Journal of Imagery Research in Sport and Physical Activity

Volume 7, *Issue* 1 2012 *Article* 7

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Recommended Citation:
Parker, John K. and Lovell, Geoff P. (2012) "Age Differences in the Vividness of Youth Sport Performers' Imagery Ability," *Journal of Imagery Research in Sport and Physical Activity*: Vol. 7: Iss. 1, Article 7.
DOI: 10.1515/1932-0191.1069

Age Differences in the Vividness of Youth Sport Performers' Imagery Ability

John K. Parker and Geoff P. Lovell

Abstract

The Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al., 2008) is a recent addition to tools developed for investigating movement imagery ability. To date, few studies have adopted this measure within youth sport cohorts, as a result little is known about the vividness aspect of imagery ability in samples of 21 years of age and younger. Participants included 169 youth sport performers between 12 and 21 years of age (M = 16.62, SD = 3.02), representing 14 sports at 4 levels of competitive engagement. Participants completed the VMIQ-2 and were grouped according to age, competitive level, and gender. Significant differences between the VMIQ-2's subscales were demonstrated with participants recording greatest imagery vividness for internal visual imagery and least vividness for external visual imagery. Significant age differences existed for kinesthetic imagery between the 12-13 and 20-21 age groups, with the 20-21 group recording greater imagery vividness than their younger counterparts. The results demonstrate age can influence imagery vividness with youth sport performers recording higher vividness for internal visual imagery compared to kinesthetic and external visual imagery. Future investigations should attempt to determine why age cohort differences in vividness of imagery occur.

KEYWORDS: Imagery, Vividness, Youth, Sport

Introduction

The capability to recreate sensory, affective, and perceptual experiences in the mind is often referred to as imagery (Morris, Spittle, & Watt, 2005). Primarily within the sport sciences researchers have endeavored to investigate the extent imagery is effective in contributing to both motor skill acquisition and sport performance (Martin, Moritz, & Hall, 1999). Evidence suggests that improvement on tasks using imagery alone is usually worse than groups given the opportunity to engage in physical practice but better than groups who participated in neither (de Vries & Mulder, 2007). Consequently, imagery as a covert rehearsal technique has been widely popularized and adopted by applied sport psychologists being used extensively in psychological skills interventions (Cox, 2002; Thelwell, Greenlees, & Weston, 2006).

To date a number of variables have been proffered to influence imagery's effectiveness within sporting contexts. Indeed, models designed to optimize the delivery of imagery interventions have incorporated a variety of factors known to be influential during the imagery process (e.g., Holmes & Collins, 2001; Martin et al., 1999). One variable often considered pivotal in determining the efficacy of imagery use concerns an individual's imagery ability. Although no standardized definition regarding this facet of imagery exists, Morris (1997) offered a succinct explanation of its main tenets, referring to imagery ability as 'an individual's capability of forming vivid, controllable images and retaining them for sufficient time to effect the desired imagery rehearsal' (p. 37). Of importance to the current study is the dimension of vividness which relates to the clarity and realism of the evoked image (Roberts, Callow, Hardy, Markland, & Bringer, 2008). The phenomenological experience of image vividness has been reported to maintain the integrity of the image during active rehearsal in working memory (Baddeley & Andrade, 2000). Vividness has often been used as measure of imagery ability amongst athletes with self-report questionnaires frequently adopted to access this introspective quality of the image (e.g., Isaacs & Marks, 1994).

Researchers have demonstrated that variations in vividness do occur in a number of domains relevant to sport. For example, Isaac (1992) provided evidence that vividness had a moderating effect upon motor performance with participants low in vivid imagery performing more poorly than their vivid imagery counterparts. Furthermore, vividness appears to be a quality of the imagery process that enables practitioners to differentiate between elite and non-elite athletes with elite athletes reporting more vivid imagery (Eton, Gilner, & Munz, 1998). These research findings are important as images of movement have been shown to influence the subsequent enactment of movement (Johnson, 1982), with movement reproduced at a higher caliber in participants who demonstrate higher imagery ability (Hall, Pongrac, & Buckolz, 1985). Results such as the ones presented have led some authors to propose that mental images are the representation that supports and facilitates action planning (e.g., Marks & Isaac, 1995; Gabbard, 2009).

Explanations why vividness has the potential to moderate psychological and behavioral outcomes have been linked to its manifestation during information processing. As identified by Baddeley and Andrade (2000) vividness reflects the richness of representations held in working memory and likely to facilitate a constellation of imagery processes (i.e., image generation, maintenance, transformation). Furthermore, the concept of vividness has been supported by neurophysiological data that demonstrates particular measures of blood flow (e.g., functional magnetic resonance imagery) can differentiate between individuals high or low in imagery vividness. Recently, Cui, Jeter, Yang, Montague and Engleman (2007) reported that higher visual activity indexes greater imagery vividness in the same sensory modality. These results add to a growing body of evidence for the physiological signature of vividness represented in neural substrates supporting both imagery and perception (Finke, 1985). Similar functional equivalence findings have also been presented for imagery and movement (Jeannerod, 1994).

However, although studies have considered individual differences in imagery vividness (Isaac & Marks, 1994), few have investigated differences across samples of athletes, with fewer still considering youth sport performers. Isaac and Marks (1994) reported variations in imagery vividness in both visual and movement modalities using age groups ranging for seven years to over fifty years of age, but their initial sample was not taken from a sporting population. A subsequent follow up study by the same authors explored the influence of sporting discipline amongst elite athletes' vividness of visual and movement imagery. Of interest, when matched against controls, apart from track and field athletes, the remaining disciplines recorded more vivid imagery. Unfortunately, the extent of age differences in reported vividness scores could not be considered as participants had been matched for age and gender.

Further, the questionnaire used by Isaac and Marks to measure vividness of movement imagery has since been subjected to revision. Although the Vividness Of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986) has reliably demonstrated a capability to capture the effects of movement imagery ability (e.g., Taktek, Zinsser, & St-John, 2008) it is compromised by certain conceptual inadequacies. For example, the instructional set of the VMIQ requires participants to image movement from an external perspective achieved via imagining someone else performing the required movement class (e.g., running, jumping). This interpretation of external imagery is problematic as it is possible to watch oneself execute a movement sequence adopting a third-person perspective which is similar to seeing oneself being played back on video (White & Hardy, 1995). Interestingly some researchers have reported that imagery of the self and imagery of someone else activate different neural substrates (Farrer & Frith, 2002), with greater levels of vividness experienced when imaging the self (Rymal & Ste-Marie, 2009). Subsequently, the introduction of the Vividness Of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al., 2008) has attempted to address these imagery modality and perspective issues. This has been achieved foremost by the VMIQ-2 requiring participants generate imagery of the self for both visual and kinesthetic modalities and when adopting internal and external visual imagery perspectives. However, the VMIQ-2's utilization within cohorts of youth sport performers is far from extensive. This is a concern as imagery vividness is an important characteristic of imagery ability known to influence motor performance (Issac, 1992). Moreover, imagery ability is a prominent factor in the eventual success of applied models of imagery use (e.g., Martin, Moritz, & Hall, 1999). Thus, knowledge of potential age differences in imagery vividness would no doubt contribute to how practitioners integrate and train young athletes to use imagery effectively.

The purpose of this study was twofold. Firstly, the VMIQ-2 is a recent addition to measures available for sport practitioners interested in capturing the movement imagery abilities of athletes. Consequently, determining its utility within representative samples is necessary. Secondly, scant attention has been paid to whether age differences in movement imagery ability exist within samples of youth sport performers. Previous research has demonstrated minimal differences in vividness of movement imagery amongst adolescent sport performers (Parker & Lovell, 2011); however, the sample selected was homogeneous in composition with all participants competing at county level. The current study aimed to address this limitation and included a range of ages that constituted more broadly a youth sport population.

Method

Participants

Participants were 169 (male = 90, female = 79) youth sport performers recruited between the ages of 12 and 21 years of age (M = 16.62, SD = 3.02). Participants represented 14 sports; rugby (n = 42), cricket (n = 37), football (n = 39), netball (n = 23), hockey (n = 12), swimming (n = 4), basketball (n = 3), athletics (n = 2), triathlon (n = 2), volleyball (n = 1), tennis (n = 1), cycling (n = 1), martial arts (n = 1), and gymnastics (n = 1). This study classified participants relative to four competitive levels; recreational (n = 5), club (n = 82), county (n = 58), and national (n = 24). Participants had engaged in their respective sport competitively for (M = 6.46, SD = 3.37) years (referred to as competitive exposure), and practiced [calculated from most recent week of participation] (M =

4.38, *SD* = 2.62) hours per week (referred to as practice volume). None of the participants declared they had previously received imagery training.

Measures

The Vividness Of Movement Imagery Questionnaire –2 (*VMIQ-2; Roberts et al., 2008*). The VMIQ-2 measures the ability to image a variety of movements (e.g., walking, jumping sideways, kicking a ball in the air). It is comprised of 12 items that require movements to be imaged using internal visual imagery (IVI), external visual imagery (EVI), and kinesthetic imagery (KI). Participants are instructed to rate the vividness of their image on a five-point Likert scale with 1 representing (*perfectly clear and vivid*) to 5 (*no image at all*). Vividness has been judged to be a reliable introspective quality of images (Isaac, Marks, & Russell, 1986) and an important characteristic of imagery ability (e.g., clarity and realism of the image). Baddeley and Andrade (2000) have suggested vividness maintains the integrity of the image and is reliant upon active rehearsal in working memory. Constraints upon image vividness appear to be determined by the images shape, colour, detail, context, saliency and ease of access from long-term memory (Cornoldi, De Beni, Cavedon, & Mazzoni, 1992). Importantly, Isaac and Marks (1994) have demonstrated that vividness has a moderating effect upon motor execution indicating its efficacy as a performance enhancing attribute during the imaging process. The factorial validity of the VMIQ-2, including both its construct and concurrent validity has been robustly demonstrated (see Roberts et al., 2008). Reliability analysis for IVI, EVI, and KI subscales have recorded Cronbach alpha values of .95, .95, and .93 respectively. To accommodate younger participants the current study adopted a modified version of the VMIQ-2 used previously by Parker and Lovell (2011) where icons supplemented text descriptions of imagery concepts deemed difficult to understand.

Procedure

Ethical clearance was approved by all participating institutions with consent forms signed by parents (where appropriate) and participants prior to data collection. Prior to distribution of the questionnaire the lead researcher defined imagery, discussed which sensory modalities would be operationalized, and detailed that all images needed to pertain to the self. Participants were informed of the two imagery perspectives to be used in the study with examples given to clarify the concept of perspective taking. The subscales of the VMIQ-2 were counterbalanced across participants to avoid order effects. Participants completed the questionnaire in groups of no more than 25 with the lead researcher present at all times to deal with any queries. There was no specified time limit to complete the VMIQ-2 but generally, participants took 8 minutes to complete the questionnaire.

Data Analysis

Internal consistency reliability estimates were performed on the three subscales of the VMIQ-2. Descriptive statistics were computed to demonstrate mean values for EVI, IVI, and KI respectively. To evaluate whether differences existed in participants' EVI, IVI, and KI vividness scores a repeated measures analysis of variance (ANOVA) was conducted. Bivariate correlations were calculated to assess the relationship between subscales of the VMIQ-2, age, competitive exposure, and practice volume. Group differences for gender, competitive level, and age were calculated using three one-way multivariate analysis of variance (MANOVA).

Results

Reliability Analysis

In accordance with Biddle and Brooke (1992) who recommend that when working with children internal reliability scores of (r = .60) are acceptable, the current study recorded Cronbach's alpha coefficients of EVI = (r = .92), IVI = (r = .91), and KI = (r = .88) respectively.

Descriptive Statistics

Means and standard deviations were calculated for subscales of the VMIQ-2 (see Table 1). A repeated measures ANOVA revealed significant differences in participants' imagery ability, F (2, 167) = 15.169, p = < .001, η^2 = .15. Pairwise comparisons adopting a Bonferroni procedure at p = .016 to preserve an alpha of 5% revealed significant differences between IVI and EVI, and IVI and KI. The results demonstrated vividness of imagery was greatest when participants employed IVI (M = 2.16, SD = 0.80) and least vivid when using EVI (M = 2.52, SD = 0.91). Results indicate participants' vividness of imagery was clear and reasonably vivid to moderately clear and vivid (M = < 3.00). Please note that the VMIQ-2's rating scale associates increased vividness with lower scores.

Table 1: Means (SD) for VMIQ-2 subscales by age group

VMIQ-2	Total (N = 169)	12-13 (*n* = 35)	14-15 (*n* = 29)	16-17 (*n* = 33)	18-19 (*n* = 28)	20-21 (*n* = 44)
EVI	2.52 (0.80)	2.53 (0.82)	2.62 (0.78)	2.62 (0.77)	2.34 (0.81)	2.50 (0.81)
IVI	2.16 (0.91)	2.21 (0.62)	2.51 (0.71)	2.21 (0.74)	1.93 (0.71)	2.00 (0.76)
KI	2.35 (0.77)	2.61 (0.91)	2.50 (0.72)	2.39 (0.72)	2.34 (0.75)	2.01 (0.64)

Abbreviations: EVI: External Visual Imagery, IVI: Internal Visual Imagery, KI: Kinesthetic Imagery. The VMIQ-2's rating scale associates increased vividness with lower scores.

Correlation Analysis

Bivariate correlations were calculated for age, competitive exposure (CE), weekly practice volume (PV), and VMIQ-2 subscales (see Table 2).

Table 2: Bivariate correlations between variables and VMIQ-2 subscales

Variable	1	2	3	4	5	6
1 Age	1.00					
2 CE	.57**	1.00				
3 PV	.20**	.14	1.00			
4 EVI	-.05	-.07	-.19*	1.00		
5 IVI	-.18*	-.09	-.20*	.37**	1.00	
6 KI	-.26**	-.17*	-.03	.32**	.36**	1.00

Abbreviations: CE = Competitive Exposure, PV = Practice Volume, EVI = External Visual Imagery, IVI = Internal Visual Imagery, KI = Kinesthetic Imagery.
** $P < .01$, * $P < .05$

Group Differences

As some previous studies have demonstrated imagery ability scores to be influenced by gender (e.g., Lovell & Collins, 1997; Wolmer, Laor, & Toren, 1999) and varying participation levels (Eton, Gilner, & Munz 1998; Isaac & Marks, 1994), two one-way MANOVA's were used to determine whether these aspects of the data set could be collapsed. No significant gender, Wilks' Λ F (3, 165) = 1.677, $p > .17$, $\eta^2 = .03$, or participation level, Wilks' Λ F (3, 163) = .966, $p > .76$, $\eta^2 = .01$, differences for imagery vividness where found. For age, results from MANOVA demonstrated significant differences between the VMIQ-2's subscales, Wilks' Λ F (12, 428) = 2.175, $p < .01$, $\eta^2 = .05$. Subsequent post-hoc analysis using a Bonferroni correction $p = .016$ revealed significant differences in KI between the 12-13 and 20-21 age groups, with the 20-21age group recording greater imagery vividness for this imagery modality than their 12-13 year old counterparts (see Table 1).

Discussion

The present study examined the vividness aspect of imagery ability levels amongst youth sport performers between 12 and 21 years of age. Overall, participants recorded vividness of movement imagery scores for EVI ($M = 2.52$, $SD = 0.80$), IVI ($M = 2.16$, $SD = 0.91$), and KI ($M = 2.35$, $SD = 0.77$) respectively. In a recent study, Parker and Lovell (2011) demonstrated no significant participant rating differences post-hoc between the VMIQ-2's subscales, however, participants did record greater mean imagery vividness scores for IVI with EVI recording the least vivid scores. The current investigation demonstrated imagery of the self that was clear and reasonably vivid to moderately clear and vivid. These results suggest that generally these youth sport performers generate vivid images using both visual and kinesthetic modalities from internal and external perspectives. Furthermore, the psychometric properties of the VMIQ-2 have proven to be robust with internal consistency reliability scores comparable to those of Roberts et al. (2008), Parker and Lovell (2011), and Callow and Roberts (2010). However, practitioners should exercise caution, as imagery ability measures (e.g., VMIQ-2) are not designed to evidence participants' imagery perspective preference. Previous studies have demonstrated the relationship between imagery perspective preference and imagery ability is far from strong with IVI, EVI, and imagery perspective preference correlation coefficients recording values of (r = .30, P = .01) and (r = -.31, P = .01) respectively (Callow & Roberts, 2010). Consequently, future investigations should consider variables that impinge more dynamically upon imagery perspective preference and devise tools that appropriately measure it (see Callow & Roberts, 2010).

The relationship between age and imagery vividness recorded significant values for IVI and KI subscales. Although these correlation coefficients were low, (r = -.18) and (r = -.26), accounting for 4.2% and 5% respectively of the overall variance, their direction does tentatively suggest that with increased age comes increases in imagery vividness when employing IVI and KI. As imagery ability has been presented as malleable to improvements similar to that of other skills (Morris et al., 2005), a plausible reason for this result could be older age cohorts may have had more opportunities to use imagery in their respective sports for longer. This supposition is supported by the relationship found between age and competitive exposure (r = .57). Furthermore, PV levels were associated with EVI (r = -.19) and IVI (r = -.20) with participants recording more time engaged in weekly practice also reporting greater imagery vividness for these modality and perspective combinations. Indeed, previous studies have found that certain characteristics of imagery can be influenced by environmental constraints. For example, Parker and Lovell (2009) using the Sport Imagery Questionnaire (Hall et al., 1998) demonstrated increased levels of practice volume (e.g., hours spent in non-competitive practice) impacted upon the frequency of imagery functions used in a sample of academy youth sport performers. Of particular interest was the recorded relationship was with only the motivational functions of imagery use (e.g., motivational specific, motivational-general). The authors speculated that athletes may employ these functions in an attempt to increase levels of motivation during arduous practice sessions. However, they cautioned practitioners working with youth athletes to be vigilant of a preoccupation with result orientated images as doing so could prove counterproductive to an athlete's development if not supplemented with images that pertain to skill acquisition. In addition, there is evidence that a number of activities are becoming more prominent in our environments that have a capacity to impact upon spatial abilities, of which imagery features. For example, Quaiser-Pohl, Geiser, and Lehmann (2006) reported male computer-game preferences (i.e., action-and-simulation) influenced scores on a mental rotation test with males preferring action-and-simulation games recording higher scores than their non-player counterparts. Therefore the current investigation adds to this growing body of literature suggesting that imagery capabilities maybe far from static. Where the environment we find ourselves in, the time spent in it, and activities we choose to participate in; contributing to the subtle modification of numerous characteristics of imagery (e.g., vividness, perspective, function).

Regarding age, the present findings revealed a significant multivariate effect with subsequent post-hoc analysis identifying KI subscale differences between the 12-13 and 20-21 age groups. Similarly, previous studies have reported imagery ability age consequences with a consistent pattern between vividness and image control emerging (e.g., Wolmer et al., 1999; Isaac & Marks, 1994). Generally, researchers have proposed that the image system is subject to maturational changes of which age would be influential in this process (Kosslyn, Margolis, Barrett, Goldknopf, & Daly, 1990). However, the current study provides evidence that not all subjectively reported imagery abilities are likely to be influenced by age equally. One viable reason for the KI differences between the 12-13 and 20-21 age groups maybe the ability to delineate between imagery modalities.

Drawing from physiological data Roberts et al. (2008) advance the opinion that IVI and KI are separate modalities. For example, differences in corticospinal activity between KI and 1st person visual imagery have been recorded using transcranial magnetic stimulation (Fourkas, Avenanti, Urgesi, & Aglioti, 2006). Previously traditional conceptualizations of motor imagery attest to the combined effect of these modalities with IVI and KI being used simultaneously (e.g., Jeannerod, 1994; Lotze & Halsband, 2006). However, based upon performance measures where imagery has been used, research has demonstrated that KI can impact upon performance more so than visual imagery (Hardy & Callow, 1999). Based upon this evidence Roberts at al. have developed an inventory that attempts to maintain this physiological distinction. However, although this judgment may appear sound on the basis of the aforementioned physiological results, it does not necessarily equate to presenting one at a subjective level of analysis. It is possible that the younger cohort in this study may have experienced difficulty in separating the kinesthetic feel from their image if the image represented visual information also. This assumption is based on the premise that when assessing information from a mental image the imagery system allows only a finite amount of information to be held in short-term memory (Pylyshyn, 2003). Research has demonstrated that the amount of elements an image is composed of, its complexity, the time available to image, and familiarity with what is being imaged, can all contribute to the success of using imagery (Holmes & Collins, 2001). Consequently, some individuals may be more adept in using KI that is not supported by either IVI or EVI, and in doing so increase the amount of attentional resources available to inspect the image. Currently the VMIQ-2 does not stipulate that when participants image using KI the feeling of doing the movement should be devoid of visual features. Although speculative, it is possible that this issue may influence subsequent vividness scores. Future research could consider the implications of how participants interpret what is being asked of them when requested to use KI by making changes to the VMIQ-2's instructional set or by implementing robust manipulation checks during the time participants are given to image.

The aim of this investigation was to extend the initial findings of Parker and Lovell (2011) across a heterogeneous sample of youth sport performers using the VMIQ-2. Participants were found to possess imagery ability that was clear and reasonably vivid to moderately clear and vivid. In general, when vividness has been employed as the main characteristic of imagery ability, youth sport performers across an age range of 12 to 21 years of age have acceptable imagery abilities of the self across both visual and kinesthetic modalities and from external and internal visual imagery perspectives. However, unlike Parker and Lovell (2011) the current study recorded differences between the VMIQ-2's subscales with participants demonstrating greater vividness for IVI with EVI recording the least vivid scores.

Furthermore, age differences in imagery ability proved to be subtle with the 20-21 age group recording significantly higher scores in KI than participants of 12 and 13 years of age. A plausible explanation for this result infers that older participants may have developed the capability to discriminate between imagery modalities used to support KI. This explanation is based on the VMIQ-2's instructional set not making explicit reference to whether other imagery modalities should or should not be used when employing KI. Secondly, older participants may have developed the capability to use KI independently of other modalities or have become adept in differentiating between the modalities if the imagery employed is composed of more than one modality. Altering the instructions of the VMIQ-2 and using manipulation checks are suggested as ways forward to determine if these speculations are correct.

References

Baddeley, A. D., & Andrade, J. (2000). Working memory and the vividness of imagery. *Journal of Experimental Psychology. General*, *129*, 126-145.

Biddle, S., & Brooke, R. (1992). Intrinsic versus extrinsic motivational orientation in physical education and sport. *British Journal of Educational Psychology*, *62*, 247-256.

Callow, N., & Roberts, R. (2010). Imagery research: an investigation of three issues. *Psychology of Sport and Exercise*, *11*, 325-329.

Cornoldi, C., De Beni, R., Cavedon, A., & Mazzoni, G. (1992). How can a vivid image be described? characteristics influencing vividness judgments and the relationship between vividness and memory. *Journal of Mental Imagery*, *16*, 89-108.

Cox, R. H. (2002). *Sport psychology: concepts and applications* (4th ed). Boston: McGraw-Hill.

Cui, X., Jeter, C. B., Yang, D., Montague Read, P., & Eagleman, D. M. (2007). Vividness of mental imagery: individual variability can be measured objectively. *Vision Research*, *47*, 474-478.

de Vries, S., & Mulder, T. (2007). Motor imagery and stroke rehabilitation: a critical discussion. *Journal of Rehabilitation Medicine*, *39*, 5-13.

Eton, D. T., Gilner, F. H., & Munz, D. C. (1998). The measurement of imagery vividness: a test of the reliability and validity of the vividness of visual imagery questionnaire. *Journal of Mental Imagery*, *22*, 125-136.

Farrer, C., & Frith, C. D. (2002). Experiencing oneself vs another person as being the cause of action: the neural correlates of the experience of agency. *NeuroImage, 15*, 596-603.

Finke, R. A. (1985). Theories relating mental imagery to perception. *Psychological Bulletin*, *98*, 236-259.

Fourkas, A. D., Avenanti, A., Urgesi, C., & Aglioti, S. M. (2006). Corticospinal facilitation during first and third person imagery. *Experimental Brain Research*, *168*, 143-151.

Gabbard, C. (2009). Studying action representation in children via motor imagery. *Brain and Cognition*, *71*, 234-239.

Hall, C. R., Mack, D. E., Paivio, A., & Hausenblas, H. A. (1998). Imagery use by athletes: development of the sport imagery questionnaire. *International Journal of Sport Psychology, 29*, 73-89.

Hall, C. R., Pongrac, J., Buckolz, E. (1985). The measurement of imagery ability. *Human Movement Science*, *4*, 107-118.

Hardy, L., & Callow, N. (1999). Efficacy of external and internal visual imagery perspectives for enhancement of performance on tasks in which form is important. *Journal of Sport & Exercise Psychology, 21*, 95-112.

Holmes, P. S., & Collins, D. J. (2001). The PETTLEP approach to motor imagery: a functional equivalence model for sport psychologists. *Journal of Applied Sport Psychology, 13*, 60-83.

Isaac, A. (1992). Mental practice- does it work in the field? *Sport Psychologist*, *6*, 192-198.

Isaac, A. R., & Marks, D. F. (1994). Individual differences in mental imagery experience: developmental changes and specialization. *British Journal of Psychology*, 85, 479-500.

Isaac, A. R., Marks, D. F., & Russell, D. G. (1986). An instrument for assessing imagery of movement: the vividness of movement imagery questionnaire (VMIQ). *Journal of Mental Imagery*, *10*, 23-30.

Jeannerod, M. (1994). The representing brain: neural correlates of motor intention and imagery. *Behavioural and Brain Sciences, 17*, 187-245.

Johnson, P. (1982). The functional equivalence of imagery and movement. *Quarterly Journal of Experimental Psychology*, *34*, 349-365.

Kosslyn, S. M., Margolis, J. A., Barrett, A. M., Goldknopf, E. J., & Daly, P. F. (1990). Age differences in imagery abilities. *Child Development, 61*(4), 995-1010.

Lotze, M., & Halsband, U. (2006). Motor imagery. *Journal of Physiology (Paris)*, *99*, 386-395.

Marks, D. F., & Isaac, A. R. (1995). Topographical distribution of EEG activity accompanying visual and motor imagery in vivid and non-vivid imagers. *British Journal of Psychology*, *86*, 271-282.

Martin, K. A., Moritz, S. E., & Hall, C. R. (1999). Imagery use in sport: a literature review and applied model. *The Sport Psychologist, 13*, 245-268.

Morris, T. (1997). *Psychological skills training in sport: an overview* (2^{nd} ed). Leeds: National Coaching Foundation.

Morris, T., Spittle, M., & Watt, A. P. (2005). *Imagery in sport.* Champaign, IL: Human Kinetics.

Parker, J. K., & Lovell, G. (2009). Characteristics affecting the use of imagery: a youth sports academy study. *Journal of Imagery Research in Sport and Physical Activity*, *4*(1), 1-16.

Parker, J. K., & Lovell, G. P. (2011). The influence of experience upon imagery perspectives in adolescent sport performers. *Journal of Imagery Research in Sport and Physical Activity*, *6*(1), 1-17.

Pylyshyn, Z. W. (2003). *Seeing and visualizing: it's not what you think.* London: The MIT Press.

Roberts, R., Callow, N., Hardy, L., Markland, D., & Bringer, J. (2008). Movement imagery ability: development and assessment of a revised version of the vividness of movement imagery questionnaire. *Journal of Sport & Exercise Psychology*, *30,* 200-221.

Quaiser-Pohl, C., Geiser, C., & Lehmann, W. (2006). The relationship between computer-game preference, gender, and mental-rotation ability. *Personality and Individual Differences*, *40*, 609-619.

Rymal, A. M., & Ste-Marie, D. M. (2009). Does self-modelling affect imagery ability or vividness? *Journal of Imagery Research in Sport and Physical Activity*, *4*(1), 1-14.

Taktek, K., Zinsser, N., & St-John, B. (2008). Visual versus kinesthetic mental imagery: efficacy for the retention and transfer of a closed motor skill in young children. *Canadian Journal of Experimental Psychology, 62*(3), 174-187.

Thelwell, R. C., Greenlees, I. A., & Weston, N. (2006). Using psychological skills training to develop soccer performance. *Journal of Applied Sport Psychology*, *18*, 254-270.

White, A., & Hardy, L. (1995). Use of different imagery perspectives on the learning and performance of different motor skills. *British Journal of Psychology*, *86*, 169-180.

Wolmer, L., Laor, N., & Toren, P. (1999). Image control from childhood to adolescence. *Perceptual and Motor Skills*, *89*, 471-485.