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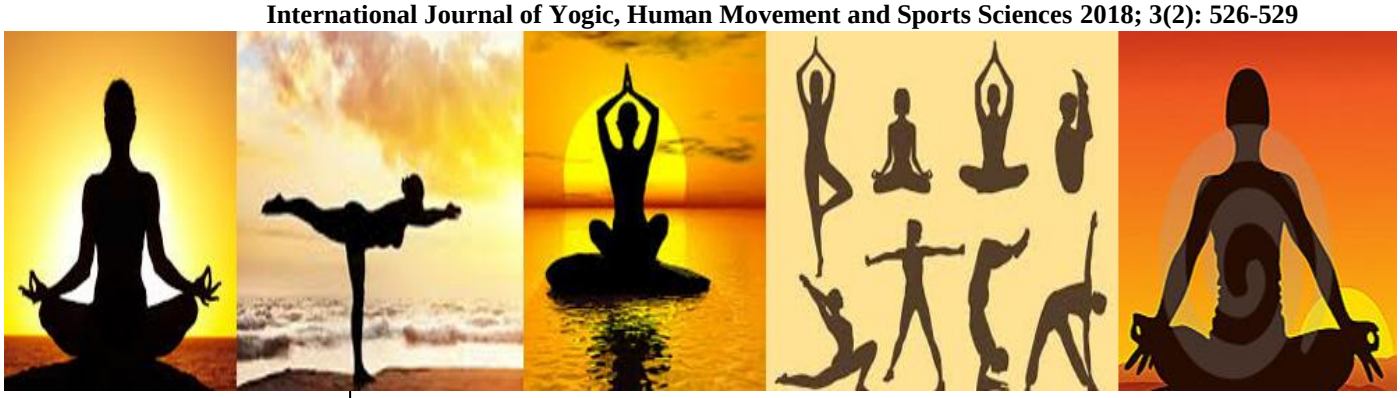

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An analysis of literature on imagery used in sports and its relation with performance

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Abstract
Imagery has an important role to play in the sportsman's motor performance. Extensive experiential and observational research, have led to the development of applied models in the field of sport psychology which seek to highlight some of the key components required to ensure its effective implementation. The following manuscript reviews theories and applied models that has been well-documented in the literature and is supported in its validity. Furthermore, research is reviewed examining the efficacy of mental imagery interventions within sports performance with an emphasis on (a) uses of imagery, and (b) factors affecting imagery. Discussion is aimed to accentuate the significance of implementing the most appropriate imagery interventions.

Keywords: An analysis, literature, imagery used, sports, its relation with performance

Introduction
The nature of human intelligence has been discussed and debated for literally thousands of years. Terms such as imagery, visualization, mental practice, and mental rehearsal have been used interchangeably among researchers, sport psychology consultants, coaches and athletes to describe a powerful mental training technique (Taylor & Wilson, 2005) [15]. Presently, most practitioners use the broader term mental imagery to describe structured mental practice techniques to create or recreate an athletic performance (Holmes & Collins, 2001; Vealey & Greenleaf, 1998) [5, 16]. For some athletes and performers, the use of imagery is typically unstructured and may appear to serve no specific purpose and it may be difficult to verbalize the content and details of their imagery (Hardy, Jones & Gould, 1996). However, mental imagery is more than individuals spontaneously imagining performances. The value of imagery lies in its use as a structured program that incorporates written or audio scripts designed to address areas in which athletes want to improve (Taylor & Wilson, 2005) [15]. Imagery scripts have become common when implementing imagery training programs and imagery content may be influenced by the instructions and how they are communicated (Guillot & Collet, 2008) [4].

Sport psychology practitioners have sought to explain the mechanisms that allow imagery to work. Several theories exist, as there is no one single theory that can explain the effectiveness of imagery in its wholeness. The attention-arousal set theory seeks to explain imagery rehearsal while incorporating the cognitive and physiological components (Sheikh & Korn, 1994) [13]. The theory suggests that imagery is a technique in which athletes prepare for a motor performance both physiologically and psychologically. It is suggested that in the cognitive domain, imagery may help athletes focus on task relevant cues as opposed to irrelevant stimuli, which detracts from performance (Feltz & Landers, 1983) [2]. Through this mental technique, athletes also become aware of their physiological state, reduce inhibitions to the motor action, and improve attention to cues for motor responses (Feltz & Landers, 1983; Hecker & Kaczor, 1988) [2]. It is assumed that there is an optimal state of arousal where peak performance is achieved, and imagery can facilitate an athlete's attempt to reach that optimal arousal level (Sheikh & Korn, 1994) [13].

The bio-informational theory proposed by Lang (1979) [7], suggests that mental images should be viewed and classified as products of the brain's information processing capabilities.

He argues that an image carries on a finite amount of information in its structure which can be broken down to specific functional units. The use of imagery involves a network of representational information that is coded and stored in long-term memory (Hecker & Kaczor, 1988). The representational information presented in the image can be separated into two categories of information: information regarding the characteristics of the *stimulus* presented in the imagined situation, and the information pertaining to the physiological *responses* during the imagined scenario (Lang, 1979) [7].

Ahsen's (1984) [1] triple code model expands on the bio informational theory of imagery by highlighting three effects of the image that are essential to the imagery program. Ahsen (1984) [1] identifies these effects as ISM; (I) the image itself, (S) the somatic response, and (M) the meaning of the image. The image generated is a representation of the individual's perspective in reality and the sensory mechanisms incorporated allows the individual to experience and respond to the image as it were in reality (Ahsen, 1984) [1]. The somatic response implies that during the imagining, psycho-physiological changes occur in the body (similar to Lang's bio-informational theory). Every image imparts a personal meaning or significance to the individual and the same set of imagery instructions will never produce the same imagery experience for any two individuals (Ahsen, 1984; Weinberg & Gould, 2006) [1]. The individual's personal meaning attached to the image has to be accounted for in the imagery scripts. Suinn (1982) developed a cognitive enhancement technique termed visuomotor behavioral rehearsal (VMBR), combining progressive relaxation and mental imagery practice. More specifically, VMBR practice consists of three stages: (1) having the athlete achieve a relaxed state by way of a progressive relaxation technique, (2) mental practice highly relevant to the requirements and demands of the athletes' respective sport and (3) physically practicing specific skills under simulated lifelike conditions (Suinn, 1982). In the early introduction of VMBR training, reports were anecdotal lacking experiential control, prompting researchers to provide empirical support for its use and efficacy. For example, VMBR training has been shown to enhance performance of a variety of athletic tasks including free-throw shooting (Hall & Erffemeyer, 1983; Onestak, 1997), karate (Weinberg, Seabourne, & Jackson, 1981), serving in tennis (Noel, 1980), racquetball (Gray, 1990), and golf, track and field, gymnastics, and diving (Lohr & Scogin, 1998). It is suggested that by repeating the VMBR process of incorporating specific skills during mental training, the enhanced coordination of the imagery component with the physical performance allows for minor adjustments in the skill and/or the imagery process (Behncke, 2004).

Sackett (1934) [12] was the first to propose the symbolic learning theory, a motor-based explanation to the role of mental practice. The primary assumption of the symbolic learning theory is that movement patterns are symbolically coded in to one's central nervous system (Janssen & Sheik, 1994). Therefore it is proposed that imagery act as a cognitive coding system that provides athletes with a mental blueprint for specific movement patterns (Martin, Moritz, & Hall, 1999) [9]. Consequently, imagery is effective because it enables athletes to become more familiar with the movements and facilitates automaticity through cognitive processes. Sackett (1934) [12] demonstrated that mental rehearsal improved performance on a finger maze task, and suggested that the improvement was seen due to the fact that the task was primarily cognitive in nature and could be easily symbolized (Janssen & Sheikh, 1994).

Martin *et al*. (1999) [9] proposed a four-component model that sought to describe how varying types of motor imagery (MI) has the potential to impact cognitive, affective, and behavioural outcomes. Researchers examined the use of imagery in sporting situations, and examined the use of motor imagery during training in preparation for a competitive event, immediately prior to, and during competition, as well as during rehabilitation. The imagery types highlighted in this model are very similar to those of the model by Paivio (1985) [11] and Hall, Mack, and Paivio (1998), (i.e. Cognitive General, Cognitive Specific, Motivational General-Arousal, Motivational General-Mastery and Motivational Specific).

The PETTLEP model developed by Holmes and Collins (2001) [5] incorporates seven elements (i.e. physical, environment, task, timing, learning, emotion and perspective) all derived from neuro scientific and behavioural functional disciplines. Physical relates to the individual's physical nature and feelings during imagery (i.e. increased HR, or feeling relaxed), while Environment refers to the inclusion of stimulus materials that help mimic motor performance. Timing signifies the importance of incorporating the imagery to mimic the actual performance duration. The task component includes the exact nature of imagery to be performed, the expertise level of the performer, as well as the imagery perspective Learning relates to the use of imagery for the purpose of becoming familiar with new motor skills, and for the correction of some technical aspects required of the skill. Emotion relates to the individualistic incorporation of meaningful emotional components in the mental images presented in imagery. Lastly, perspective supports the use of an internally imagery perspective, while indicating the importance of an external perspective as it relates to the characteristics of the motor skill being performed.

Munroe, Giacobbi, Hall, and Weinberg (2000) [10] helped identify where, why, what type and when (Four W's) athletes should use imagery. The authors used a qualitative approach based on a six stage model, which described how athletes may integrate imagery into their sporting context. Where differentiates between training and competitive environments, while when identifies the use of imagery during sporting activity as opposed to outside practice, in addition to immediately before, during and after a competitive event. Why refers to the use/purpose of the imagery (i.e. cognitive or motivational functions). The length and frequency, nature, surroundings, effectiveness and controllability refers to *what* the athlete should imagine. The last two stages of the model include many other essential components, one being the type of imagery (e.g. auditory, kinesthetic, olfactory), the imagery perspective (internal vs. external visual imagery), or the inclusion positive and negative images. In the domain of competitive sporting situations, this model may very well serve as a guide for the development of effective imagery interventions (Guillot & Collet, 2008) [4]. The major strength of the model emerged from its qualitative design in that a number of key components of imagery use emerged from the questionnaires proposed by the authors. However, the list of components is not extensive and does not consider the specificity of each component as it relates to the athletes' expected outcomes. Furthermore, the model did not account for the effects of imagery during the injury rehabilitation process.

Paivio (1985) [11] suggested that a critical function of mental practice for athletes may be their motivation level when other

re enforcers are not clearly present. Motivational–Specific (MS) imagery involves specific goals and goal-oriented behaviours, such as imagining oneself winning an event, receiving a trophy, and being congratulated by teammates and coaches for a good performance. Motivational general-mastery (MG-M) imagery serves as a motivational and mastery perspective function (Murphy & Martin, 2002). The content of MG-M imagery includes effective coping and mastery of challenging situations, such as imagining being confident, focused and resilient during competitive sporting situations. Motivational general-arousal (MG-A) imagery focuses on emotional experiences in the sporting context. MG-A imagery represents feelings of relaxation, stress, arousal, and anxiety in conjunction with sport competition (Murphy & Martin, 2002).

Robin, Dominique, Toussaint, Blandin, Guillot, and Le-Her (2007) examined the effects of imagery training on the motor performance improvement of the service return accuracy in skilled tennis players. Participants were placed into three groups based on their Movement Imagery Questionnaire score (good imager, poor imager or control) and physically performed 15 service returns toward a target during the pre-test. During the intervention phase, participants completed 15 imagery training sessions, where each session consisted of 2 series of 15 imagery trials and 15 physical trials. Lastly, forty-eight hours after the final training session, participants completed a post-test similar to the pre-test. Results indicated that the motor imagery intervention significantly improved the accuracy of the service returns in skilled players. Furthermore, following the 15 imagery sessions, those deemed as good imagers, significantly improved their accuracy in direction and were less variable compared to those of lower imagery ability.

Surburg, Porretta, and Sutlive (1995) [14] sought to examine the effects of imagery as a supplementary form of rehearsal/practice for the learning and performance of a throwing task. The study included 40 participants, who were classified as 15-18 yr old adolescents with mild mental retardation based on the Stanford-Binet Intelligence test and certain behavioral characteristics. The process of preparing participants for imagery practice involved multiple trials of closing the eyes and rehearsing the task while avoiding the use of overt movements. Participants engaged in seven practice sessions during which performance scores of a throwing task were recorded an analyzed. Participants stood behind a line 4.57 m from three concentric circle targets and executed an underhand throw with the non-dominant hand, attempting to hit the bull's eye. The non-dominant hand was used to enhance the novelty of the throwing task, ensuring that all participants had roughly minimal experience with the task. At the completion of the seven session training/testing period participants who engaged in imagery practice displayed a greater performance on the motor skill task than those individuals who did not engage in imagery.

Malouff *et al*. (2008) [8] evaluated the effects of pre-competition positive imagery and self-instructions on serving accuracy of 115 adult tennis players in a tennis serving competition. Participants were assigned to one of three conditions: self-instructions, positive imagery or a control group. Before each serve, participants were instructed to imagine, the entire serve, including seeing the ball going into the target zone. Each participant attempted 20 serves with the objective to score as many points as possible by hitting a serve in the correct service box. Results revealed that participants in both the imagery and self-instruction conditions served significantly more accurately than those in the control condition. Researchers offered the explanation that during pre-competition imagery practice, athletes are focusing on how to efficiently perform the task, excluding distracting negative thoughts related to poor performance and the negative consequences that may follow. Additionally, it is suggested that the anxiety-reduction effect could best explain the greatest difference between the experimental and control groups.

Glisky, Williams and, Kihlstrom (1996) [3] examined the effects of two variables, imagery perspective and task type, of which both may influence the efficacy of imagery practice. Results of the study signified that participants who predominately use an external perspective exhibited greater performance on a motor/kinesthetic task (balancing a stabilometer), while solely internal imagers showed greater improvement on a cognitive/visual task (estimating angle of reflection.

Conclusion

The aforementioned research, exploratory studies, and anecdotal reports underline the importance of incorporating differing types of imagery to achieve various outcomes. Since its early introduction and application into the sports domain, sport psychology practitioners have continuously sought to elucidate the mechanisms that allow imagery to work and produce favourable outcomes. Over time, numerous theories emerged as research studies were completed, while each theory expanded on the results and conclusions of prior studies. Most theorists have been in agreement as it relates to the importance of incorporating physiological and psychological components into imagery interventions to maximize the effectiveness of the imagery session. It appears evident that the same set of imagery instructions, propositions, and images may never produce the same response and experience for any two individuals. Ahsen (1984) [1] provided support for Lang's (1979) [7] bio-informational theory, emphasizing the importance taking into account the personal meaning/significance attached to the images presented in the imagery intervention. though cognitive processes. Additionally, neuroimaging technologies have provided support for theories that have suggested that neural mechanisms play a role in imagery via incorporating the same neural pathways that are used in memory, emotions, and motor control. Numerous applied models have provided evidence that the proposed models were reliable frameworks for imagery interventions, highlighting several variables for athletes' use of imagery (Guillot & Collet, 2008; Wilson *et al*., 2007) [4]. Martin *et al*. (1999) [9] applied model emerged after examining studies that have assessed the effects of motor imagery use by athletes during training, competition, and rehabilitation. Similar to Paivio (1985) [11], the five functions of imagery (e.g. MG-A, CS) were highlighted and three outcomes were reported. It was concluded that motor imagery in sports was most often used for (a) facilitating skill learning, (b) modifying cognitions associated with self-confidence and motivation, and (c) factors relevant to regulating arousal and competitive anxiety.

In summary, imagery research has, over time, evolved and advanced the field of sport psychology and its applied practice since its early review by Feltz and Landers (1983) [2]. Researchers have not only focused on imagery as one aspect of mental practice, but also its influence on various mental skills (e.g., confidence, arousal, concentration). Additionally, imagery has been effectively used for rehearsing general

strategies, learning sport specific skills, and facilitating effective responses to competitive scenarios and stressful emotions. More recent theoretical developments (e.g., Four W's, PETTLEP) has expanded the understanding of imagery in sporting contexts regarding how to improve imagery's effectiveness as well as describing why, when, and what type of imagery may be most effective. Although the aim of this manuscript focuses on imagery for sport performance, it is worthwhile to note that recent research has indicated that imagery can be helpful for non-athletes in exercise settings as well. Further research that tests the predictions of previously established guidelines will only advance the field as researchers and practitioners should be enthused to develop even more effective imagery interventions. Finally, as noted earlier, as the field continues to advance, sport psychology practitioners may be presented with numerous opportunities to assess how imagery can help individuals in a variety of ways and settings.

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