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Original article

Imagery perspective among young athletes: Differentiation between external and internal visual imagery

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Abstract

Purpose: This study aimed to investigate the construct of external visual imagery (EVI) *vs.* internal visual imagery (IVI) by comparing the athletes' imagery ability with their levels of skill and types of sports.
Methods: Seventy-two young athletes in open ($n = 45$) or closed ($n = 27$) sports and with different skill levels completed 2 custom-designed tasks. The EVI task involved the subject generating and visualizing the rotated images of different body parts, whereas the IVI task involved the subject visualizing himself or herself performing specific movements.
Results: The significant Skill-Level × Sport Type interactions for the EVI task revealed that participants who specialized in open sports and had higher skill-levels had a higher accuracy rate as compared to the other subgroups. For the IVI task, the differences between the groups were less clear: those with higher skill-levels or open sports had a higher accuracy rate than those with lower skill-levels or closed sports.
Conclusion: EVI involves the visualization of others and the environment, and would be relevant to higher skill-level athletes who engage in open sports. IVI, in contrast, tends to be more self-oriented and would be relevant for utilization by higher skill-level athletes regardless of sport type.

Keywords: External visual imagery; Internal visual imagery; Open sports; Skills; Youth

1. Introduction

Motor imagery can be divided into visual (or termed visuo-motor) imagery (VI) and kinesthetic imagery (KI).[1,2] VI involves the visualization of a movement from the first- (internal VI, IVI) or third-person (external VI, EVI) perspective. IVI requires an individual to mentally generate movements by oneself, which is analogous to visualization taking place while a camera is mounted in one's own head and scans one's own body. EVI requires an individual to visualize the movements generated by others in their surroundings, whilst the observer is a spectator. KI, on the other hand, emphasizes the feelings and sensations associated with the movements being visualized.[3–5] KI has been found to be helpful in facilitating the performance of complex movements in a relatively stable environment,[5,6] such as diving and gymnastics. The focus of this paper is to investigate the constructs of EVI from IVI, which has been reported less in the literature.[7–9]

In terms of mental processing, IVI was reported to rely heavily on visual and visuo-spatial processes, which were mediated by the superior parietal lobe and the occipital cortex.[8] Since a third-person perspective was used, EVI required additional visuo-spatial transformation, and was found to be mediated by the lingual gyrus.[10] The practice of EVI would require athletes to engage in more complex mental processing than IVI. A few studies have explored the utility of EVI and IVI in sport training. Barr and Hall[11] used a self-report method and showed that rowers tended to use IVI rather than EVI prior to competition as a preparation strategy. White and Hardy[5] reported that EVI was more effective than IVI for enhancing skill learning in

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sports, particularly gross movement patterns such as in gymnastics. Glisky et al.[12] found that EVI was more useful than IVI for learning new moves in fencing, whereas IVI was more useful than EVI for developing and refining strategies for competitions. White and Hardy[13] reported that gymnasts employed more mental imagery than slalom canoeists. Hardy and Callow[4] reported that both experienced athletes and novices benefited significantly more from using EVI than IVI when learning new skills in karate, gymnastics, and rock climbing. There are 2 conclusions that can be made on the results of the 5 above studies. First, EVI was useful for learning new skills regardless of the type of sport, such as karate (open sports) *vs.* rock climbing (closed sports). Second, IVI was more useful than EVI for the development of strategies regardless of the type of sport, such as fencing or rowing. These findings are counter-intuitive, because EVI involves higher level mental processing such as visual transformation, which should be for practicing response strategies, particularly in open-sport competition.

Recent studies on the employment of visual imagery in sports have shifted their focus to the competence level or type of sport. For instance, Arvinen-Barrow et al.[14] and Watt et al.[15] reported that elite athletes tended to employ cognitive-related imagery (measured by the Sport Imagery Questionnaire, SIQ) more frequently than non-elite athletes. Athletes specializing in open sports (rugby and martial arts) engaged in more imagery than those in closed sports (golf and figure skating).[14] Athletes who specialized in closed sports employed more mental imagery such as visualization than those who specialized in open sports.[16] Roberts and co-workers[17] reported that athletes with higher skill-levels had a better ability to conduct visual imagery than those with lower skill-levels. Other researchers reported similar results: higher level athletes tended to have a higher capability for imagery than lower level athletes.[18,19] One potential reason for this superiority in imagery ability was that higher level athletes had more opportunities to engage in imagery practice than lower level athletes.[16,20] There are 2 main drawbacks in these studies. First, the researchers did not attempt to categorize the visual imagery into EVI and IVI despite their uniqueness in mental processing. Second, except for 1 study, the level of competence of the athletes was not taken into account for the different types of sports.

This study was motivated by the fact that EVI and IVI were loosely defined in previous studies. Even if they had been clearly defined, researchers tend to rely on the participants' self-report of preference of using VI. Another issue was that the level of skill (or competence) and the type of sports were not commonly incorporated as one of the main effects in the same study. Open sports are characterized as sports in which the participants perform in environments that are changing rapidly and execute externally-paced actions. In contrast, closed sports are characterized by participants who perform under relatively static environments and execute self-paced actions.[21] We investigated the characteristics of EVI and IVI in terms of the athletes' level of skill and type of sports. Rather than using a self-report format, 2 custom-designed EVI and IVI tasks were used to quantify the athletes' ability for imagery. The participants were adolescent athletes, with their physical and mental sports-related skills developing rapidly.[22,23] They had been receiving intensive training, and gaining experience in open competition in both open and closed sports. It was hypothesized that the abilities of different imagery perspectives developed by young athletes would be associated with the type of sports they engaged in and their level of skill. Young athletes who specialized in open sports and have a higher level of skill would have a stronger EVI ability than those who specialized in closed sports or have a lower level of skill. The rationale is that athletes who compete in unpredictable environments (i.e., open sports) and achieve better results would need a higher EVI ability than those in closed sports for developing and refining strategies when facing their opponents. Those who participated in closed sports or achieved a higher level of skill would have stronger IVI ability than those who specialized in open sports or have a lower level of skill. This is because IVI would enable these athletes to further refine their movements, speed, and gestures by mentally generating movements as if in actual execution of these movements. Thus, visualization of the movements would enhance motor execution during the competition.

2. Methods

2.1. Participants

The participants were 72 young athletes recruited from the Guangdong Sports and Technology School that provides education to young athletes in Guangdong, a southern province of China. There were 35 males (14.70 ± 0.96 years, mean ± SD) and 37 females (13.90 ± 1.11 years). Among them, 27 specialized in closed sports, including weight lifting, diving, track and field, and shooting, and the other 45 in open sports, including fencing, judo, and wrestling. The participants were further classified into high and low skill-levels. The criterion behind this classification was the participants' recent performance in open competitions. Participants who won prizes in open competitions organized at the provincial level or above in 2009–2010 were classified as high skill-level, and those who had won prizes in open competitions organized at the municipal level or below were classified as low skill-level. Each participant engaged in practice for about 20 h per week. Written informed consents were obtained from the participants or their guardians prior to the study. Ethical approval for this study was obtained from The Hong Kong Polytechnic University Institutional Review Board.

2.2. Instruments and experiment design

2.2.1. EVI task

The EVI task adopted a mental rotation paradigm,[24,25] which measured the participants' ability to generate and visualize rotated images of different body parts. This task required the participants to superimpose a human body figure onto a computer-generated figure composed of small white circles (called an artificial figure) displayed on a screen (Fig. 1A). The human body figure was captured from 5 sets of 4-s video clips