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Imagery research: An investigation of three issues

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ABSTRACT

Objective: The objective of the present study was to investigate three issues in imagery research: how imagery perspective preference may relate to imagery ability; the angle of external visual imagery usage; and the order of visual and kinesthetic imagery experience.

Methods: One hundred and fifty nine athletes (M age = 19.60, SD = 2.67 years) completed an adapted version of the Vividness of Movement Imagery Questionnaire – 2 (Roberts, Callow, Hardy, Markland, & Bringer, 2008).

Results: Significant but small correlations between imagery perspective preference and imagery perspective ability were revealed. With reference to angle, athletes reported imaging from a variety of external angles. However, angle of external visual imagery did not relate to differences in imagery ability. In terms of the order of visual and kinesthetic imagery, regardless of visual imagery perspective, athletes' experienced visual and kinesthetic imagery concurrently most often.

Conclusions: The results are discussed in terms of the importance of taking imagery preference into account when designing imagery studies. Further, future research directions are proposed in relation to exploring angle of external visual imagery and order of visual and kinesthetic imagery.

Imagery research has progressed considerably since Mahoney and Avener (1977) highlighted the differential use of imagery by successful versus non-successful Olympic trialists. Indeed since then, experimental research has demonstrated the efficacy of imagery for the acquisition and performance of motor skills (see Hall, 2001 for a review). Moreover, this effect is now known to be moderated by several factors including: the modality of the image (i.e., the sensory experience of the image, namely, visual, kinesthetic, auditory, olfactory, and gustatory; see Hardy & Callow, 1999); the visual imagery perspective used (e.g., White & Hardy, 1995) and imagery ability (e.g., Gregg, Hall, & Nesterhoff, 2005). Further, previous methodological weaknesses such as a failure to take task characteristics into account, and the use of manipulation checks to scrutinize adherence to imagery treatments (see Goginsky & Collins, 1996) are less evident (e.g., Fourkas, Avenanti, Urgesi, & Aglioti, 2006). However, despite the increase in knowledge and improvements in experimental rigor, academic debate and reviews (e.g., Callow & Hardy, 2005; Hardy, 1997; Holmes & Calmels, 2008) have revealed a number of issues that need to be explored in order for certain aspects of imagery research to progress further. Consequently, the objective of the present study was to explore three of these issues with a view to guiding future imagery research and applied practice.

The first issue relates to the fact that although the differential effects of visual imagery perspectives (i.e., external visual imagery and internal visual imagery) are relatively well understood (see Callow & Hardy, 2005 for a review), the role of visual imagery perspective preference is not (Hall, 1997). This is especially the situation in terms of how imagery perspective preference may relate to imagery ability (i.e., the vividness and controllability of an image, Hall, 2001). Given that athletes use visual imagery extensively (Hall, 2001), it is understandable that they sometimes establish a preference for using either an external visual imagery perspective (i.e., watching themselves performing as if they are on TV) or internal visual imagery perspective (i.e., looking out through their own eyes while performing), and subsequently use that perspective when imaging (e.g., Calmels, Holmes, Lopez, & Naman, 2006). Further, as imagery use and imagery ability are positively related (Gregg et al., 2005), it seems likely that athletes with a preference for a particular visual imagery perspective may have greater imagery ability with that perspective because it is being used more often.

Interestingly, it has been proposed that imagery preference can be identified through an examination of scores on imagery ability questionnaires (Holmes, 2007), suggesting that imagery preference

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and imagery ability are strongly correlated. However, if a weak relationship between these variables is established then this would indicate that they underlie two different constructs. If this is the case, preference should perhaps be controlled for when conducting imagery research so that it does not act as a confound (Callow & Hardy, 2004). Therefore, in terms of being able to maximize experimental rigor in future studies, an examination of the precise relationship between imagery preference and imagery ability would be worthwhile. However, to the best of the present authors' knowledge, such an examination has yet to take place. Consequently, the first purpose of the present study was to explore the relationship between visual imagery perspective preference and imagery ability.

The second issue examined in the present study relates to external visual imagery. Specifically, although external visual imagery (EVI) is often manipulated in imagery studies (e.g., White & Hardy, 1995) and by athletes (Fournier, Deremaux, & Bernier, 2008), researchers have yet to examine the angle of EVI that can be taken (Callow & Hardy, 2005; Holmes & Calmels, 2008). For example, a gymnast imaging a routine using EVI could image from behind, in front, and/or from the side. Further, there are theoretical grounds to suggest that angle of EVI used may impact on the efficacy of EVI in terms of EVI ability. To expand, imagery ability is often assessed via introspective reports of the *vividness* of imagery experiences using validated self-report measures such as the VMIQ-2 (Roberts et al., 2008). Vividness refers to the clarity and realism of an image and reflects the richness of the representation that is displayed within short-term working memory (Baddeley & Andrade, 2000). With regard to the representation of EVI, it seems reasonable to suggest that different angles of EVI may lead to more (or less) vivid images, because the angle taken during EVI may impact on the richness of the representation displayed in working memory. If angle and vividness of imagery (i.e., ability) are correlated, because imagery ability influences the effectiveness of imagery interventions (Callow & Waters, 2005) angle should be considered when designing imagery interventions. Thus, the second purpose of the present study was to investigate the angle of EVI used by athletes, and to examine whether angle of EVI is related to imagery ability (in terms of vividness).

The final issue relates to the debate surrounding the order in which visual and kinesthetic imagery are experienced (e.g., Collins, Smith, & Hale, 1998). Researchers (e.g., Cumming & Ste-Marie, 2001) have highlighted that athletes report using kinesthetic imagery (i.e., the feeling of movement) with both EVI and internal visual imagery (IVI). Further, a number of studies (e.g., Callow & Hardy, 2004; Hardy & Callow, 1999) have provided evidence in support of the fact that the experience of the two modalities (i.e., visual and kinesthetic imagery) can be concurrent. However, Collins and Hale (1997) contend that kinesthetic imagery can only be experienced with an internal visual perspective, and that the order with which EVI and kinesthetic imagery are experienced is EVI and *then* kinesthetic imagery (Collins et al., 1998).

The possibility of concurrent usage makes intuitive sense because visual and kinesthetic images are encoded using different neural networks in the brain (Jeannerod, 1994) and these neural networks can be activated at the same time (Klatzky, 1994). Indeed, more recent theoretical reviews from the neuroscience of imagery literature support this view (see Holmes, 2007; Holmes & Calmels, 2008 for more detail). It is important to establish the order in which these modalities are experienced, as this may well have implications for how these modalities are administered during experimental manipulations (such as imagery scripts). Consequently, the third purpose of the present study was to examine the order in which visual and kinesthetic imagery are experienced when imaging from internal visual and external visual perspectives.

To summarize, the objective of the present study was to examine three separate, but related issues, in the current imagery research, with a view to guiding future imagery research and applied practice. These three issues refer to: how imagery perspective preference may relate to imagery ability; the angle of external visual imagery usage and its relationship with imagery ability; and, finally the order of visual and kinesthetic imagery experience.

Method

Participants

An opportunistic sample of 159 British athletes (M age = 19.60, SD = 2.67 years, n = 84 males, n = 69 females, n = 6 sex not reported) was recruited for the study. Athletes had an average of 6.52 years (SD = 3.97) competing in their sports, and were from a variety of team and individual sports. The level of competition ranged from recreational to international. Informed consent and Institutional ethics approval was obtained.

Measures

Vividness of movement imagery questionnaire – 2 (VMIQ-2: Roberts et al., 2008)

The VMIQ-2 is a revision of the Vividness of Movement Imagery Questionnaire (VMIQ: Isaac, Marks, & Russell, 1986) and comprises 12 items that assess the ability to image a variety of movements. Participants are required to image each item in three ways: using internal visual imagery; external visual imagery; and kinesthetic imagery, and rate the vividness on a five-point Likert scale from 1 (*perfectly clear and vivid*) to 5 (*no image at all*). The VMIQ-2 has demonstrated acceptable factorial validity, construct validity and concurrent validity (see Roberts et al.). For the purpose of the present study, the VMIQ-2 was adapted by adding the following items related to preference and order after the ability items.[1]

Imagery perspective preference

Imagery perspective preference was assessed on an 11 point Likert-type scale from 0 (*strong IVI preference*) to 10 (*strong EVI preference*), with further anchors at 3 (*moderate IVI preference*), 5 (*no preference*) and 7 (*moderate EVI preference*). The item was based on previous assessments of imagery perspective use (e.g., Cumming & Ste-Marie, 2001), but was modified to reflect preferences for a particular perspective, as opposed to the use of a particular perspective. That is, participants were asked to indicate on the scale if they had a preference for using a particular visual imagery perspective.

Angle of EVI

To assess the angle used, on completion of the VMIQ-2 participants were presented with a picture of a mannequin and were asked to illustrate, by way of an arrow and short explanation, the angle that they imaged from most of the time when completing the EVI items.

Order of visual and kinesthetic imagery

Participants were asked if they experienced kinesthetic imagery at the same time as the designated imagery perspective when completing the EVI and IVI scales of the VMIQ-2. If they did, order was explored for *each* perspective. Specifically, participants were given three options: visual and kinesthetic imagery at the same time; visual then kinesthetic imagery; kinesthetic then visual

[1] An adapted version of the VMIQ-2 can be obtained from the second author.

imagery, and were asked to rank the order of usage from 3 (*most often*) to 1 (*least often*).

Procedure

Participants completed the VMIQ-2 in small groups. The order in which participants completed the three factors of the VMIQ-2 was counter-balanced to prevent ordering effects. Following completion of the VMIQ-2 they were asked to complete the items regarding imagery perspective preference, order of visual and kinesthetic imagery, and angle of EVI. Participants were asked to complete all questions without conferring with others, and were assured of the confidentiality of their responses.

Results

Fourteen participants reported scores of 49 or greater on at least one subscale of the VMIQ-2. A score of 49 corresponds to an average score per item of more than 4, indicating that participants were unable to image items on the respective subscale(s). Consequently the data from these 14 participants were removed, and all analyses were performed on the remaining sample of 145 athletes. Descriptive statistics and Cronbach's alphas for each subscale were as follows: EVI $M = 29.53$, $SD = 9.02$, $\alpha = .89$; IVI $M = 25.26$, $SD = 8.92$, $\alpha = .93$; KIN $M = 25.19$, $SD = 7.89$, $\alpha = .91$.

Imagery perspective preference

Pearson's product-moment correlations were calculated to assess the strength of the relationship between imagery preference and imagery ability. Separate correlations were performed between preference and IVI ability, and preference and EVI ability. The analyses revealed that imagery perspective preference and imagery ability were significantly correlated, IVI ability and preference $r = .30$ ($p < .01$), EVI ability and preference $r = -.31$ ($p < .01$).

Angle of EVI

Participants reported imaging from 10 different external angles. Inspection of the frequency with which the angles were reported revealed that four angles were reported most often: behind (40); in front (44); side on from the left (23); and side on from the right (16). A single-factor ANOVA conducted on the data from these four angles revealed no significant differences in reported EVI ability, F (3, 114) = 1.01, $p > .39$, $\eta^2 = .03$, 1-β = .27. The other angles reported were: behind side left (1) right (2); front side left (1) right (2); birds eye view (5); did not use EVI (2). In addition, 11 participants did not complete the question.

Order of visual and kinesthetic imagery

As the order data were ranked, Friedman tests with a Bonferroni adjusted alpha level of .025 were employed. Significant effects were followed up using Wilcoxon Signed Ranks tests with a Bonferroni adjusted alpha level of .017.

Order of visual and kinesthetic imagery experience for EVI

Fourteen participants did not experience kinesthetic imagery when completing the EVI scale, and four participants did not complete the order items. These data were removed and the subsequent analyses performed on the data from the remaining 127 participants. The Friedman test revealed a significant difference between the ranks, $\chi^2(2) = 21.79$, $p < .01$. Follow-up Wilcoxon tests revealed no significant difference between experiencing the two modalities concurrently and experiencing visual imagery *then* kinesthetic imagery, $z = -1.08$, $p < .09$. However, participants reported experiencing the two modalities concurrently significantly more often than experiencing kinesthetic imagery *then* visual imagery, $z = -4.58$, $p < .01$, and visual *then* kinesthetic imagery significantly more often than kinesthetic *then* visual imagery, $z = -2.88$, $p < .01$.

Order of visual and kinesthetic imagery experience for IVI

Eleven participants did not experience kinesthetic imagery when completing the IVI scale, and five participants failed to complete the order items. These data were removed and the analyses were performed on the data from the remaining 129 participants. The Friedman test revealed a significant difference between the ranks, $\chi^2(2) = 37.47$, $p < .01$. Follow-up Wilcoxon tests revealed that participants experienced the modalities concurrently significantly more often than either visual *then* kinesthetic imagery, $z = -4.28$, $p < .01$, and kinesthetic *then* visual imagery, $z = -5.63$, $p < .01$. Participants also reported experiencing visual *then* kinesthetic imagery more often than kinesthetic *then* visual imagery, $z = -2.25$, $p < .02$ (although this difference was not significant at the adjusted alpha level).

Discussion

The purpose of the present study was to examine three issues in imagery research, namely: the relationship between imagery perspective preference and imagery ability; the angle of EVI used by athletes; and the order with which visual and kinesthetic imagery are experienced when imaging from different visual perspectives.

The data examining the relationship between imagery perspective preference and imagery ability revealed a significant correlation between these two variables. A significant correlation was unsurprising, given that athletes with a preference for a particular perspective are likely to have greater imagery ability in that perspective. However, of more interest was the *strength* of the correlation between imagery ability and imagery preference. Indeed, the correlation between these constructs was only moderate (preference and IVI ability = .30, preference and EVI ability = −.31). Thus with approximately only 9% of variance being shared, we would suggest that imagery perspective ability and imagery perspective preference, although related, are different constructs. These results have general implications for future imagery research. First, due to the significant relationship between the variables, and given that imagery ability moderates the effectiveness of imagery interventions, preference should also be considered in the allocation of participants to treatment groups in imagery studies. Second, as the variables are different constructs, researchers wishing to identify the imagery perspective preference of an athlete should use reports of preference from the athletes (cf. Calmels et al., 2006), rather than just ability (cf. Holmes, 2007). With reference to specific future studies, in order to examine the nature of the relationship between imagery ability and preference, experimental and longitudinal designs should be conducted so that causality can be established (i.e., whether ability causes preference or preference causes ability).

Future research should also explore the operationalization of imagery perspective preference (in particular whether it should be viewed as a unidimensional or multidimensional construct) and develop a psychometrically rigorous measurement tool. Indeed, the present study has a potential limitation due to a single item being used to assess imagery perspective preference (cf. Feltz & Chase, 1998). Another measurement limitation relates to the fact that imagery ability was only assessed in terms of vividness. Given that imagery ability is commonly conceptualized as both vividness and controllability (Hall, 2001), future research might wish to examine the role of image controllability within the preference/ability relationship.

In terms of enhancing motor performance, it would be relevant to examine the possible interactive effects of imagery perspective and preference, especially in relation to task characteristics (e.g., whether the task has form or perceptual requirements, cf. Hardy & Callow, 1999). In particular, for a significant performance gain to be obtained, it is not known if the visual imagery perspective used needs to be matched with both the characteristics of the task and the visual perspective preference of the athlete, or whether simply matching the visual perspective with task characteristics is sufficient. To expand, and in relation to applied practice, if matching perspective to task type is sufficient, a gymnast with a preference for IVI, might be best advised to switch and use EVI when imaging aspects of his/her routine (because of the benefits of using EVI for form-based tasks, cf. Hardy & Callow). Conversely, if preference needs to be matched to the perspective used, as the gymnast has an IVI preference, EVI might not be effective despite the form-based nature of the task. Thus advising a switch to EVI, without any EVI training, might be inappropriate. Clearly, practitioners need to be mindful of both the characteristics of the task, as well as the preference of the athlete when considering which imagery perspective an athlete should use.

The data examining the angle of EVI revealed that athletes reported imaging from a variety of external angles, although no differences were found between angles in terms of reported vividness. Thus, in relation to imagery vividness specifically, angle perhaps does not need to be considered. However, the non-significant result may be due to imprecise measurement. Specifically, the crudeness of arrow placement on the mannequin and subsequent categorization of the angle, coupled with the fact that this assessment occurred only for the angle used *most* of the time, rather than for *every* item, perhaps meant that subtle differences were not detected. The present authors would welcome attempts to improve on this method of assessing angle of EVI. For example, allowing respondents to use 3-dimensional pictures displayed via television or computer screen may allow for better assessments of the angle used (see Fournier, 2000 for developments of this nature).

The necessity for precision in the assessment of angle is further highlighted in relation to the cognitive neuroscience and spatial coding literature. Within this literature, Vogeley and Fink (2003) refer to perspective taking in terms of a first-person perspective (1PP) and a third-person perspective (3PP). These perspectives relate directly to IVI and EVI respectively. It is stated that 1PP utilizes an egocentric reference frame (i.e., the representation of object locations in relation to an individual and his/her physical configuration, as in a polar coordinate system) and is proposed to operate within the dorsal stream of the brain (cf. Milner & Goodale, 1995). Alternately, 3PP uses an allocentric reference frame (i.e., an object framework that is independent from the individual, as in a Cartesian coordinate system) and operates within the ventral stream (cf. Milner & Goodale, 1995). Given the conceptual similarity, IVI and EVI could logically be mapped onto the two reference frames. More specifically, IVI could be egocentrically coded, and EVI allocentrically coded (cf. Fourkas et al., 2006). Clearly, given the potential difference in the reference frameworks of EVI and IVI, and that switching between the two reference frameworks occurs at 135° (e.g., Waller & Hodgson, 2006), the precise angle of EVI needs to be examined in relation to the nature of imagery scripts and the point at which switching of visual imagery perspectives is appropriate for a task. More generally, given the proposal that switching between visual imagery perspectives would be particularly effective for tasks requiring form *and* perceptual elements (Hardy & Callow, 1999), and that imagery is only effective when it provides information to a performer that would otherwise be unavailable (Hardy, 1997), the possible influence of angle on motor performance would be a valuable contribution to the applied literature.

There is, however, an alternative explanation for the lack of significant findings between angle of EVI and imagery ability related to the nature of the movements that are imaged on the VMIQ-2. Specifically, the movements on the VMIQ-2 do not rely heavily on the use of form for their successful completion, and it is for form-based tasks that EVI has shown to result in beneficial effects (Hardy & Callow, 1999). Thus, with reference to imagery ability it could be that angle only becomes relevant when a task is form-based. Further, the effects of angle may not be related to vividness. Clearly, these arguments are highly speculative. However, an examination of the vividness of an image (i.e., the representation that is displayed within short-term working memory) related to the angle for a particular form-based task using fMRI would be an interesting line of research (cf. Cui, Jeter, Yang, Montague, & Eagleman, 2007).

With regard to the final issue in the present study, the order data indicated that, for both perspectives, athletes reported experiencing the visual and kinesthetic modalities concurrently more often than experiencing one modality before the other (e.g., visual *then* kinesthetic imagery). These data support theoretical positions (e.g., Jeannerod, 1994; Klatzky, 1994) and research (e.g., Cumming & Ste-Marie, 2001; Hardy & Callow, 1999) advocating the possibility of concurrent experience of visual and kinesthetic imagery, regardless of perspective. Thus the data contrast the view that, for EVI, the order with which these modalities are experienced is visual and then kinesthetic imagery (cf. Collins et al., 1998). However, it must be noted that participants were not asked to report on whether they switched backwards and forwards between visual and kinesthetic imagery, and there is the possibility that this switching could have been interpreted as concurrent usage. Despite this potential limitation, the results do indicate reported differences in order, thus the administration of order during experimental manipulations (such as imagery scripts) should be given consideration. Further, future research should establish if participants *actually* switch backwards and forwards between visual and kinesthetic imagery rather than use it concurrently. Specifically, fMRI would be a suitable technique for exploring the specific brain pathways to establish sequential, concurrent, or switching usage of visual imagery perspectives and kinesthetic imagery (cf. Olsson, Jonsson, Larsson, & Nyberg, 2008).

In summary, we hope that the present report starts to provide clarification on three issues that have been in the research literature for some time, their relevance when designing methodologies, and interesting future research directions that emanate from them.

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