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Megan Lorains[1], Clare MacMahon[1], Kevin Ball[1] and Josh Mahoney[2]
[1]Victoria University, School of Sport and Exercise Science,
PO Box 14428, Melbourne VIC, Australia, 8001
E-mail: Megan.Lorains@vu.edu.au
[2]Melbourne Football Club, Australia

ABSTRACT
Decision-making is identified as a key element of elite sporting success. There are many challenges, however, in the design and implementation of a decision-training tool. These include difficulty in recreating a scenario in which the simulation allows the participant to feel like they are performing in the 'real game', and creating a training tool that can complement an existing physical training regime. The main aim of this paper is to present arguments for the use of above-real-time training, as popularly used in military and pilot training, as a viable simulation training method in the sporting arena. Above-real-time simulations are simulations that are played above normal speed. The potential benefits of using traditional video simulations are discussed, especially with respect to the promotion of key characteristics of elite performance, such as automaticity. Furthermore, the possible practical applications of using above-real-time video simulations will be explored in relation to fast-paced invasion sports.

Key words: Above Real Time Training, Aviation Science, Decision Making, Military Training, Perception-Action Coupling, Video Simulation

INTRODUCTION

Elite athletes are often described as 'having all the time in the world' to execute their skills [1]. They can 'read the play' and more accurately anticipate opponents' movements than less skilful performers [1]. Several studies support the idea that this feature of expert performance arises from superior perceptual-cognitive skills, such as anticipation and decision making [2, 3]. Hence it is important to develop our understanding of perceptual-cognitive skills for training and performance improvement. This may be particularly the case in complex fast-paced team invasion sports, in which decision making has been identified as a key aspect of superior performance [4]. The importance of accurate and timely decision making is not only evident in the sporting arena, but also within military settings, where skilled decision making can be a life or death matter [5].

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Both sport and military domains require personnel to perform their skills in complex and dynamic situations using a range of perceptual abilities. They often need to act upon partial or incomplete information or cues and almost always are acting under time pressure [5]. This article explores the idea that certain aspects of military training may benefit sport, given the similarities of demands [5], and so opens up new avenues to train decision making. Furthermore, the article addresses current methods of testing and training decision making and presents above real time training (ARTT) as a new manipulation of traditional simulation training in sport. Preliminary data will be presented to highlight to coaches and researchers the possible application of ARTT to fast-paced invasion sports.

CURRENT DECISION TRAINING: DESIGN ISSUES AND IMPLICATIONS

Coaches and sports scientists are in agreement that decision making is an integral aspect of elite sporting performance and therefore should be included in training [4]. There is little research, however, dedicated to the development of appropriate and effective methods to actually train this skill. Notably, much of the research in decision making in sport focuses on single tests of performance [6-8] rather than training of skills, a much more difficult but worthwhile task that may benefit many sports scientists, researchers and coaching staff. To allow for ease of access to, and implementation of decision training, coaching staff need a training tool that is easy to administer, simple to set up, and can be completed without imposing on a player's already physically taxing training regimes. Traditional video-based simulations, in which participants face a screen and respond to stimuli verbally or via a mouse click, can cater for each of these needs.

Video use is currently employed by many sports clubs for player analysis, skill analysis, and match reviews, but few use video for decision training. Nevertheless, research suggests that video can be utilised to improve decision accuracy [9]. Starkes and Lindley [9] trained female basketball players to respond to video-based scenarios. Participants were asked to watch a series of video clips and select whether to shoot, pass or dribble. Results showed that in as little as six 30-minute training sessions, decision accuracy was increased compared to a control group, which received no training. More recent decision training research has moved with the trend for coupling perception and action in training [10]. In this approach, athletes are asked not only to decide on an action, but to carry out the intended movement. However, in this article we argue that an over-emphasis on perception-action coupled approaches to decision training may neglect some of the clear benefits of traditional video-based training. Table 1 shows some of the differences between traditional video-based simulations and perception-action coupled simulations.

Table 1. Traditional versus Perception-Action Coupling Simulations

	Traditional Video-Based Simulations	**Perception-Action Coupling Simulations**
Resources Needed	Low	High
Physical Demands	Low	High
Financial Risks	Low	Medium-High
Perceptual Demands	High	High
Ecological Validity	Low	Medium-High

The benefit of perception-action coupling versus traditional video simulation training is still hotly debated among skill acquisition researchers and coaches alike. While traditional video-based simulations require few implementation resources, place low physical demands on performers and impose limited financial risk, previous research has questioned their ecological validity, suggesting that video simulation may not simulate real-world tasks, and thus do not elicit real-world behaviour [11, 12].

Dicks [12] found that eye movements and performance in a visual anticipation simulation task can differ from when the participant is performing in-situ. This line of research suggests that decisions are altered when a skill needs to be performed, due to a person's considerations of their physical ability or that of their teammates and even their opponents. Dicks and colleagues [12] even suggested that visual cues and information pick-up may change when using a simplified video simulation. One aspect of the issue of ecological validity is that participants may not feel like they are performing the real task [13]. As mentioned previously, many skill acquisition researchers argue that decision training needs to involve skill execution, which requires the coupling of perception and action in a training tool. Typically, this is done by having the player watch a video clip on a large screen, make a decision and actually execute the desired movement [10, 14]. While perception-action coupling is supported by good theoretical and practical arguments [13], many of its features negate the practical advantages of traditional video simulation.

This article does not advocate solely the use of traditional video-based simulations, but simply presents the benefits of video-based simulations, and suggests how coaches and researchers may manipulate aspects of simulations to closer replicate real-world tasks. One of the features of real-world performance that we would like to address in particular, however, is that a person's decision may be altered by the amount of time pressure they are under. This is a significant real-world demand that has proven difficult to recreate using video simulations and is a feature that is evident in both sport and military settings [5].

ABOVE REAL TIME TRAINING FOR DECISION MAKING

Military and pilot training has combated the issue of fidelity (how real-world a simulation feels), and in particular, the time-pressure aspect of performance, by creating above real time training. ARTT is a training method that places the participant in a simulated environment that functions faster than normal time [15]. An example of successful ARTT [16] involved training air traffic controllers to direct an aircraft through a single turn, to intercept at an exact point in time. Participants in two groups received one three-hour training session. The first group was trained with a simulated plane travelling at 260 knots (real time) and completed approximately seven to nine trials per hour. The second group trained with the plane travelling at 5200 knots (20 times above real time) and completed approximately 72 to 80 trials per hour of training. When post-tested at real time, the second, ARTT group, was more accurate at intercepting the point.

The use of ARTT in the sporting domain is applicable given the similarities between military/aviation and sport domains. Both require their personnel to make decisions in a complex and changing environment, often using incomplete information or cues. They also require their personnel to acquire a tactical advantage over the opposition, and to work both as a team and on their own [5]. Research reviewing expertise in sport and military settings has also highlighted that sport expertise can inform military training [17]. Based on these commonalities, Lorains and MacMahon [7] used ARTT in the sporting domain to examine expert-novice differences in a decision-making task using normal and above-real-time video simulations. The results showed that elite performers were more accurate in their decisions in above-real-time situations compared to their lesser skilled counterparts. Interestingly, elite performers were more accurate in decisions made at above real time than those made in normal time. Lorains and MacMahon concluded that the elite performers were acting more automatically, a key characteristic of elite performance. The benefits of ARTT are likely to be linked to this key characteristic of skill development: automaticity, which can be described as a subconscious mechanism that is fast, has few limitations on processing capacity and demands little or no attention [18]. Consequently, automatic skills can be completed without directed attention, which is therefore available for other tasks. Such automaticity is developed through training [19], and as described repeatedly in the skill-acquisition literature [20, 21], high-level skills can run off without attention to the subcomponents of performance. In fact, research has shown that paying attention to the subcomponents of skills results in performance disruption in elite performers [22]. This finding has resulted in the use of extraneous dual-task conditions for training novice performers (e.g., performing while monitoring auditory tones or performing mathematical calculations) in order to accelerate progression to the automated stage of performance. The benefit of being able to perform automatically is that performers think less about the skill at hand, and are therefore not 'over-analysing' the situation, which can lead to choking and a breakdown of skills [23, 24].

Another method, designed to decrease reliance on directed attention, was trialled by Beilock et al. [21]. They suggested that time/speed constraints placed on performance may aid experienced athletes as by preventing them from focussing on the skill at hand. The authors used a golf putting task to show that when an expert's main focus was on skill execution and accuracy, performance was disrupted. When golfers were asked to make the putt as quickly as possible, emphasising speed rather than accuracy of putting, performance was enhanced. Apparently, time pressure allowed the experienced or elite athletes to perform the skill automatically, a key characteristic of expertise. Johnson and Raab [25] provide more specific support for the idea that time pressure may result in improved decision making for performers at the automated stage of skill. In a study to understand option generation in handball decision making, experienced players who chose the first option that intuitively came to mind were judged to have made good decisions. Time pressure in decision training may thus allow performance to run off automatically and result in superior performance for skilled performers.

Adding time pressure to allow experts to perform more automatically is supported by earlier research by NASA [15] in which university students were trained on three aviation tasks at different simulation speeds. Participants were assigned to one of five speeded groups (normal speed, 1.6, 2.0, mixed or sequential speed). They were familiarised with the simulation tasks (daytime helicopter flying, night helicopter, night tank). Each trial required the participant to 'kill' the target before being timed out. The training phase consisted of 15 randomly assigned trials with each of the three tasks performed five times. After this, a transfer task of similar trials at normal speed was completed. Results revealed that those trained under normal speed performed worse on the transfer test, and that those trained under mixed speeds performed best.

Guckenberger et al. [15] argue that, as well as being essential for training in fields such as aviation (due to the high financial and personal risk), even minimal training using ARTT simulations can potentially result in faster acquisition of high-performance skills and greater automaticity levels, with sustained motivation levels throughout the training process. These arguments frame above-real-time simulations as an exciting new training possibility for video-based, decision-training simulations, which elicit real-world behaviours of elite performers (performing automatically).

SIMULATION FIDELITY: KEEPING IT REAL

In terms of traditional simulation training, it is important to consider how the simulation looks and feels. Simulation fidelity can be used to measure effectiveness of a simulation training, how a person behaves in the simulated environment, compared to their behaviour in the real-world experience [26]. Using video-based simulations and ARTT obviously alters the physical fidelity of a simulation (i.e., how the simulation looks). Psychological or experiential fidelity is how the participant perceives the simulation and how ‘game like’ they believe it to be [26]. The effect of ARTT on psychological or experiential fidelity is still open to debate. Much skill-acquisition research would argue that changing the speed of the training environment reduces the high fidelity needed for optimal transfer of the given skill [27]. Kolf [28], however, highlighted the benefits of designing fast-time simulations and suggested that implementing this method of simulation training would give pilots a more precise experience of flying while under real-world stress. Anecdotal evidence suggests that “regardless of the type or amount of pre-flight simulator training accomplished by the pilot, the actual flight seems to take place in a much faster time than real time” [28, p.1]. Verbal reports [28, 29] following real-time simulator training revealed that pilots perceived events to happen faster in the real situations. When they performed above-real-time simulator training, the pilots described it as feeling more like the actual aircraft.

Moreover, in current work in the sporting domain, testing decision-making clips in sport, feedback from coaches and players is that above real time conditions are more ‘game like’ than video played at normal time. For example, Lorains and MacMahon [7] provide promising findings in the use of above-real-time video simulations for decision making. While this research was only a one-off test of performance, elite performers displayed better results when tested on above-real-time video, compared to sub-elite and control participants, suggesting that using above-real-time video allowed the elite athletes to perform more automatically, as they would in a real game. While the existing evidence is largely anecdotal or of single tests of performance, it does provide a useful foundation to apply this manipulation from military training to the sporting domain.

It is important to note that findings in both the sporting and military/pilot domains are for elite or expert participants and may not generalise to novices. ARTT may be too difficult or the speeds implemented may be too fast for novice performers initially, but it may be an effective method of training novice performers. As when implementing any training tool, it is important to consider the level of the learner or participant. Traditional video simulations may provide a more controlled learning environment for beginners, but without any manipulations, may be too basic or simplified for training elite athletes.

PRACTICAL APPLICATIONS AND CONSIDERATIONS

To evaluate this type of training in a professional fast-paced, team-sport environment, a pilot test was conducted in which three players were involved in a test-and-evaluation session. Further, a coach was involved in overseeing the pilot test and was consulted about the implementation of this type of decision training in the team-sport environment. Each player and the coach watched 10 video clips at speeds varying from normal speed to double the normal speed (as for ARTT). Videos were edited using Adobe Premiere Elements 3.0 and were viewed via E-prime Psychological Software. At the end of the viewing, players were asked which speed seemed the most realistic to make a decision in, and whether they saw this type of training as useful in their development. As this was not a performance-related pilot test, and due to the relatively new nature of ARTT in the sporting domain, performance data was not collected. The use of an ARTT intervention is currently being investigated. The following section will explore comments and suggestions made by coaches, players and researchers on the practical design of an ART training schedule.

Both players and the coach reported speeds of up to 1.5 of the normal video speed to be most game like. This speed is in line with the ARTT research in military domains, in which pilots felt that flying simulations were more ‘real world’ at 1.5 times the normal speed [27, 28]. This preliminary data emphasises the need to investigate performance and perceptions at various speeds, in an attempt to identify if optimal training speeds exist, what these speeds are and if they vary for different individuals. Moreover, it is important to identify speeds that may be too fast and lead to an over-reaching of cognitive skills resulting in a potential super-compensation effect thereby reducing simulation fidelity [7].

A number of important considerations for such work were also reported by both players and the coach. Firstly, consideration of positional differences when training decision making was a strong theme. Players noted that in some game situations they had more time to make a decision whereas in other situations decisions had to be made very quickly. The higher speed clips were considered to be very powerful for training the fast-decision aspects of the game, but less so for the situations in which the player was likely to have more time. The coach felt strongly that tailoring training programs based on position played would be the most appropriate way to implement the training into the schedule efficiently. For example, this might mean designing training for defensive players on defensive video clips, and offensive players on offensive video clips.

A second consideration discussed was how the training might best be implemented into the training week. Players felt that ‘short and sharp’ sessions would be best – similar to the session which they had just performed with 10 clips. The coach also felt this was the best approach for the players to maintain concentration otherwise the exercise would lose its effectiveness. Further, the ARTT programme should be incorporated as one element of a broader decision-making programme that includes other elements, such as well designed game-based drills at training and various forms of feedback from competitive games.

These are each important aspects of the practical application of video-based ARTT simulations. While this was only pilot work, it does provide a starting point to develop appropriate training programs using ARTT simulations that benefit both coaches and researchers.

CONCLUSION

The main aim of this paper was to present the application of military and pilot video-simulation training as a viable training method in the sporting arena. A second aim was to present training method possibilities for the essential skill of decision making in fast-paced, team invasion sports; training methods that may be theoretically sound, yet still practical for coaching staff to apply in the field. Research [5, 17] reviewed the use of sports science research to aid in military training, highlighting the comparable demands on decision making between sport and military personnel. The approach in this article was to investigate how military training may aid in training successful decision making in sport.

The use of traditional video simulation in above-real-time is an exciting development in how decision training may be designed. The practical benefits of video-based training have been discussed for coaches to consider in an applied setting. Training in above-real-time adds the time pressure essential to decision training. Considering that this is a very new manipulation in the sporting domain, these methods are currently being explored in further detail to fully understand the mechanisms and benefits of ARTT as a potential training tool for decision making in sport.

REFERENCES

1. Abernethy, B. and Zawi, K., Pickup of Essential Kinematics Underpins Expert Perception of Movement Patterns, *Journal of Motor Behaviour*, 2007, 39(5), 353-367.
2. Abernethy, B., Expert-Novice Differences in Perception. How Expert Does This Expert Have to Be? *Canadian Journal of Sport Science*, 1989, 14(1), 27-30.
3. Abernethy, B., Gill, D., Parks, S. and Packer, S., Expertise and the Perception of Kinematic and Situational Probability Information, *Perception*, 2001, 30, 233-252.
4. Baker, J., Cote, J. and Abernethy, B, Sport Specific Practice and the Development of Expert Decision Making in Team Ball Sports, *Journal of Applied Sport Psychology*, 2003, 15, 12-25.
5. Ward, P., Farrow, D., Harris, K., Williams, M., Eccles, D. and Ericsson, K.A., Training Perceptual-Cognitive Skills: Can Sport Psychology Research Inform Military Decision Training? *Military Psychology*, 2008, 20(1), 71-102.
6. Blomqvist, M., Vanttinen, T. and Luhtanen, P., Assessment of Secondary School Students' Decision-Making and Game-Play Ability in Soccer, *Physical Education and Sport Pedagogy*, 2005, 10(2), 107-119.
7. Lorains, M. and MacMahon, C., Adapting the Functional Overreaching Principle to Cognitive Skills: Expertise Differences Using Speed Manipulations in a Video-Based Decision-Making Task, *Proceedings of the 12th World Congress of Sport Psychology (ISSP),* Marrakesh, Morocco 2009.
8. McMorris, T., Performance of Soccer Players on Tests of Field Dependence/Independence and Soccer-Specific Decision-Making Tests, *Perceptual and Motor Skills*, 1997, 85, 467-476.
9. Starkes, J. L. and Lindley, S., Can We Hasten Expertise by Video Simulation? *Quest*, 1994, 46, 211-222.
10. Farrow, D. and Fournier, J., Training Perceptual Skill in Basketball: Does it Benefit the Highly Skilled?, in: International Society of Sport Psychology, *Proceedings of the 11th World Congress of Sport Psychology: Promoting Health and Performance for Life,* Sydney, Australia, 2005.
11. Dicks, M., Button, C. and Davids, K., Representative Task Designs for the Study of Perception and Action in Sport, *International Journal of Sport Psychology*, 2009.
12. Dicks, M., Button, C. and Davids, K., Examination of Gaze Behaviors Under In-Situ and Video Simulation Task Constraints Reveals Differences in Information Pickup for Perception and Action, *Attention, Perception and Psychophysics*, 2010, 72(3), 706-720.
13. Araujo, D., Davids, K. and Hristovski, R., The Ecological Dynamics of Decision Making in Sport, *Psychology of Sport and Exercise*, 2006, 7, 653-676.
14. Gabbett, T., Rubinoff, M., Thorburn, L. and Farrow, D., Testing and Training Anticipation Skills in Softball Fielders, *International Journal of Sports Science and Coaching*, 2007, 2(1), 15-24.
15. Guckenberger, D., Uliano, K. and Lane, N., Training High Performance Skills Using Above Real-Time Training, *Report for National Aeronautics and Space Administration*, Dryden Flight Research Facility, 1993.
16. Vidulich, M., Yeh, Y. and Schneider, W., Time Compressed Components for Air Intercept Control Skills, *Proceedings of the 27th meeting of the Human Factors Society,* 1983, 161-164.
17. Williams, A.M., Ericsson, K.A., Ward, P. and Eccles, D.W., Research on Expertise in Sport: Implications for the Military, *Military Psychology*, 2008, 20, 123-145.
18. Williams, A.M., Davids, K. and Williams, J.G., *Visual Perception and Action in Sport,* Routledge, New York, 1999, 26-59.
19. Abernethy, B., Attention, in: Singer, R.N., Murphey, M. and Tennant, L.K., eds., *Handbook of Research on Sport Psychology*, 3rd edn., Macmillian, New York, 1993.
20. Fitts, P. and Posner, M., *Human Performance,* Belmont, CA: Brooks/Cole, 1967.
21. Beilock, S., Bertenthal, B., McCoy, A. and Carr, T., Haste Does Not Always Make Waste: Expertise, Direction of Attention, and Speed Versus Accuracy in Performing Sensorimotor Skills, *Psychonomic Bulletin and Review*, 2004, 11(2), 373-379.
22. Beilock, S., Carr, T., MacMahon, C. and Starkes, J., When Paying Attention Becomes Counterproductive: Impact of Divided Versus Skill-Focused Attention on Novice and Experienced Performance of Sensorimotor Skills, *Journal of Experiential Psychology: Applied*, 2002, 8(1), 6-16.

23. Beilock, S. and Carr, T., On the Fragility of Skilled Performance: What Governs Choking Under Pressure? *Journal of Experimental Psychology: General,* 2001, 130, 701–725.

24. Masters, R., Knowledge, Nerves, and Know-How: The Role of Explicit Versus Implicit Knowledge in the Breakdown of a Complex Motor Skill Under Pressure. *British Journal of Psychology*, 1992, 83, 343–358.

25. Johnson, J. and Raab, M., Take the First: Option-Generation and Resulting Choices, *Organizational Behaviour and Human Decision Processes*, 2003, 91(2), 215-229.

26. Stoffregen, T., Bardy, B., Smart, L. and Pagulayan, R., On the Nature and Evaluation of Fidelity in Virtual Environments, in: Hettinger, L.J. and Haas, W., eds., *Virtual and adaptive environments: Applications, implications, and human performance issues,* Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 2003, 111-128.

27. Adams, J.A, A Closed-Loop Theory of Motor Learning, *Journal of Motor Behaviour*, 1971, 3, 111-150.

28. Kolf, J., Documentation of a Simulator Study of an Altered Time Base, *Unpublished Manuscript, NASA Dryden Flight Research Facility,* Edwards, CA, 1973.

29. Hoey, R., Time Compression as a Means for Improving the Value of Training Simulators, in: Crane, P., Guckenberger, D., Schreber, B. and Robbins, R., eds., *Above Real-Time Training Applied to Air Combat Skills: Final Report,* (Technical Report AFRLTR-1997-0104). Air Force Research Laboratory, Mesa, AZ, 1976, 41-65.