B C D E
30. A B C D E
31. A B C D E
32. A B C D E
33. A B C D E
34. A B C D E
35. A B C D E
36. A B C D E
37. A B C D E
38. A B C D E
39. A B C D E
40. A B C D E

P3



41. A B C D E
42. A B C D E
43. A B C D E
44. A B C D E
45. A B C D E
46. A B C D E
47. A B C D E
48. A B C D E
49. A B C D E
50. A B C D E

V4

MULTIDIMENSIONAL APTITUDE BATTERY

SIMILARITIES

Listed below are pairs of words. You are to decide in what way they are the same and then mark the answer which **best** describes how they are alike.

Look at the following example:

How are a knife and a spoon alike?
A. they have different shapes.
B. a knife is more dangerous than a spoon.
C. they are both used to eat soup.
D. they both weigh less than a pound.
E. both are used for eating.

The correct answer is E. Answers A and B are not similarities; answer C is not generally true. Answer D is true, but it is not the **most important** way in which a knife is like a spoon.

As soon as the examiner gives the signal, turn the page and begin. Mark your choices on the answer sheet. You have **seven minutes**. Continue working until time is called, working **only** on this section of the test.

WAIT FOR THE SIGNAL

V4

1. How are motion pictures and novels alike?
   A. both tell a story
   B. contain pictures
   C. take a long time to finish
   D. have more than one author
   E. both are fictional

2. How are longitude and latitude alike?
   A. map co-ordinates
   B. one runs vertically, the other horizontally
   C. psychological measurements
   D. useful to people
   E. mechanical tools

3. How are bears and foxes alike?
   A. people fear them both
   B. they look alike
   C. one has black fur, the other brown
   D. both are animals
   E. both attack

4. How are length and width alike?
   A. tell how tall an object is
   B. dimensions of measurement
   C. width and length are always equal
   D. one cannot go without the other
   E. the area of a square is length multiplied by width

5. How are music and painting alike?
   A. forms of artistic expression
   B. people make them
   C. people go to their exhibitions
   D. people like them
   E. one is appreciated auditorily, the other visually

6. How are Farenheit and Centigrade (or Celsius) alike?
   A. found on a speedometer
   B. measures of temperature
   C. Christmas themes
   D. musical notes
   E. ancient Greek kings

7. How are a pen and a pencil alike?
   A. one writes in ink, the other in lead
   B. both are narrow in length
   C. both are writing implements
   D. they sound the same
   E. a pen is used more often than a pencil

8. How are rakes and shovels alike?
   A. used for forest fires
   B. outdoor implements
   C. both have handles
   D. made of metal
   E. people enjoy using them

9. How are skiing and swimming alike?
   A. one occurs during the winter, the other during t summer
   B. not everyone likes them
   C. both are good for you
   D. must be competitive
   E. both are sports

10. How are brick and wood alike?
   A. are always the same color
   B. easily burned
   C. construction materials
   D. farmers use both
   E. natural products

11. How are candies and cakes alike?
   A. sweet and rich delicacies
   B. candy is bad for your teeth
   C. one can bake them
   D. people enjoy them
   E. one can be bought by the pound, the other cann

12. How are revolutions and evolutions alike?
   A. one happens slowly, the other fast
   B. one system evolves, the other revolts
   C. both are unavoidable
   D. means of getting things done
   E. both are forms of change

V4

13. How are hydrogen and oxygen alike?
    A. found on the moon's atmosphere
    B. components of the compound, carbon dioxide
    C. each used alone puts out fires
    D. chemical elements
    E. you can't have one without the other

14. How are salt and cinnamon alike?
    A. used at the same time
    B. essentials for dieting
    C. both are powdered substances
    D. seasonings
    E. found on all kitchen tables

15. How are entrées and desserts alike?
    A. means of getting in and out of doors
    B. one is the beginning of a meal, the other is at the end
    C. geographical or topographical regions
    D. components of a full-course meal
    E. people like to drink them

16. How are admiral and colonel alike?
    A. commissioned officers
    B. heads of state
    C. honored guards
    D. war medal recipients
    E. frontiersmen

17. How are tuberculosis and asthma alike?
    A. cardiac disorders
    B. lung disorders
    C. both are fatal
    D. require medication daily
    E. both involve a high fever

18. How are sea level and equator alike?
    A. sea level is most accurately measured at the equator
    B. used to describe location and size of mountains
    C. one refers to altitude, the other to latitude
    D. they are marked on maps
    E. they are used as a basis for geographical measurements

19. How are a phoenix and a dragon alike?
    A. they are both associated with fire
    B. both are extinct now
    C. a phoenix is a bird, a dragon is not
    D. they are both mythical creatures
    E. both could fly

20. How are statues and mummies alike?
    A. buried under the ground
    B. sometimes made of marble
    C. often honor the dead
    D. people can admire them
    E. serve no functional purpose

21. How are coconut trees and fig trees alike?
    A. both are trees.
    B. both are trees with large leaves
    C. both only grow in the Northern hemisphere
    D. palm trees are taller than fig trees
    E. both are trees with edible fruit

22. How are floors and ceilings alike?
    A. one is below, the other is above
    B. essential parts of the room
    C. they go together
    D. they are both horizontal
    E. the floor is to the ground as the ceiling is to the sky

23. How are leaves and snowflakes alike?
    A. people like to watch them
    B. fluttering natural phenomena
    C. they are put in large piles
    D. both have five points
    E. they carry germs

24. How are a level and a plumb line alike?
    A. a level is used horizontally and a plumb line vertically
    B. both are used in the construction of apartment buildings
    C. both measure the trueness of distance
    D. they are alignment measures
    E. they are used for checking right angles

GO TO NEXT PAGE

V4

25. How are the North Star and the Sun alike?
    A. both are stars
    B. both reflect light back to earth
    C. both are circled by the earth
    D. both are in outer space
    E. the North Star shines at night and the Sun shines in the day

26. How are onomatopoeia and oxymoron alike?
    A. rhetorical devices
    B. exotic birds
    C. diseases
    D. Greek rivers
    E. describe lack of intelligence

27. How are a koto and a timpani alike?
    A. tropical diseases
    B. karate moves
    C. Australian trees
    D. oriental garments
    E. musical instruments

28. How are socks and gloves alike?
    A. socks are worn on your feet and gloves on your hands
    B. both are sold in pairs
    C. forms of wearing apparel
    D. made of the same material
    E. socks are put on before gloves

29. How are a larva and an embryo alike?
    A. both will develop in time
    B. both are terminal stages
    C. a larva is an insect
    D. both are contained in a sac
    E. both are small

30. How are income taxes and conscription alike?
    A. neither existed before World War II
    B. one concerns money, the other concerns service
    C. neither program is popular
    D. disobeying either can lead to imprisonment
    E. both force people to give something to the country

31. How are chaff and jetsam alike?
    A. both produce friction
    B. people eat chaff and fish eat jetsam
    C. forms of humor
    D. both are discarded
    E. inorganic materials

32. How are a skald and a bard alike?
    A. burns
    B. freight boats
    C. poets
    D. surgical instruments
    E. pieces of armor

33. How are tempera and frittata alike?
    A. measurements of time
    B. Spanish dances
    C. sautéed Italian dishes
    D. eggs used in both
    E. painting techniques

34. How are covey and pride alike?
    A. they are associated with envy
    B. both refer to a lair
    C. both refer to a group of animals
    D. a covey involves birds and a pride involves lions
    E. both relate to ownership

Appendix L: Water Polo Imagery Concurrent Verbalisation (CV) Activity

Script for Concurrent Verbalisation Study of Water Polo Players

General Introduction

This activity requires you to generate images of four common moves in water polo. After you have read through the script for the specific move to be imagined, you will be asked to 'talk aloud' **in as much detail as you can** what you are actually imaging while you image the move. Don't think you have to remember exactly what is in the script, it's just a guide to base the image you try to generate on. Thus, **as you imagine** each part of the move, describe your experience of the image in words. Try to comment on a) the lifelikeness of the imagery, b) how clear the images are, c) if you are able to control the image through the entire move, d) if the image changed or varied, e) which of the senses you are experiencing within your images, that is what you see, hear, feel (of your muscles), smell, taste and touch, and f) your emotions or feelings during the imagery. Feel free to image with your eyes open or closed, whichever makes you comfortable. Please, ask questions at any time if you need to.

Warm-up Activity

Imagine yourself in your favourite room at home, you are sitting or lying comfortably, flipping through the pages of a new magazine or book. A favourite piece of music is playing in the background, and a special meal is being prepared in the kitchen. While you are there a close friend drops by to visit and you get Try and generate this image and describe it by 'talking aloud' about what you are imaging.

Feel free to image with your eyes open or closed, whichever makes you comfortable

Try to comment on:

a) the lifelikeness of the imagery,

b) how clear the images are,

c) if you are able to control the image through the entire scene,

d) if the image changed or varied,

e) which of the senses you are experiencing within your images, that is what you see, hear, feel(of your muscles), smell, taste and touch, and

f) your emotions or feelings during the imagery.

1. Shooting Manoeuvre

"You are situated at the opposition 4 metre line to the left of goal and in line with the post. You tread water vigorously directly in front of your opponent, who is marking you closely. You lift up out of the water to receive a clean pass from a player to your right who was calling out to you. You swim back slightly and raise the ball out of the water above your head. The goalie looks toward you and moves into a defensive position to the left of goal. You shoot the ball powerfully over the top of your opponent to the top right corner of the goal and it smashes into the back of the net. Your team mates are pleased that your shot for goal is successful."

2. Passing Manoeuvre

"You are swimming quite quickly with a big splash, the ball just in front of your face. You move from your back line to the centre line toward an opponent, who is swimming rapidly in your direction. An unmarked team mate situated to your left, in a good scoring position, is calling out loudly for the ball. You manage to release a perfect straight pass and the ball lands cleanly in the outstretched right hand of your team mate, just as the opposition reach you and force you vigorously under the water. Your team mate then shoots for goal straight away and scores. Team mates yell congratulations at the successful shot."

3. Chase and Steal Manoeuvre

"An open opposition player is waving their arms and yelling for the ball to your left. They receive a wet pass just over the centre line. and then swim very quickly toward an open goal. You must change direction and start swimming as fast as you can toward this player. You chase really hard and catch up to the player and prepare to tackle them. As you struggle with the player for the ball, water splashes in your face. You are still able to legally steal the ball from directly out of their hand just as they are about to pass it off. You have successfully stopped an important opposition scoring opportunity. "

4. Defensive Block Manoeuvre

"The opposition players are passing the ball to each other just outside the 4 metre line and are preparing to shoot for goal. The scores are tied with 60 seconds to go in the game . There is a lot of noise from spectators and players in both offence and defence as they struggle for position. You see your opponent receive a beautiful backhand pass and you swim in front of them just below the 2 metre line. The player lifts themself out of the water and fakes a shot. You stay focused on them and continue to pressure them in defence. They lift the ball out of the water again ready to release a powerful shot. You lunge toward them and successfully block the shot. The ball bounces off you hands, with a loud 'whack', straight to one of your team mates to your left."

Appendix M: Example of CV transcript

Example 1

I imagine myself sitting at home on the couch just watching TV, just being really relaxed sort of like a Saturday afternoon, sitting there and you can smell the roast lamb in the oven, just roaring away and you got a nice beer sitting beside you, watching the cricket or something, umm, and a mate pops round and we talk about what we did last night, just chatting, a bit of goss.

T: you don't have any trouble generating that image, it comes really clearly?

No, I could see it straight away, I could imagine exactly what it would be like.

T: And the changing elements of this thing. You're able to go from a sitting situation to having someone come in, that image is mobile?

Yes.

T: OK. What about with respect to the food sensation? Would you say it is a genuine sensation of smell?

Mmm, I can smell it exactly.

T: O.k. Did you get any associated sensations of taste/

Yes

T: And what about with respect to, while there's not a lot of physical movements in that image,the sensation of movement, did you get that sensation of movement?

There is no movement .I can feel it but I'm very relaxed, I'm just sitting there doing nothing.

I'm just sitting down, some mates have come in, we're pushing against in the flight position, then release, jump up, catch the ball across the body and then still splashing everywhere and throw as hard as I can in the top right hand corner and then I can see the goalie sitting there, probably waiting for a donut, and I do a bounce shot so I fly up to the top corner. That's about it.

I can see stealing the ball from the back line and moving up the middle of the court for a fast break and I'm looking around, because you can see the fender coming and you thinking should you're thinking if I should turn him or try to make a pass off, you get the pass off and it's a perfect pass and you shift off before he gets there and you get drowned.

You're swimming down into attack and you can feel a big counter coming on but then you loose the ball and you're the last one in defense, so you're going to have to turn around quickly and you know that that always hurts to change direction really quickly so you're struggling already before you even start chasing him and all you can think about is getting to him first before he gets the shot away and swimming down, head in the water, going as fast as you can and when you get to him, the pressure stuffs up and as he's passing the ball you can feel it, you can see it there and you just knock it out and then it feels really good and you go on the counter attack again.

Sixty seconds to go and everyone's jumping, everyone's very fidgety, everyone's careful about what they do and doesn't want to make a mistake, you're tired and all you can think about is wanting to get another goal and stopping this goalie from trying to defend. All I can think about is I hope that it doesn't come near me so I don't have to. So, the last defense and then it does and it comes passed me and all you can do is just go for the ball, work, work, work, and then you stop the ball and you get a steal. And then you counter attack like hell.

Example Two

I'm in the lounge room lying on the couch listening to a nice piece of music, and there's a knock at the door. I'm going to answer it, just walking down the corridor, get to the door, I say hello, my friend comes in, go into the lounge room and he just automatically goes to change the music. We're just sitting down talking. I'm going to get a new bike I say to him. We just talk about what sort of bike I should get, I ask him if he wants to stay for tea and he says I have to ring my mum, he walks to the phone, and I'm just sitting down listening to his music, he says Hi Mum. She say's, " No he's not allowed to stay for tea." He walks back in, grabs a CD and says he has to go home and do some homework and walks back out.

T: Was the image nice and clear?

It wasn't really clear .I can imagine where he would sit.

T: Was he life like in the image?

He wasn't perfect.

T: Was he closer to a life like representation than not?

Yes

T: Was there any sensation of smell or taste of the meal?

No

T: You didn't have any idea of what might have been cooked for dinner?

No.

T: What about the nature of the physical movements , did you get any associated muscle sensation?

Just like my legs were sore when I stood up.

T: Now well go through the four set moves.

I'm sitting on the post really pushing hard against my player and somebody's out on the front floor just walking, waiting for a pass. I sit up and I come back down because he doesn't pass it to me because the guys right on my back. He's pushing me right down on my hips, I come up and I push into him a few strokes backwards and come back and then I sit up again, I keep getting pushed down, I cant get up, so the ball comes in. It lands right in front of me, I get up and bring it right around behind my back, lift it up towards my head, the goalie is moving towards me, so I come towards the side of the goal ,I push the ball down under the guys arm, up so it goes around the guys arm into the goals, just misses the post, goes up into the corner and curves around into the net and hits back down onto the floor and as soon as that happens I just push off the guy and slowly back stroke and every ones going "yea, well done", and we get back to the center and that's it.

The goalies got the ball, I've taken two strokes back stroke and he's passed the ball in front of me, and I'm swimming out to my right hand side, straight along the right hand side of the goal, I'm aiming for the post, sprinting as hard as I can, kicking as hard as I can, I pick up the ball and he's swimming straight towards me so I don't really have time to pick up the ball so I just flick it to the guy on the right, who's sitting right up out of the water, on his own, he collects it with his right hand and brings it straight back and shoots it off his hand as quickly as he can, keeping the goalie out of position, it bounces of the bottom of the water and goes into the left hand corner position, hits it up at goal, everyone behind me who hasn't swum up , keeps in cheering saying "well done " to the guy who got the goal.

We're in offence, somebody has just taken a shot and the balls just gone straight into their goalie, the goalies got and the guy is swimming off to my left, sprinting really hard and I'm sprinting towards him, about a body length behind him, He's not a very big swimmer but he's got the ball in front of his face , apparently he's trying to edge me in so if I come forward he's going to go straight into the goal and then shoot off, but I swim straight towards him, I get towards him, he's right on the goal and there's a player behind me and I've gone to hit him and a big splash off water gets him right in the eye and he wont be able to see for a second and then I jump, I keep my left hand up , as he goes to pass it I keep my left hand up and it hits my hand, the ball its my hand and its like jammed between the two hands and I've got to push really tightly against it and it spins off and spins right next to me so I push it away and start swimming.

There's sixty seconds to go and the crowds really cheering, spurring us on to get a goal because this team isn't very good and we should be able to beat them, it's a pretty important match , there are so many people here. Were all in the water. The other teams just passing around, their in a big mushroom. I'm on the left hand side, of my own player, everyone's marking their own player, then the ball goes into the center forward who's just sitting on side too, ready to take a back hand shot. So I swim straight for him and then the guy who was behind him just swam out into my path and I'm starting to mark him, he's gone up, he's lifted the ball up and takes a big shot. It nearly freaked me out, but I kept in going, I kept my legs under me and I kept on pushing him and he's leaning back, he's moving right back leaning with his legs underneath so I'm on top of him. He's taking another shot, I chucked up my left hand to imitate what he does and it smacked right inside of my left hand and landed over from my right hand player, he's got the ball ready to pass it.

Example Three

In the back room at home, probably playing pool. The radio is probably on. Probably playing pool with my dad or me mates. Mum's cooking lasagne or something in the kitchen. The pool table is over to the right. The kitchen is to the left. The couch is there in front of the TV

T: Can you get any smell related to the cooking?

No.

T: Can you get the sensation of the physical movements if you were making a pool shot?

Yes

I'm on the 4mtr. Line , left post, up position players behind me, the balls probably being passed around the top, I pop out and the ball comes in, I sit up, just shoot it into the back of the net and the goalie misses it. Probably the goalie threw it up, probably impressed or something with that pass, landed in front of, come swimming up.

We're in counter attack, so obviously they have a shot that's missed or something. Probably swimming up, center of the pool as it sets, I pick it up and throw to the guy whose hand it puts it in and then I'll probably drown by the tidal wave.

It's mostly the opposition players at the counter attack, and we change our position, we follow up, we chase and then he's probably reached back for another push off, like you would normally try, and then you touch his arm or something to give him second thoughts and then you just try to drown him, you grab the ball and just manage to pass it off without getting a penalty kick out of it.

Probably say you were extra man by the set up. Everybody's moving around quite quickly trying to get into position. The guy that sits up has the ball, and your player jumped in the first line, pulls out and receives the ball and you just managed to get your arm to it. He's probably getting deep or something like that, to lock it and you're about to move your arm and it goes over the top, and onto your man who is probably pressing the top people.

Appendix N: SIAM Administration Instructions

SIAM Administration Instructions (Group)

1. Welcome the participants and briefly outline reasons for administering the multi-modal, multi-dimensional imagery questionnaire, for example, to examine the nature of individual differences in the way athletes generate images prior to implementing an imagery training program. More complete information relating to sport imagery should be provided at the **completion** of the test sessions.

2. Confirm the confidential nature of the project and that participants should feel relaxed and respond naturally in completing the imagery activities. Indicate there are **no right or wrong responses, everyone images in their own way.**

3. Wait for participants to be seated comfortably, distribute questionnaires (See appendix 1 for a copy) and ask if the session could be conducted with a minimum of unnecessary noise. Ask participants to complete the personal information sheet and read carefully through the introduction page. Ensure the instructions are clearly understood. This is particularly important with reference to the placement of the **INTERSECTION** of the cross on the rating scale.

4. Allow participants time to ask questions relevant to the questionnaire and the example on the introduction page.

5. Instruct participants that they should **not** turn the page when they finish reading through the introduction page. They should wait until asked to turn over the page by the administrator.

6. Instruct participants that for each scene they will be asked to read through the description, then image the scene for 60 seconds, and then respond to the 12 scales. When you feel all participants have finished reading the scene description, 60 seconds should be allowed for the imaging activity. A stopwatch should be used to time the imaging activity.

7. After the participants have read through the scene description, start and stop imagery for each scene using the following start and stop instructions: 'Start imaging now' and after 60 seconds 'Stop imaging. Go ahead and complete the questions'. Ensure participants do not respond to the scales until the end of the 60 second imaging activity. Ask participants to place their pens or pencils down upon completing all 12 scales to signal they have finished marking their responses for that scene. Remind them not to turn the page. When all participants have finished responding ask them to 'turn the page and read the next scene'.

8. Next ask participants to complete the practice 'fitness' scene under assessment conditions, that is follow steps 6 and 7. Following completion encourage participants to ask questions.

9. Then ask participants if they are ready to continue. If so ask them to turn the page and read the next scene. Steps 6 and 7 should be followed for each of the remaining scenes of the measure.

10. Provide advice and support at any time during the imagery assessment session, but avoid directing participants.

11. Upon completion of the final scene thank participants for responding to the questionnaire and remind them that they should feel free to ask any questions or make any comments relating to the measure.

12. Give a summary of the purpose of the exercise and answer any questions, if this is the end of the participant's involvement (Don't do this if there is to be further testing using the SIAM).

13. Provide project contact details to each participant so that any follow-up questions may be pursued at a later date.