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Visual uncertainty influences the extent of an especial skill

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ABSTRACT

An especial skill in basketball emerges through highly repetitive practice at the 15 ft free throw line. The extent of the role vision plays in the emergence of an especial skill is unknown. We examined the especial skills of ten skilled basketball players in normal and blurred vision conditions where participants wore corrective lenses. As such, we selectively manipulated visual information without affecting the participants' explicit knowledge that they were shooting free throws. We found that shot efficiency was significantly lower in blurred vision conditions as expected, and that the concave shape of shot proficiency function in normal vision conditions became approximately linear in blurred vision conditions. By applying a recently proposed generalization model of especial skills, we suggest that the linearity of shot proficiency function reflects the participants' lesser dependence on especial skill in blurred vision conditions. The findings further characterize the role of visual context in the emergence of an especial skill.

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1. Introduction

In the original especial skill experiment exploring set shot basketball performance, Keetch, Schmidt, Lee, and Young (2005) observed that performance accuracy decreased as distance increased from the basket (9 ft, 11 ft, 13 ft, 15 ft, 17 ft, 19 ft and 21 ft). This finding is in line with the force-variability principle that predicts outcome performance decreases as distance from a target increases (Harris & Wolpert, 1998; Schmidt, Zelaznik, Hawkins, Frank, & Quinn, 1979). An unexpected finding was that accuracy in performance at the 15 ft distance was similar to that at nearer distances to the basket, a finding that was not in line with the force-variability principle (see Keetch et al. (2005)). Keetch et al. (2005) termed this an especial skill, which is a highly specific skill embedded within a more general class of motor skills. The emergence of the especial skill was attributed to player's accumulating massive amounts of specific practice at the 15 ft distance in comparison to other distances as 15 ft represents the foul line in basketball (Czyż et al., 2013).

Keetch et al. (2005) proposed three possible hypotheses regarding the emergence of especial skills, which are (1) the visual-context hypothesis, (2) the learned-parameters hypothesis, and (3) the specific-motor-program hypothesis (for a review see Breslin, Schmidt, and Lee (2012)). According to the visual-context hypothesis (Proteau, 1992; Proteau, Marteniuk, & Levesque, 1992) the memory representation for the especial skill contains the specific visual angle and distance from the basket. The hypothesis predicts that if any change occurs to the visual-sensory information available before or during skill execution

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degradation in performance may occur. The learned-parameters hypothesis suggests that especial skills are represented by a specific set of movement parameters that belongs to the general motor program for the basketball free throw. When the force parameters of the task are changed by increasing the weight of the ball, the especial skill is degraded or disappears (Breslin, Hodges, Kennedy, Hanlon, & Williams, 2010). The specific-motor-program or especial Generalized Motor Program (eGMP) hypothesis assumes that extensive practice leads to the formation of a new memory representation or motor program, which is dedicated to a specific task (i.e. 15 ft free throw). Accordingly, environmental changes such as a modification to the distance or weight of the ball will cause the player to no longer demonstrate an especial skill shooting advantage.

The visual-context hypothesis was first examined by Keetch et al. (2005, Exp. 2). They covered the floor of a basketball court with a tarpaulin removing court lines which, according to the authors, could provide a player with visual context. Keetch et al. (2005) predicted that if the memory representation for the especial skill contained visual components, by their removal, performance will decrease and the especial skill would disappear, this prediction is in line with previous research (Magnuson, Wright, & Verwey, 2004; Wright & Shea, 1991). Results showed that especial skills were present in the absence of visual context information suggesting either that court lines are not critical visual cues, or that visual-context cannot completely determine the emergence of an especial skill. In a subsequent study, Keetch, Lee, and Schmidt (2008) manipulated the players' visual angle to the target. Basketball players performed set shots from seven different angles to the basket: one perpendicular to the basket and three locations to left and three to the right. Performance at the foul line was significantly better than from any other location, even though the distances to the basket were identical in all angles (e.g., 15 ft). According to Keetch et al. (2008), the deterioration in performance at the non-foul line positions was due to the unfamiliar visual angles and, as a result, hindered the emergence of the especial skill. Keetch et al. (2008) argued that their results support the visual-context hypothesis. Two studies contradict each other in whether visual context is a critical component of the underlying memory representation for the especial skill. It is possible that these findings may in part be due to the manipulation of visual context being confounded by participants losing the explicit context that they were shooting free throws. When participants were shooting on a covered court or at angled positions, participants may have lost not only the visual cues informing distance and angle to the target, but also the explicit awareness that they were shooting free throws. Therefore, it is not clear whether the observed findings were caused by the lack of explicit awareness of the type of shot to be taken or lack of the presence of critical visual information as per what is stored in the memory representation. To determine the viability of the visual context hypothesis as an explanation of the especial skill these factors would require consideration as per a recent study by Stöckel and Breslin (2013). In their experiment Stöckel and Breslin (2013) manipulated visual context by modifying the distance of the rim from the free throw line. They positioned the rim 30 cm closer to, or 30 cm farther from the original rim position. Participants were not aware that the free throw distance had been changed. In the control condition, in which the distance from the free throw line to the rim was not modified, especial skill emerged at the free throw line as expected. In the experimental conditions, in which the distance from the free throw line to the rim was modified, especial skills emerged at the free throw line that was in fact 30 cm closer to, and then again 30 cm farther from the rim than regular free throw distance. Even though the distance had been changed, the free throws from "falsely marked" distances outperformed the overall shot proficiency at other distances. Stöckel and Breslin (2013) concluded that visual-context may explain the especial skill and determine a successful performance. Furthermore Stöckel and Breslin (2013) suggest explicit knowledge that you are at the free throw line may be essential to "triggering" the most appropriate memory representation for performing the especial skill, a suggestion that requires further experimental exploration.

Considering recent findings by Stöckel and Breslin (2013) we seek to advance the hypothesis that occluding visual information during performance of the especial skill will affect the presence of an especial skill and its magnitude. In our experiment we manipulated visual information by asking players to perform free throws under two conditions: (1) Normal viewing conditions and (2) whilst wearing vision blurring goggles. As such, we could selectively alter visual information while maintaining the explicit context about the shooting position, that is, participants were aware that they were shooting at the free throw line even when their vision was blurred. If the availability of specific visual information is a factor affecting the emergence of especial skill, the presence and perhaps the magnitude of especial skill (the percentage difference between the actual and predicted performance) will decrease.

2. Method

2.1. Participants

Ten male basketball players (mean age 17.7, SD 2.16) participated in the experiment. All participants were senior basketball players in Poland's 2nd Division and represented various positions on the team (e.g. point guard, shooting guard and center). Each player had at least 7 years' experience in basketball shooting (mean 7.75, SD 1.9). All participants exhibited normal visual acuity according to a sport medical examination. All participants gave written informed consent to take part. The study was approved by Wrocław's University School of Physical Education Research Ethics Committee.

2.2. Design and procedure

A two (condition) by seven (distance) within groups design was adopted. Condition had two levels: normal vision and blurred vision. Participants performed set shots from the following seven distances: 2.74 m (9 ft), 3.35 m (11 ft), 3.96 m

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