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Can imagery facilitate improvements in anticipation behavior?

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ABSTRACT

Objectives: We examined the effectiveness of interventions involving imagery, video, and outcome feedback in improving anticipation in skilled junior cricket batters.
Design/method: Participants ($N = 34$, Mean age = 14.9 years, SD = 0.75) were allocated to one of three groups matched on imagery ability or a no practice control. The experimental groups received a four-week, film-based training intervention.
Results: All experimental groups improved anticipation performance during training. Pre to posttest improvements were greater for the group that received outcome Knowledge of Results (KR) compared to groups that also received a video replay of the bowler's action or imaged the previously seen action. All experimental groups improved visual imagery ability, measured by the VMIQ-2, but only the imagery intervention group improved in the kinesthetic dimension.
Conclusion: Our findings show that all three interventions are effective in improving anticipation and benefit imagery ability.

The ability to anticipate the intentions of an opponent or team member is an important component of performance in high level sport (Abernethy & Russell, 1987; Jones & Miles, 1978), as well as in other domains such as driving (Chan, Pradhan, Pollatsek, Knodler, & Fisher 2010; Muhrer & Vollrath, 2010), nursing (Henneman, Blank, Gawlinski, & Henneman, 2006), medical surgery (Zheng, Swanstrom, & MacKenzie, 2007), and military combat (Ward et al., 2008). The ability to anticipate the outcome of any action is crucial because it provides the individual with more time to prepare and execute an appropriate response. In light of its importance, scientists have focused on how various instructional approaches can facilitate the more rapid acquisition of anticipation across a number of sports (for reviews, see Williams & Ericsson, 2005; Williams, Ward, & Smeeton, 2004).

The role of imagery as a potential intervention to improve anticipation has not been examined empirically. It has been suggested that imagery can improve visual perception and attention through the same neural mechanisms associated with action observation (see Murphy, Nordin, & Cumming, 2008) and may provide concomitant benefits to anticipation where visual perception and attention are heavily implicated. In this paper, we use a novel training intervention to examine whether imagery practice can lead to improvements in anticipation. We combine imagery with a video-based, temporal occlusion protocol in an attempt to optimize learning and investigate whether improvements in anticipation are related to changes in imagery ability (*c.f.* Rymal & St Marie, 2009; Williams, Cumming, & Edwards, 2011).

The emergence of anticipation in cricket has been reported to occur between 15 and 20 years of age in skillfull individuals. The hours accumulated in organized sport-specific practice as well as the player's developmental age are significant predictors of anticipation performance (Weissensteiner, Abernethy, Farrow, & Muller, 2008). By 13–15 years of age, players who differ in performance on a standard test of anticipation can be discriminated by the amount of hours accumulated in sport-specific organized practice (Ford, Low, McRobert, & Williams, 2010). Weissensteiner et al. (2008) suggest that between the ages of 15 and 20 years anticipation is needed to overcome the increased temporal constrains of the task.

The literature on anticipation training has predominately focused on the effects of various instructional approaches (Farrow & Abernethy, 2002; Smeeton, Williams, Hodges, & Ward, 2005; Williams, Ward, Knowles, & Smeeton, 2002). The use of explicit instruction is thought to accelerate early learning by reducing time spent searching for relevant information (Smeeton et al., 2005). However, skills that are learned through explicit instructions are suggested to be more likely to break down under pressure, because individuals reinvest effort in controlled processing (Masters, 1992). Several researchers have critiqued the practical utility of coaches

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using implicit learning strategies (Maxwell, Masters, & Eves, 2000; Mayer, 2004; Vereijken & Whiting, 1990). An alternative is presented by 'guided discovery' (Williams, Davids, & Williams, 1999). With guided discovery, learners are directed toward the general location of relevant sources of information so that their search for regularities between various postural orientations and eventual response requirements are somewhat constrained without explicitly directing attention to specific sources (Williams et al., 2004).

While observation of video has been linked to improvements in perception, it has been suggested that the cognitive processes involved in observational learning and imagery are related (Jeannerod, 1999). In observational learning, a demonstration is viewed, encoded, and a response is produced. During imagery, an image is generated in the visual and kinesthetic modalities, rehearsed, and then a response is produced (McCullagh & Weiss, 2001). The visual modality contains information about what the individual "sees" in the imagery, and this can be viewed from either an internal (first person) or an external (third person) perspective. Internal visual imagery involves imaging one's own performance (e.g., taking a 'through the eyes of' perspective – typically used in anticipation training protocols) but it can also be used to adopt the perspective of someone else. According to Jeannerod (2006), this viewpoint allows the individual to predict and understand the actions of others and may explain why internal visual imagery is considered more beneficial for tasks depending on perceptual information (Hardy, 1997; White & Hardy, 1995). In contrast, an external visual perspective provides visual information not available from an internal viewpoint about the action or movement to be performed; either oneself or another person can be the agent of the behavior (Holmes & Calmels, 2008), and the additional information gained from the external viewpoint can be particularly useful for tasks that emphasize technical form or body shape (Hardy, 1997).

It has been suggested that external visual imagery and observational learning involve the same cognitive processes because individuals view themselves, or others, performing from the position of an observer (White & Hardy, 1995). The kinesthetic modality involves internally representing the position and movement of body parts, as well as the force and effort perceived during movement (Callow & Waters, 2005). This internal feel can be experienced simultaneously with visual imagery, from either internal or external viewpoints (Callow & Roberts, 2010; Cumming & Ste-Marie, 2001).

The observation of video simulation has been shown to be linked to both perception and imagery; therefore, it is plausible to suggest that there may be a link between perceptual skill and imagery (Jordet, 2005). It has been proposed that imagery has some degree of equivalence to the mechanisms underpinning perception and motor control (Finke, 1979; Jeannerod, 2001). That is, imagery recruits similar neural networks to those used to perceive and to plan and execute an action (Jeannerod, 2001; Kosslyn, Ganis, & Thompson, 2001). In support of imagery being a perception-like process, researchers have reported co-activation between visual imagery and perception of the same sensory modality (Kosslyn, Thompson, & Alpert, 1997). It is also well established that imaging an action or movement activates the motor-related areas of the cerebral cortex (Lotze & Halsband, 2006; Munzert, Lorey, & Zentgraf, 2009). To capitalize on this similarity in neural activation, individuals can create conditions for imagery rehearsal that mimic as closely as possible the circumstances of physical practice by following the tenets of the PETTLEP model (Holmes & Collins, 2001). This model contains seven elements (Physical, Environment, Task, Timing, Learning, Emotion, and Perspective) that can be used individually or in combination to produce increased benefits to performance of an action compared to no imagery placebo controls or traditional imagery conditions (e.g., Smith, Wright, Allsopp, & Westhead, 2007; Smith, Wright, & Cantwell, 2008).

While imagery has been used to effectively improve physical performance of the imaged action, its use to improve perception of an observed action has received less attention. Successful motor performance of an 'open' skill involves frequently sampling information from the person's surroundings by the perceptual system (Munzert, 2008). Because of the co-activation in neural processes involved, visual imagery may be integral to developing the necessary perceptual skills of athletes who perform in 'open' environments. In support of this latter argument, imagery interventions have improved learning and performance indicators in 'open' skill sports (Evans, Jones, & Mullen, 2004; Robin et al., 2007), including selective attention (Calmels, Berthoumieux, & d' Arripe Longueville, 2004) and visual search (Jordet, 2005). In a preliminary study using a multiple baseline case study approach, Jordet (2005) trained three elite soccer players to improve their visual 'exploratory behavior' using imagery. Two out of three players showed improvements in exploratory behavior after the intervention and all participants felt such an intervention was beneficial to their performance. However, the generalizability of these results has not been examined.

No researchers have attempted to address whether imagery practice can lead to improvements in anticipation behavior. In this paper, we examine whether imagery can be used to enhance performance when the task is to anticipate the outcome of an opponent's actions. We selected the task of cricket batting because anticipation is heavily implicated in skilled performance (e.g., Müller, Abernethy, & Farrow, 2006; Renshaw & Fairweather, 2000). Specifically, we examined the ability of skilled junior cricket batters to learn to anticipate the direction of spin when facing a bowler. All batters allocated to the experimental groups were trained using a video-based occlusion paradigm where the image is occluded when the ball is released by the bowler (see Smeeton et al., 2005).

To compare the effects of Imagery (internal visual perspective combined with kinesthetic imagery) and video-based feedback, batters either watched a video replay of the action (Video Replay Group) or imaged the delivery with the aid of a verbal description of the imagined movement (imagery script) instead of a video replay (Imagery No Replay Group) and both groups received guided discovery instructions either alongside the video replay or embedded in the imagery script in the case of the Imagery No Replay Group. To control for the effect of receiving advance cue instructions, another group of participants were only told the correct spin direction of the occluded delivery (Outcome KR No Replay group). Additionally, a final group just performed the pre and posttest (No Practice Control group) to rule out any familiarity effects associated with performing in these tests. Imagery ability was measured using the revised Vividness of Movement Imagery Questionnaire (VMIQ-2; Roberts, Callow, Hardy, Markland, & Bringer, 2008) before and after training.

We expected all participants in the training groups to improve their anticipation performance from pre to posttest as a result of completing the occlusion-based protocol and receiving feedback (Smeeton et al., 2005). However, the provision of advanced cue instructions was expected to result in the greatest improvement compared to the other Outcome KR No Replay group. The Video Replay group was expected to show greater improvement than the Imagery No Replay group because video replays would provide an accurate representation of the bowling action from which advance cue behavior could be identified. We expected that participants in the Imagery No Replay group would show the greatest improvements in imagery ability because of the amount of imagery practice to which they were exposed. We expected the Video Replay group to improve imagery ability to some degree because of the links between imagery and action observation (Jeannerod, 1999; Rymal & St Marie, 2009; Williams et al., 2011), but no improvements in imagery ability were expected in the Outcome KR No Replay group because the feedback was not based on a visual image.