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The Influence of Experience upon Imagery Perspectives in Adolescent Sport Performers

John K. Parker and Geoff Lovell

Abstract

Current imagery literature suggests that imagery perspectives may be subject to a default position (Morris & Spittle, 2001), with experience influencing how successfully individuals can utilize internal and external visual imagery. According to this proposition, the default imagery perspective is an internal 1st person perspective. However, few imagery inventories have been designed to differentiate and accurately measure these imagery perspectives (see Morris, Spittle, & Watt, 2005). Fewer still have considered athletic populations, in particular adolescent cohorts. Consequently, the current research examined the use of internal visual imagery (IVI), external visual imagery (EVI), and kinesthetic imagery (KI) amongst adolescent sport performers and whether the amount of hours engaged in practice outside of competition influenced their adoption. Eighty-seven (36 male, 51 female) county level participants from sports academies in the United Kingdom (M age = 14.0, SD = 1.92), from 6 interactive sports, completed the Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al., 2008). Participants were grouped relative to the amount of practice they had engaged in since playing their current sport competitively. A repeated measures ANOVA recorded significant differences amongst participants vividness of imagery, Wilkes' Λ F (2, 85) = 3.166, $p < 0.05$, $\eta^2 = .07$, post hoc pairwise comparisons using a Bonferroni adjustment revealed no significant differences between sub-scales. Results to MANOVA recorded no significant differences between VMIQ-2 sub-scales and three accumulated practice groupings, Wilkes' Λ F (3, 82) = 436.14, $p > 0.32$, $\eta^2 = .04$. The results demonstrate adolescent sport performers possess between clear and reasonably vivid to moderately clear and vivid imagery ability when using IVI, EVI, and KI. Future research should consider the impact of environmental factors that influence the development of these modalities and perspectives.

KEYWORDS: hypothesis, perspective, environment

Introduction

Imagery has been shown to be an effective covert mental strategy for enhancing the performance of motor skills (Feltz & Landers, 1983) and psychological skills (Weinberg, 2008) within the context of sport. It is widely used by athletes as a cognitive technique to enhance performance, reliably demonstrating efficacy in increasing levels of self-confidence (Mamassis & Doganis, 2004), motivation (Beauchamp, Halliwell, Fournier, & Koestner, 1996), and reductions in competitive anxiety (Evans, Jones, & Mullen, 2004). A number of variables have been identified as influential in determining the subsequent effectiveness of imagery use (see Weinberg, 2008). Of these, imagery perspective appears to be associated with contributing to the success of learning and performing different motor skills (White & Hardy, 1995). In addition, contemporary applied models of imagery use have suggested that the perspective adopted contributes to the potential success of the imagery intervention (Holmes & Collins, 2001).

Mahoney and Avener (1977) have described imagery perspectives as either internal or external and possessing a distinctive phenomenology unique to the individual. Internal imagery requires that the individual imagine being inside their own body experiencing the same sensations as would occur if they were performing the task overtly. External imagery places an individual in the position of a third person observer (e.g., similar to watching oneself on television). Although this taxonomy has caused some conceptual confusion in that internal imagery can be interpreted as either using visual or kinesthetic imagery (see Hardy, 1999), most researchers have taken a pragmatic view that to achieve an internal or an external view of the self it is necessary to employ visual imagery. Consequently, contemporary opinion regarding imagery perspectives suggest that internal imagery can be referred to as internal visual imagery (IVI) with external imagery described as external visual imagery (EVI) (see Roberts, Callow, Hardy, Markland, & Bringer, 2008). Subsequently, kinesthetic imagery (KI) (i.e., feelings and sensations associated with movement) can justifiably constitute a separate imagery modality, but one that can be accompanied with a representation of the self using IVI (Gabbard, 2009).

Most research conducted on imagery perspectives have reported that the perspective adopted can be influenced by the type of task being performed (Annett, 1995). The rational for this position is based upon the different form (White & Hardy, 1995) and spatial elements (Paivio, 1985) the skill places upon the performer. If imagery is looked upon as an information bearing representation then each perspective positions the individual in either egocentric (1^{st} person) or allocentric (3^{rd} person) space. Consequently additional information is available that one perspective alone could not provide. Dependent on the constituent elements of the type of task being performed this has the potential to influence which perspective will be adopted and is most pertinent to the demands of the motor behaviour being performed. Noteworthy though it is that little research has attempted to establish whether this assumption holds (Morris, Spittle, & Watt, 2005), research does suggest that performance on different tasks can be influenced by the perspective used (Hardy & Callow, 1999). However, it is problematic that the measures utilized to record imagery perspectives in these studies were not designed specifically for the purposes of measuring imagery perspectives (see Callow & Hardy, 2004).

More recently some researchers have considered the impact athletes' exposure and prior experiences have upon imagery perspectives (Morris et al., 2005). Whether the process of imagery perspective adoption is automatic or due to rational decision has not been fully examined. To guide current research in this endeavour Morris and Spittle (2001) proposed a default theory hypothesis. It stipulates that an internal perspective could be the default position whereby an external perspective becomes more widely used relative to an athlete's experience, especially during childhood. Default theory presents the case of how variables can have multiple states yet for the purposes of stability remain in one condition, not until the presentation of other certain variables do any of the alternative states emerge. These variables in the context of sport could be when an athlete is given the opportunity to witness their performance as a spectator would, for example seeing themselves on video (Morris & Spittle, 2001). Alternatively, it could be as simple as working on technique and form using mirrors to establish the position of various parts of the body during task execution. Another potential variable could be the amount of time spent in practicing the task. This potentially increases the amount of time engaged in an environment where the skill is performed by the self and others. It is likely that in this situation an individual will not have continually practiced in isolation and thus learned and reinforced certain movement sequences by observing the performance of others completing similar tasks.

Reasons as to how this process could occur can be linked to two features of imagery as a distinct representational code. Firstly, imagery possesses a second-order isomorphic quality that allows images to behave in a similar fashion to the objects they represent (Shepard & Chipman, 1970). Continued work on the analogous nature of mental imagery has confirmed that a functional equivalence exists between imagery and perception and imagery and movement (Finke, 1980, 1985; Jeannerod, 2001). Furthermore, neurophysiological studies have developed a strong thesis for the shared neural substrate between these forms of cognition (Kosslyn, Thompson, & Ganis, 2006). Secondly, imagery is a flexible form of cognition that can facilitate imaginative ideation (Simonton, 1999). Taken together these features of imagery can allow increases in task relevant information providing a greater variety of detail from which the imager can choose. Relevant

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to this study are that previous practice opportunities and their diversity may have the capacity to influence imagery perspective by way of facilitating novel recombination of both old and new information. Further, not only are images similar to the objects that they represent, it is also possible to visualize future events to guide current behaviours even though the future is just that, the future (see Bandura, 2008). As it is our image we can use almost any information we choose to represent the event or desired sequence of action even though it has not been physically accomplished. For example, it is possible to imagine swinging a golf club like a tour professional using information gained from observing their virtuoso performance without yet having had to observe oneself achieve the same level of motor coordination.

As reported by Bandura (1997) such observational learning techniques can impact both positively and negatively upon the acquisition of numerous social and motor behaviours. Further, according to motor-simulation theory our perception of actions either of our own or others requires internal simulation (i.e., motor imagery) of the action observed (Jeannerod, 2001). These are theoretical positions that provide partial support for a default hypothesis that advances the view that imagery perspectives are likely to be malleable to environmental influences. Currently, the prediction proposed would be the likely dominance of an internal perspective amongst younger cohorts (Morris et al., 2005). However, there is little evidence as to whether this prediction holds as most research on imagery perspectives has used adults as participants of choice (e.g., Holmes, Coughtrey, & Connor, 2008). This leaves current research in the unenviable position of having few studies that contribute to a normative data set from which to judge the efficacy of Morris and Spittle's (2001) default hypothesis.

A potential reason as to why little progress has been made in this area is due to the inappropriate psychometric tools available for measuring imagery perspectives. Previous investigations have either used inventories that have not been validated for the intended purposes of the study (e.g., Callow & Hardy, 2004) or adopted post-session evaluations were participants are asked to rate their preference of a particular imagery perspective to determine its stability over time (e.g., Cumming & Ste-Marie, 2001). In the Callow and Hardy (2004) study the Vividness of Movement Imagery Questionnaire (VMIQ) was adopted. Although, this tool is widely used by sport and exercise scientists to measure imagery ability as determined by the self-reported vividness of the image it is designed specifically to access visual and kinesthetic imagery modalities and not imagery perspectives. Thus the VMIQ encounters problems when attempts are made to extract reliable imagery perspective measurements for the following reasons. Firstly, to record KI participants are asked to imagine doing movements themselves without any guidance as to whether a visual modality should or should not be employed for this cognitive process. Secondly, the instructional ambiguity is further compounded by the fact that should an individual decide to use visual imagery to represent the self whilst attempting to simulate the feel of a movement, either EVI or IVI could be adopted. This possibility has been reliably documented with individuals using both modalities together or interchangeably (Glisky, Williams, & Kihlstrom, 1996). Of importance here is whether the modalities are distinct and can be measured separately. Aligned to this Fourkas, Avenanti, Urgesi, and Aglioti (2006) using transcranial magnetic stimulation have recently provided evidence of differences in corticospinal activity when participants were asked to image using either IVI or KI. The results suggest that these imagery modalities have distinct physiological signatures and warrant the development and testing of psychometric inventories that can accommodate such a distinction. Moreover, when measuring visual imagery ability it is necessary to ensure that instructions pertain to the self as opposed to watching somebody else perform the action. With clear instructions given as to whether the self should be viewed from either a 1st or 3rd person perspective. Currently, the VMIQ measures EVI not of the self but by asking participants to watch someone else perform movements, this has recently been shown to decrease the vividness of imagery compared to images of the self (Rymal & Ste-Marie, 2009).

The purpose of this study was to investigate imagery perspectives used by adolescent sport performers, and the degree by which experience obtained during practice influences the vividness of IVI, EVI, and KI. It was hypothesised that the vividness for IVI would be greater than EVI and KI with the amount of time engaged in practice contributing significantly to this relationship. Furthermore, the vividness of EVI would be influenced more so by increased amounts of practice than either IVI or KI. Finally, this study explored the appropriateness of using the VMIQ-2 in a youth cohort as a psychometric tool to measure contemporary conceptualizations of imagery modality and perspectives (Roberts et al., 2008).

Method

Participants

The participants for this study were eighty seven (36 male, 51 female) youth athletes recruited from local sports academies between the ages of 12 to 15 years of age (M_{age} = 14.0, *SD* = 1.92). The study included 6 interactive sports; rugby (*n* = 20), cricket (*n* = 28), football (*n* = 18), hockey (*n* = 7), and netball (*n* = 14). Participants were classified as competing at county level. Athletes had participated in their sport for 4.86 ± 2.21 years and practiced 3.96 ± 1.91 hours per week. None of the athletes in this sample had previously received formal

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imagery training or participated in coaching sessions that had used video feedback.

Measures

The Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al., 2008). The VMIQ-2 is a 36 item inventory designed to measure general movement imagery ability. It assesses participants' capabilities in visual and kinesthetic imagery. The VMIQ-2 also assesses the ability to perform internal (1st person) and external (3rd person) visual imagery of the self. Visual and kinesthetic modalities are recorded upon a 5 point Likert scale with 1 representing (perfectly clear) and 5 (no image at all). Participants are asked to rate the vividness of the image created when imagining 12 movements of varying complexity (e.g., running, jumping sideways, throwing a stone into water). It is important to note that vividness in the context of imagery research is a characteristic of imagery ability (i.e., image clarity and realism) and has been shown to be a reliable introspective quality of the image (Isaac, Marks, & Russell, 1986). It has also demonstrated a moderating effect upon motor performance (e.g., Eton, Gilner, & Munz, 1998; Isaac & Marks, 1994). Adherents of vividness as a measure of imagery ability have proposed that the phenomenological experience of the image is linked to our ability to maintain the integrity of the image through the process of active rehearsal in working memory (Baddeley & Andrade, 2000). Consequently, the perceived vividness of an image describes the richness of the representation held in working memory, and no doubt is influential in the three main imagery processes (i.e., generation, maintenance, and transformation of images) as proposed by Kosslyn (1994). With differences in electroencephalographic activity recorded between vivid and non-vivid imagers, the evidence suggests that the phenomenological experience of vividness has a physiological basis (Marks, & Isaac, 1995).

To calculate vividness of movement imagery the VMIQ-2 requires a summation of 12 actions completed for IVI, EVI, and KI sub-scales. Reliability analysis for the sub-scales has produced Cronbach alpha values for IVI (r = .95), EVI (r = .95), and KI (r = .93) respectively. The VMIQ-2 has demonstrated adequate concurrent validity with both IVI and EVI factors significantly correlated with the Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997) visual imagery sub-scale. Both the VMIQ-2 and MIQ-R kinesthetic imagery factors were significantly correlated. The construct validity of this measure has also been shown to be robust.

In line with the recommendations made by Stadulis, MacCraken, Edison, and Severance (2002) who propose that when administering an adult version of a questionnaire to children, reliability, and validity can be compromised due to difficulties in comprehending technical terminology and concepts, a pilot study was initiated. In a series of trial sessions using the VMIQ-2 participants found the initial layout of the questionnaire confusing due to the considerable amount of text and the word length of the initial instructional set (see Roberts el al., 2008). It was also highlighted by participants that certain words did not provide a suitable indication of what was being asked of them. Issues related to appropriate formatting and the use of age sensitive language to reflect the concerns relevant to the sample used is supported by Brustad (1998). Consequently, the following modifications to the VMIQ-2 were made. In consultation with coaches, sport psychologists, and a small sample of youth sport performers it was agreed that visual aids could be introduced to complement the words internal, external, and kinesthetic. To facilitate the use of EVI a small illustration of someone watching television was placed above the EVI's rating scale. A pair of eyes was selected to cue IVI and a dumbbell being lifted by a small cartoon character was adopted to guide the use of KI. It was also agreed that these should be placed within the instruction page of the questionnaire to elaborate further on what participants would be required to do. The visual aids acted as informational heuristics to activate correct imagery modality and perspective use.

Total Practice Volume

To determine the amount of practice athletes engaged in during involvement in their respective sports a Total Practice Volume (TPV) measure was calculated. Athletes were asked to estimate hours spent in practice (not time spent in competition) in a typical week. Before any figure was accepted for the study it was scrutinized by the players coach as a realistic representation of time engaged in practice and one that reflected a likely example of a typical week the player would have engaged in during their time in the sport competitively. Once this figure had been verified a composite sum was calculated by multiplying the weekly hourly estimate by 52 then multiplying that total by the number of years involved in the sport competitively. This departs from the recommendations made by Starkes (2000) where previous studies have asked participants to estimate the hours in a typical week they had practiced each year since participation in their sport began. This figure is then multiplied by 52 and with each total relative to years played added together to provide an accumulated practice total across the athlete's career. Additional to this, Starkes (2000) advocates that to increase the relative reliability of retrospective estimates a bivariate correlation between the amount of practice in a typical week and the amount of practice in the most recent year of practice should be conducted. An (r = 0.75) appears to be an acceptable relationship (see Cumming & Hall, 2002), suggesting that estimates can be construed as reliable. In the current study due to time restrictions and the

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consequent age of participants, less information regarding the structure of practice activities was obtained. As frequent behaviours have been reported to lack time and space markers which impair accurate episodic recall (Strube, 1987), coaches verification of weekly estimates was deemed to be adequate for the purposes of this study, thus improving sufficiently the reliability of participants' retrospective self-report estimates.

Procedure

Ethical clearance was approved from all participating institutions prior to any data collection. All participants volunteered to participate and were notified that their inclusion was on a purely voluntary basis and that they were free to withdraw from the research at any time. A consent form was signed by all participants and only after this was participation granted. Before questionnaires were distributed the lead researcher initiated a small discussion to detail what imagery was, how it involves the use of different sensory modalities, and that all images should be of the self. Participants were also made aware of the two imagery perspectives that would be adopted and how to use the visual aids as a means of preventing semantic and conceptual confusion. Once this had been done the VMIQ-2 was distributed amongst participants in groups of no more than 6 at any one time. The lead researcher was available throughout to deal with any queries. No time limit was specified related to the completion of the VMIQ-2 with most participants completing the questionnaire in approximately 10 minutes. All sub-scales were counterbalanced across participants to control for order effects.

Data Analyses

Initially a reliability analysis was conducted on the subscales of the VMIQ-2 (see table 1). Descriptive statistics were calculated for all VMIQ-2 subscales. To examine the differences between participants' imagery vividness scores when using the VMIQ-2 a one-way repeated measures analysis of variance (ANOVA) was conducted. To examine relationships between TPV and subscales of the VMIQ-2, Pearson bivariate correlations were conducted. To determine differences in imagery perspective based on TPV a one-way multivariate analysis of variance (MANOVA) was used. Participants were grouped into three categories for TPV and categorised as low total practice volume (LTPV), between 156 to 780 hours practice, medium total practice volume (MTPV) 832 to 1560 hours, and high total practice volume (HTPV) between 1664 and 5720 hours practice.

Results

Reliability Analysis

Internal consistency reliability estimates were conducted on the subscales of the VMIQ-2. Based upon the recommendations made by Biddle and Brooke (1992) that values of 0.60 when working with children are acceptable, the current study conformed to guidelines (see Table 1).

Descriptives

Repeated measures ANOVA, using the Greenhouse-Geisser correction for sphericity revealed a main effect for participants VMIQ-2 subscale ratings, Wilkes' Λ F (2, 85) = 3.166, $p < 0.05$, η^2 = .07. A simple pairwise comparisons with a Bonferroni adjustment of p = 0.01 indicated this difference was not significant. Mean values demonstrated IVI (M = 2.31, SD = 0.69) recorded the highest vividness with EVI (M = 2.53, SD = 0.74) the lowest (see Table 1). For participants in the HTPV group greater vividness of imagery was experienced for KI (M = 2.13, SD = 0.66), IVI (M = 2.15, SD = 0.69), and EVI (M = 2.21, SD = 0.66) than both LTPV and MTPV groups (see Table 3).

Table 1. Descriptive Statistics for VMIQ-2 sub-scales

VMIQ-2	Mean	Standard Deviation	Cronbach's alpha
EVI	2.53	0.74	0.87
IVI	2.31	0.69	0.89
KI	2.48	0.79	0.85

Abbreviations: EVI = External Visual Imagery, IVI = Internal Visual Imagery, KI = Kinesthetic Imagery. Lower score indicates higher imagery vividness.

Correlation Analyses

Pearson bivariate correlations were performed on VMIQ-2 sub-scales and TPV scores. Several significant correlations were recorded, with significant positive intercorrelations between sub-scales of the VMIQ-2 and a significant negative relationship between EVI and TPV (see Table 2).

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Table 2. Bivariate correlations for VMIQ-2 subscales and TPV

VMIQ-2	1	2	3	4
(1) EVI	1.00			
(2) IVI	.30**	1.00		
(3) KI	.43**	.37**	1.00	
(4) TPV	-.22*	-.03	-.16	1.00

Abbreviations: EVI = External Visual Imagery, IVI = Internal Visual Imagery, KI = Kinesthetic Imagery, Total Practice Volume = TPV.
** $P < 0.01$, * $P < 0.05$

Total Practice Volume

Results to MANOVA demonstrated no significant differences between VMIQ-2 sub-scales and TPV groups, Wilkes' Λ F (3, 82) = 436.14, $p > 0.32$, $\eta^2 = .04$.

Table 3. Means and (*SD*) forVMIQ-2 subscales by TPV group

VMIQ-2	LTPV *(n = 47)*	MTPV *(n = 27)*	HTPV *(n = 13)*
EVI	2.66 (0.81)	2.44 (0.60)	2.21 (0.69)
IVI	2.31 (0.70)	2.38 (0.70)	2.15 (0.69)
KI	2.59 (0.86)	2.46 (0.70)	2.13 (0.66)

Abbreviations: EVI = External Visual Imagery, IVI = Internal Visual Imagery, KI = Kinesthetic Imagery, LTPV = Low Total Practice Volume, MTPV = Medium Total Practice Volume, HTPV = High Total Practice Volume. Lower score indicates higher imagery vividness.

Discussion

This study set out to examine whether differences exist in the vividness of imagery and perspective used amongst adolescent sport performers. Overall, the results tentatively suggest, the vividness experienced for IVI (*M* = 2.31, *SD* = 0.69), EVI (*M* = 2.53, *SD* = 0.74), and KI (*M* = 2.48, *SD* = 0.79) are comparable, with a small increase in vividness (lower scores indicate greater vividness) recorded when employing IVI. However, although there was a significant VMIQ-2 subscale main effect it must be reiterated that the Bonferroni adjustment failed to record these differences as significant.

It would appear that this cohort experience imagery of the self that is on average between clear and reasonably vivid to moderately clear and vivid. This proposition concurs with Hardy and Callow (1999) who when using the VMIQ stated that a score of 72 on any of the sub-scales indicated a poor imager. More recently Rymal and Ste-Marie (2009) provide evidence of a small number (n = 7) of young divers (M_{age} = 12.43, SD = 2.07) possessing similar scores for the vividness of IVI when using the VMIQ. Of interest is the VMIQ-2 now asks participants when using EVI to imagine themselves rather than someone else. As a result the current study indicates that a degree of consistency exists in the vividness experienced for IVI, EVI, and KI of the self amongst this sample of adolescent sport performers. This is of interest as contemporary applied imagery models (see Holmes & Collins, 2001) have increasingly begun to incorporate imagery perspective as an essential characteristic that can contribute to the success of the intervention. Knowledge of the comparability in vividness of these modalities and perspectives bodes well for developing them in a unified manner. However, it is essential that further research establishes whether the content of imagery using these perspectives and modalities is effective and does indeed facilitate performance.

It is encouraging that adolescent sport performers at this competitive level (county) are using different imagery perspectives and modalities. Awareness of this flexibility offers practitioners the opportunity to be creative in the interventions they develop. In previous studies that have been more applied in nature, the researchers have rightly investigated as to the participant's imagery perspective preference (e.g., Cumming & Ste-Marie, 2001). The purpose of which is to ensure that the imagery script is commensurate with the imagery abilities of the individual. Although, such an approach is methodologically sound, practitioners can with the correct psychometric tools (e.g., VMIQ-2) explore accurately the imagery perspectives performers are capable of, thus selecting the one which suits the task most effectively. The main emphasis here is that the athlete's preferred perspective could have been adopted for no other reason than that was the first perspective that came to mind. This does not provide a comprehensive evaluation of an individual's overall imagery ability, and could potentially reduce the amount of information obtained from images that perhaps are more superior for the demands of the task. As discussed by Callow and Hardy (2004) possibly one of the most useful aspects of imagery perspectives is the information they convey, it would now appear that recommendations can be built upon a more detailed profile of a performers imagery capabilities.

The examination of the influence of experience upon imagery perspective recorded a relationship that was weaker than expected (r = -.22). With the differences between groups of athletes based upon hours practiced demonstrating a less significant role than anticipated. However, the results do lend themselves to

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investigating further Morris and Spittle's (2001) default hypothesis. Levels of TPV were related to the reported vividness of EVI only, suggesting, as stipulated in the default hypothesis, that an interaction with the environment is likely in contributing to how we adopt and utilize internal and external imagery perspectives. Although, not significant, athletes in this sample did report greater vividness for IVI than EVI, with this trend continuing across all TPV groups. It is likely that in the future, researchers should consider more heterogeneous samples than the one used in this investigation. Previous studies have reliably shown that imagery ability is related to the expertise level of the athlete (Hall, Rodgers, & Barr, 1990) and this could have impacted upon why the composite factor used in this study displayed such a small effect. Thus, the athletes in our sample may have already developed proficient imagery ability skills, reducing the likelihood of significant differences emerging. Furthermore, research should consider the type of task being investigated other than interactive sports. Novice and elite athletes have been recorded to use different types of imagery whether participating in either open or closed sports (Arvien-Barroe, Weigand, Thomas, Hemmings, & Walley, 2007). Callow and Hardy (2004) have also suggested that the type of task is influential in determining which imagery perspective should be adopted, thus warranting further exploration.

Although the support this study provides for the default hypothesis is far from overwhelming, there does appear considerable scope for future investigations to pursue. For example, the mere fact that predications based upon the default hypothesis are reliant upon differences in experience will require research to explore many more developmental factors that may influence preferences in imagery perspective. Experience is both complex and multifaceted and although the current study included the amount of practice an athlete engaged in - shown to impact decisively in the attainment of sporting expertise (Ericsson & Lehmann, 1996) and levels of imagery used (see Parker & Lovell, 2009) - a more precise and detailed description of retrospective activities that contribute to athlete development is probably needed (see Côté, Ericsson, & Law, 2005). For example a current limitation of this study was that calculations of TPV were reliant on coaches' subjective opinion of whether the amount of practice recorded by participants was authentic. This method is susceptible to artefact in that some coaches may not have been the participant's main coach for long, thus compromising the accuracy of their judgments. Subsequently this could have affected the groupings participants were assigned to. To minimize these shortcomings the utilization of practice diaries should be considered and longitudinal research programmes are warranted (see Morris, Spittle & Watt, 2005).

Furthermore, future research needs to evaluate not only domain specific experience but prior exposure to spatial activities that require solutions to figural, object, and navigational problems (e.g., puzzles, lego, model making, and video games). In a study that examined computer-game preference and mental rotation test (MRT) performance, males who preferred action-and-simulation games on average had higher MRT scores than non-players. The authors concluded that playing particular types of computer games provided an indication of possible spatial abilities, although they did concede that the low effect sizes indicated that they had not discovered exactly which characteristic/s of a computer game were responsible for this relationship (Quaiser-Pohl, Geiser, & Lehmann, 2006). However, their results do illustrate that researchers should take seriously the impact environmental influences play in shaping and determining spatial abilities of which imagery is prominent.

Regarding the use of the VMIQ-2, it would appear that Roberts and colleagues (2008) have developed a measure that is an improvement on the VMIQ allowing practitioners to investigate more thoroughly participants' imagery ability. The VMIQ-2 allows both modality and perspectives to be distinguished from one another, reducing the confusion that has often been cited when attempting to measure internal and external imagery using the previous VMIQ (Roberts et al., 2008). The subtle changes made to the questionnaire to make it more user friendly for this sample did not compromise the psychometric robustness of the questionnaire as the reliability analysis attests. However, practitioners should be mindful of the fact that the concepts and language used in imagery research can be complex to grasp, especially in those groups where the development of an adult lexicon is still a work in progress. The adoption of icons, pictures, diagrams, and illustrations are therefore useful means in enhancing understanding without dramatically altering the layout of the questionnaire and should be a consideration when working with younger cohorts, especially in the context of applied settings. Moreover, in an area of research that is well established it is rather peculiar that so few inventories exist to measure this aspect of imagery. Future research could most certainly attempt to address this imbalance.

To conclude, adolescent sport performers competing at county level experience on average imagery of the self that is between clear and reasonably vivid to moderately clear for IVI, EVI, and KI. The relationship between imagery perspectives and experience, although weaker than anticipated, provides partial support for the default hypothesis. Future research should consider different spatial activities, type of sport, and participant's skill level to more fully evaluate the efficacy of this position. Finally, practitioners should feel confident in using the VMIQ-2 when working with youth sport performers but should be cognizant that some individuals experience difficulty understanding the vocabulary used to describe important imagery concepts. To ameliorate these problems visual aids can be adopted.

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