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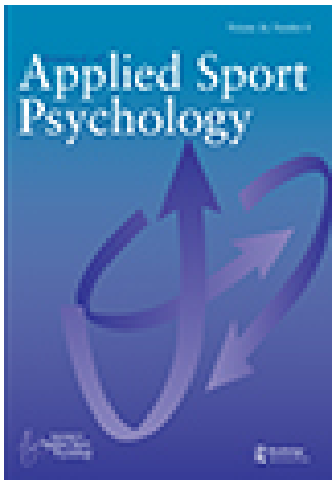

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Running head: GRIT AND SPORT EXPERTISE

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Keywords: grit; football; persistence; practice activities, performance; personality; adolescence

Abstract

We examined whether soccer players who score low and high on the personality trait grit can be differentiated based on their sport-specific engagement and perceptual-cognitive expertise. Findings revealed that grittier players accumulated significantly more time in sport-specific activities including competition, training, play, and indirect involvement. Moreover, there was a significant main effect for performance on the perceptual-cognitive skills tests across groups, with grittier players performing better than less gritty players on the assessments of decision-making and situational probability. The findings are the first to demonstrate a potential link between grit, sport-specific engagement and perceptual-cognitive expertise.

Keywords: grit; football; persistence; practice activities, performance; personality; adolescence

In sport elite performance is characterised by exceptional skill and abilities, with athletes dedicating an extensive amount of time to practice in order to achieve their goals. Numerous researchers have explored the attributes and skills that differentiate elite and sub-elite athletes, including technical ability (Coelho e Silva et al., 2010; Figueiredo et al., 2009; le Moal et al., 2013), physical fitness (Deprez, Fransen, Boone, Lenoir, Philippaerts, & Vaeyens, 2015; le Gall, Carling, Williams & Reilly, 2010), personality characteristics (Guelmami, Hamrouni, & Agrébi, 2014; Reilly, Williams, Nevill, & Franks, 2000; Stoll, Lau, & Stoeber, 2008), and perceptual-cognitive expertise (Farrow, McCrae, Gross, & Abernethy, 2010; Larkin, Berry, Dawson, & Lay, 2011; Larkin, Mesagno, Berry, & Spittle, 2014; Roca, Williams, & Ford, 2012). Moreover, researchers have investigated the practice history profiles of elite athletes to better understand what activities may contribute to the development of elite level performance (Ford, Ward, Hodges, & Williams, 2009; Ford & Williams, 2012; Ward, Hodges, Starkes, & Williams, 2007; Williams, Ward, Bell-Walker & Ford, 2012). While this research provides a profile of elite level performance, there is still limited understanding of the impact of personality traits, such as grit, on sporting expertise. Therefore the current study examines the potential influence of grit within elite youth soccer.

Personality psychology explores variations among individuals and how these differences shape peopleôs lives (Roberts, Jackson, Duckworth, & Von Culin, 2011). One personality trait that has been of interest in recent times is the construct of grit. Grit has been defined within the extant literature as trait-level perseverance and passion towards long-term goals (Duckworth, Peterson, Matthews, & Kelly, 2007). According to this definition, grit entails working obstinately toward challenges while sustaining effort and interest in the activity over years in

spite of disappointment, hardship, and plateaus (Duckworth et al., 2007). While certain individuals may change goals and direction in the wake of disappointment or boredom, gritty individuals possess the fortitude to continually endeavour toward their goal even without immediate feedback or recognition.

As a construct, grit is believed to predict perseverance and achievement over and beyond the measure of talent, implying that grit may differentiate successful from less successful athletes. Duckworth and Quinn (2009) explored the ability of grit to differentiate individualsô retention in specific programs, through multiple studies with varying populations. Grittier adults were more likely to pursue further education (Duckworth & Quinn, 2009), less likely to withdraw from military training programs (Duckworth & Quinn, 2009; Eskreis-Winkler, Shulman, Beal, & Duckworth, 2014), more likely to keep their jobs (Eskreis-Winkler et al., 2014), more likely to stay married (Eskreis-Winkler et al., 2014), and grittier spellers engaged more time in deliberate practice compared to less gritty individuals (Duckworth, Kirby, Tsukayama, Berstein, & Ericsson, 2011). Therefore, it can be suggested that potential retention and engagement in various disciplines can be explained by an individualôs level of grit.

Although researchers have identified the potential for grit to predict retention within specific programs (Duckworth & Quinn, 2009; Duckworth et al., 2011; Eskreis-Winkler et al., 2014), there remains limited understanding of the how grit may influence aspects of performance. Duckworth and colleagues (2011) have attempted to understand this link through an expertise approach examining performance at a national junior spelling competition. Participantsôperformance was specified by the position they finished in the national competition, with results indicating grittier spellers performed better than less gritty spellers. Duckworth and

colleagues therefore suggested grit may provide an indication of the potential for expert performance.

From a sporting perspective, researchers have demonstrated an expertise effect for perceptual-cognitive skills (Ward, Ericsson, & Williams, 2013; Ward & Williams, 2003; Williams, Hodges, North, & Barton, 2006), and sport-specific engagement (Ford et al., 2012; Roca et al., 2012; Williams et al., 2012). Retrospective recall techniques have been used to identify the time invested by skilled and less skilled players in sport-specific activities such as competition, training, and play. Findings have demonstrated that elite players generally accumulate significantly more hours of sport-specific engagement compared to less skilled players (Roca et al., 2012; Williams et al., 2012). Furthermore, researchers using video-based assessments have demonstrated perceptual-cognitive skills such as decision-making, situational probability assessment, and pattern recognition, differentiate skilled and lesser skilled athletes (Ward et al., 2013; Ward & Williams, 2003; Williams et al., 2006). However, researchers have not explored the potential relationship between these sport-specific variables and grit.

As the literature indicates that elite level athletes accumulate more hours of sport-specific engagement and demonstrate superior perceptual-cognitive skills, we hypothesised grittier youth players would have accumulated more hours in soccer-specific activities and would perform better on the perceptual-cognitive skills tests (i.e., decision-making, situational probability, pattern recognition).

Method

Participants

Elite youth male soccer players (n = 385) volunteered to participate in the study. All participants were competing at the age-related national youth soccer championships in Australia following their selection in a regional youth soccer development program (Under 13, n = 113, M_{age} = 12.9, SD_{age} = 0.36; Under 14, n = 139, M_{age} = 13.9, SD_{age} = 0.35; Under 15, n = 133, M_{age} = 14.7, SD_{age} = 0.50). Following approval from the institutional research ethics board, written parental consent was obtained for all participants prior to data collection.

Instruments

Grit was assessed using the child adapted version of the Short Grit Scale (Grit-S: Duckworth & Quinn, 2009). The Grit-S, a general personality inventory, is an eight item self-report questionnaire with established construct and predictive validity and test/re-test reliability (Duckworth & Quinn, 2009). Participants respond to items, such as óSetbacks (delays and obstacles) donôt discourage me. I bounce back from disappointments faster than most peopleôon a five-point Likert scale (5 = *very much like me*; 1 = *not like me at all*). The Grit-S score is obtained from the average of all eight items, with higher values representing higher levels of grit. For the current study, the internal reliability of the Grit-S was within the acceptable range (Ŭ = 0.631).

An adapted version of the Participation History Questionnaire (PHQ: Ward et al., 2007) was used to gather data relating to the players date of birth and soccer-related activities which players had undertaken from the current season back to eight years of age. The questionnaire elicited information relating to the number of hours participants engaged in soccer-related

activities at a specific age. As per previous research (Ford et al., 2009; Ford et al., 2012; Ford & Williams, 2012; Ward et al., 2007), participants were asked questions relating to the recollection of the number of hours per week and the number of months per year engaged in four soccer-related activities, including match-play (i.e., competitive soccer matches); coach-led practice (i.e., soccer practice with a coach); individual practice (i.e., soccer activity by oneself); and peer-led play (i.e., soccer activities with peers, including small-sided games). To further the current understanding of athlete participation history, an additional soccer-specific activity was presented, indirect involvement. Indirect involvement was defined as the number of hours engaged in soccer activities that were not physical in nature, such as playing soccer computer games and watching soccer games.

A film-based paradigm using the temporal occlusion method was used to determine perceptual-cognitive ability of the participants. Three activities were conducted to measure the participantôs level of perceptual-cognitive expertise. The first activity, decision-making, was designed to evaluate participantôs ability to make an informed decision of what game action to perform next with reference to the presentation of a sequence of play that was occluded at a key moment. The decision-making activity presented 20 video-clips of offensive soccer sequences. Participants were instructed to watch the clip, and at the point of occlusion make an informed decision regarding the next game action if they were the players on the ball (i.e., what would you do next?). Participants were informed that there were three possible decision outcomes: (a) pass the ball (P); (b) run with the ball (R/D); or (c) shoot at goal (S). To demonstrate the response, a picture of the last frame of the video was provided to the participants who were asked to indicate the game action (i.e., run with the ball, pass or shoot) and the direction in which the game action

would take place (i.e., draw an arrow in that direction). This procedure is consistent with the protocol used by Roca and colleagues (2012) and Ward and Williams (2003). Each trial was scored out of 2, with one point being allocated for the correct direction (as indicated by the arrow) and one point for indicating the correct game action (i.e., pass, run or shoot). A total score of 40 points was possible, with the total score for all trials being used for analysis purposes.

The second activity, situational probability, was designed to evaluate each participantôs ability to assess soccer-specific situational information by identifying the likely options for the player in possession of the ball (Williams et al., 2011). The situational probability activity presented 20 video-clips of an evolving passage of play for approximately 6-10 seconds, and at a critical moment in the footage, 120ms prior to the player in possession of the ball making a pass, the footage was frozen. This last frame was presented for 15 seconds. During this time, participants were required to indicate, on an image of the last video frame, the three most threatening players to the defence, if they were to receive the ball next. Then participants were asked to rank the identified players from one to three in order of most threatening (i.e., 1) to the defensive team to least (i.e., 3) threatening.

Each trial was scored out of 10 points, with the scoring weighted to reward correct responses. The correct identification of the most threatening player scored 6 points, second most threatening scored 3 points, and the third most threatening player scored 1 point. When a participant identified an option as being higher or lower than the identified correct ranking by expert coaches (n = 5), the total available points were subtracted by the participants ranking of the player. Therefore, if a participant identified the top ranked player as the third most

threatening player, the participant would receive 3 points for that player (6-3 = 3). The total score for all trials were calculated for analysis.

The final perceptual-cognitive activity involved a pattern recognition task. In this activity, 20 video-clips from the same game as presented in the situational probability activity were shown to the participants. Of the 20 clips presented, 10 clips had been presented in the situational probability activity, and 10 had not been seen before. Participants were asked to identify whether or not the clip had been presented in the situational probability test. To indicate this response the participants marked ôYESô or ôNOô in an answer booklet. For this activity, one point was awarded for each correct response, with a maximum score of 20. For analysis purposes each participantôs percentage score was used.

Correct responses for the perceptual-cognitive activities were determined by an expert panel of elite level youth coaches (n = 5) who are currently coaching international youth level teams. The coaching panel were presented with the individual clips, and individually recorded their response. All responses were collated and tallied with any discrepancies in the outcome of the clip discussed in a round table forum until 100% agreement was reached for the outcome of each clip. For analysis purposes, the outcomes decided upon by the coaches were deemed as correct.

Procedure

Participants first completed the Grit-S with the completion time ranging from 5 to 10 minutes. The PHQ was then administered, with participants taking approximately one hour to complete. During this time, the lead author and a research assistant were available to answer questions and provide further explanation. Finally, the participants completed the perceptual-

cognitive activities. The decision-making activity was completed first, followed by the situational probability, and finally the pattern recognition activities. Prior to each activity three familiarisation trials were presented to ensure participants were comfortable with each of the tasks. The activities were projected on to a screen (2.1 metres) with participants seated within clear view of the screen (approximately 5-7 metres away).

Data Analysis

For the PHQ, to ensure consistency with previous findings (Ford et al., 2009; Ford & Williams, 2012; Ward et al., 2007), soccer-related activities were grouped into three activity types, competition (i.e., match-play), training (i.e., coach-led and individual practice), and play (i.e., peer-led play). Accumulated hours of engagement in soccer-related activities was calculated by multiplying the reported hours per week by weeks per year, minus the number of weeks participants reported as injured. To calculate accumulated hours of indirect involvement, reported hours per week were multiplied by the reported weeks per year. This calculation did not subtract number of weeks injured, as injury was presumed to have minimal effect on participantôs ability to be indirectly involved in soccer. For the perceptual-cognitive activities, the total score for each activity was calculated and then converted to a percentage score.

To understand the potential influence of grit within an elite group of players, a percentile split approach was used. This method split the group based on grit score, with the top third forming a high grit group, and the bottom third forming a low grit group. Similar to previous research (Williams et al., 2012), the sub-groups were separated into sub-groups based on objective markers and were statistically different from each other. Therefore, the top third, high

grit group (n = 127), had a mean age of 14.04 years (SD = 0.72), and the bottom third, low grit group (n = 130), had a mean age of 13.63 years (SD = 0.78).

To assess group (i.e., high grit and low grit) differences for perceptual-cognitive and player history, separate one-way Analysis of Covariance (ANCOVA), controlling for age, were conducted. Potential relationships between all variables measured (grit, perceptual-cognitive performance and player history) were examined using Pearsonôs correlations. Due to the positive skewness in the playing history data, the values for accumulated competition, training, play, and indirect involvement were log transformed for the analysis. A significant alpha was set at 0.05, with effect sizes calculated by a partial eta-squared (η^2) and described as a small (η^2 = 0.01 ï 0.058), medium (η^2 = 0.059 ï 0.137) or a large (η^2 Ó 0.138) effect size, and correlation coefficients (r) denoted by a small (r = 0.1 ï 0.29), medium (r = 0.3 ï 0.49) or large effect (r = 0.5 ï 1) (Cohen, 1992).

Results

Descriptive statistics (mean ± standard deviation) for perceptual-cognitive activities, player history (non-transformed presented) and grit, when the cohort was separated by level of grit, are presented in Table 1. Table 2 presents the means, standard deviations and correlations from all participants for all of the measured variables. Analysis indicated significant small to medium correlations between grit and soccer-specific measures (i.e., perceptual-cognitive performance and player history).

A separate one-way ANCOVA demonstrated a significant main effect for grit when controlling for age, with the high grit group (M = 4.24, SD = 0.23) recording a significantly

greater grit score compared to the low grit group (M = 3.10, SD = 0.26). Thus, prior to further analysis, the groups were significantly different on an objective measure.

Sport-Specific Engagement

In relation to the accumulated hours of soccer-specific activity, there were significant between group differences for competition, training, play, and indirect involvement, when controlling for age. The separate one-way ANCOVA indicated the higher grit group accumulated more hours on all physical sport-specific activities than the low grit group (Competition, p = 0.004, partial η^2 = 0.035; training, p = 0.000, partial η^2 = 0.068; play p = 0.009, r = 0.029). Furthermore, the high grit group accumulated significantly more hours in indirect activities (M = 3124.72 hrs, SD = 2121.44) compared to the low grit group (M = 2030.24 hrs, SD = 1835.65). The results support hypothesis one, with gritty players accumulating more time in sport-specific activities.

Perceptual-Cognitive Performance

The separate one-way ANCOVAôs indicated a significant group effect for perceptual-cognitive skills when controlling for age. The high grit group scored significantly higher on the decision-making, $F(2, 233) = 4.65$, p = 0.032, partial η^2 = 0.020, and situational probability tasks, $F(2, 232) = 6.00$, p = 0.015, partial η^2 = 0.025, when compared with the low grit group. On the pattern recognition task, while the high grit group scored better (M = 65.68, SD = 5.42) compared to the low grit group (M = 63.20, SD = 6.39), there was no significant between group difference ($p > 0.05$). The results generally support hypothesis two, gritty players performed better on the perceptual-cognitive skills tests.

Discussion

We examined whether soccer players who score low and high on the personality trait grit can be differentiated based on their sport-specific engagement and perceptual-cognitive expertise. We predicted that grittier players accumulated more hours of soccer-specific engagement. Furthermore, we expected the high grit group to perform better on the perceptual-cognitive skills tests compared to the low grit group.

Our approach is novel since this is the first attempt to explore the personality trait of grit in a sport-specific domain, with the results supporting previous grit based findings, whereby grittier individuals were found to accumulate more time in domain specific activities compared to less gritty individuals (Duckworth et al., 2011). We speculate that grittier players are more likely to sustain long periods engaged in soccer-specific training activities to achieve their performance goals. Conversely, less gritty players may be less inclined to partake in extensive periods of domain-specific engagement, thus less likely to sustain the long periods of practice needed for successful performance (Ford et al., 2009; Ford et al., 2012; Ford & Williams, 2012; Ward et al., 2007).

In addition to supporting previous research, the current study extends both the grit and sporting expertise literature by demonstrating that gritty players accumulate significantly more hours indirectly involved in soccer, compared to less gritty players. With the increased coverage of soccer on television and the popularity of soccer-specific computer games, a limitation of previous sport-based expertise literature is the lack of acknowledgement related to the time invested by players in non-physical sport-specific activities. The results show indirect involvement accounts for almost half of total sport-specific engagement. The results corroborate

with previous grit (Duckworth & Quinn, 2007; Eskreis-Winkler et al., 2014) and sports expertise research (Roca et al., 2012; Williams et al., 2012), whereby grittier or elite athletes accumulate more time in sport-specific activities. The findings may however indicate the potential under-estimation of time players invest in sport-specific activities, if only physical engagement is calculated. As previous investigations have highlighted the potential benefit of observing sport-specific games on perceptual-cognitive skills (Pizzera & Raab, 2012), there remains little empirical evidence of the performance benefits associated with engagement in sport-specific computer games. The results of the current study indicate gritty players accumulate approximately 1000 extra hours indirectly involved in soccer.

There is an extensive body of research that indicates that performance on perceptual-cognitive tests discriminates skilled and less skilled performers (Farrow et al., 2010; Larkin et al., 2011; Larkin et al., 2014; Roca et al., 2012), coupled with findings to suggest grit may have a positive influence on academic performance (Duckworth et al., 2011). However, to date there has been no investigation of the potential link between grit and perceptual-cognitive expertise. As predicted, there was a significant main effect for perceptual-cognitive performance, with the high grit group performing significantly better on the perceptual-cognitive activities of decision-making and situational probability, compared to the less gritty players. Sport expertise based literature indicates skilled individuals outperform less skilled individuals on video-based perceptual-cognitive skills tests (Roca et al., 2012; Williams et al., 2011), with a positive correlation between perceptual-cognitive performance and time invested in soccer-specific activities (Roca et al., 2012; Williams et al., 2011). Therefore, the results may suggest gritty players are likely to invest more time within soccer-specific activities, which in turn may

positively influence perceptual-cognitive performance. While the findings supports previous grit-based expertise knowledge (Duckworth et al., 2011), the results provide initial evidence that grit may have a positive impact on the development of sport-specific expertise.

To demonstrate the link between grit and expertise, Duckworth and colleagues (2007) have speculated that achievement or success in a chosen domain is a product of talent and effort. However, the effort an individual invests in the domain may define success more than talent alone. It is proposed that to achieve this success an individual may work harder for longer periods, without switching objectives or focus on the long-term goal, or demonstrate high qualities of grit (Duckworth et al., 2007). From a practical perspective, two players may be of similar talent however one player high in grit devotes more time to practice (mean 686 hours more) to achieve their goals, such as successful decision-making performance, compared to a similar player, who is not as gritty and therefore may not make as many correct decisions. Therefore, as demonstrated in the current results, the grit of an individual may identify the athletes who are willing to dedicate more time and energy towards the development of expert performance and success.

While we attempted to control for potential confounding variables, interpretation of the results should however, be considered in respect to methodological limitations. First, the study is limited by a sample of elite youth players resulting in a fairly homogenous group. While the use of a percentile split creates distinct groups within an elite sample, in future researchers should consider using diverse cohorts with known skill differences (i.e., elite, sub-elite, and novice) to further explore the potential link between grit and sport-specific engagement and performance. Such findings may determine whether grit could be used as a potential variable for talent

identification purposes. Second, while there are differences in the reported number of hours invested in sport-specific activities, the accuracy of this retrospective data may be limited by the memory recall of the participants to recall participation in activities during childhood. Therefore, researchers may encourage the use of sport-specific participation diaries to measure sport-specific engagement. Third, perceptual-cognitive performance was measured using a video-based assessment, while there has been evidence to suggest video-based measures can differentiate skill-based differences (Ward et al., 2013; Ward & Williams, 2003; Williams et al., 2006), there is still limited evidence to demonstrate performance on video-based assessments reflect actual in-game perceptual-cognitive performance. Therefore, further research is required to determine whether video-based performance accurately replicates in-game perceptual-cognitive performance. Finally, as the current study is limited by a cross-sectional sample of elite youth players, in future researchers may consider longitudinal assessments to thoroughly understand the potential association between grit and sport-specific expertise.

Conclusions

In summary, this is the first study to explore the personality trait of grit within a sporting expertise context. Although researchers have focused on the hours invested in domain specific activities and its importance on athlete development (Ford et al., 2009; Ford & Williams, 2012; Roca et al., 2012; Ward et al., 2007), few researchers have considered the potential influence personality traits have on athlete development. In this study, we report the first attempt to demonstrate the potential link between the personality trait grit, the desire to achieve long-term goals even in the presence of failure or setbacks (Duckworth et al., 2007), sport-specific engagement and perceptual-cognitive skills. The novel findings of the current investigation may

indicate that grittier youth athletes are more likely to invest greater amounts of time in soccer-specific activities, and work towards their sporting goals, compared to less gritty individuals. Furthermore, the current investigation may highlight the potential importance of acknowledging indirect involvement when considering the practice and developmental profiles of elite youth athletes. From a performance perspective, the current results demonstrate grittier players perform better on sport-specific perceptual-cognitive assessments than less gritty players.

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Table 1. Mean (± SD) of grit, accumulated hours of soccer-related activity and perceptual-cognitive activities, when controlled for age.

	Low Grit Group		High Grit Group		*F*	p-value	Effect Size	
	Mean	SD	Mean	SD				
Grit	3.10	0.26	4.24*	0.23	1162.07	0.000	0.829	Large
Competition (hrs)	271.91	143.27	366.71*	188.51	8.64	0.004	0.035	Small
Training (hrs)	1456.32	818.63	2142.76*	1272.93	17.44	0.000	0.068	Medium
Play (hrs)	692.10	532.43	999.43*	717.75	6.91	0.009	0.029	Small
Indirect (hrs)	2030.24	1835.65	3124.72*	2121.44	9.89	0.002	0.040	Small
Decision-making (%)	54.01	15.26	59.85*	11.54	4.65	0.032	0.020	Small
Situational Probability (%)	63.20	6.39	65.68*	5.42	6.00	0.015	0.025	Small
Pattern Recognition (%)	65.17	16.02	67.93	16.47	0.10	0.752	0.000	Small

* indicates a significant difference at the 0.05 level

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Table 2. Descriptive statistics (means and standard deviation) and correlations for all variables measured.

Measure	Mean	SD	1	2	3	4	5	6	7
1. Grit	3.67	0.62	-						
2. Competition (hrs)	317.30	172.67	0.28**	-					
3. Training (hrs)	1793.30	1114.88	0.32**	0.50**	-				
4. Play (hrs)	858.70	660.69	0.20**	0.29**	0.48**	-			
5. Indirect (hrs)	2574.85	2041.70	0.28**	0.40**	0.46**	0.37**	-		
6. Decision-making (%)	56.57	13.72	0.15*	0.22**	0.12	0.09	0.10	-	
7. Situational Probability (%)	64.33	6.02	0.15*	0.20**	0.14*	0.10	0.12	0.30**	-
8. Pattern Recognition (%)	65.61	16.53	0.11	0.12	0.06	0.01	0.10	0.14*	0.11

* Correlation is significant at the $p < 0.05$ level

** Correlation is significant at the $p < 0.01$ level

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