Does Decision Making Transfer across Similar and Dissimilar Sports?

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Abstract

Objectives: The ability to make decisions under time pressure is crucial to performance in sport. However, there remains a paucity of research that examines whether the skills underpinning decision-making transfer across similar or dissimilar sports. We examine whether decision making transfers from soccer to other sports that may be deemed to be either similar (basketball) or dissimilar (tennis) based on sports taxonomy.

Methods: Skilled soccer players (N = 20) completed a video-based temporal occlusion test designed to measure decision-making involving offensive sequences of play from soccer, basketball, and tennis. Participants were required to decide on an appropriate action to execute for each situation presented.

Results: Response accuracy was higher in the soccer decision-making task compared to the basketball and tennis tasks. Furthermore, accuracy scores were higher on the basketball compared to the tennis task.

Conclusions: There appears to be some positive transfer of decision-making between sports that share similar elements, supporting the importance both of specificity and generality in expert performance.

Keywords: *expertise; perceptual-cognitive skills; similarity; specificity; skill acquisition*

Introduction

In sport, adaptations occur during practice which lead to the development of perceptual-cognitive skills that underpin *decision making* and these have been shown to be crucial to high-level performance (Williams & Ford, 2008). The ability of athletes to make decisions is based on their capacity to integrate information relating to the current situation with existing knowledge/experiences so as to plan and select an appropriate action to execute. Such adaptations are essential, particularly in sports where the speed of play and ensuing time constraints often go beyond the capacity of athletes to process information (e.g., Laurent, Ward, Williams, & Ripoll, 2005; Roca, Ford, McRobert, & Williams, 2011; Shim, Carlton, Chow, & Chae, 2005). Although over recent decades researchers have enhanced our understanding of the processes and mechanisms that facilitate decision making (for a review, see Causer & Williams, 2013), there remains a paucity of research that examines whether the skills underpinning decision making in one sport can transfer to another sporting domain. The study of transfer can provide important insights into the nature of expertise and whether experts can apply knowledge derived in one sport to other sports that are similar or dissimilar in nature (Smeeton, Ward, & Williams, 2004).

The notion of transfer of learning was first introduced by Thorndike and Woodworth (1901) in their "Identical Elements Theory". These authors proposed that the level of successful transfer depends on the level or amount of similar/identical elements (i.e., movement, perceptual, and conceptual or strategic elements) that exist between two performance tasks or domains. For example, it is argued that soccer and basketball contain similar relational and tactical elements, involving the interpretation of positions and movements of players on/off the ball and shared offensive/defensive principles of play, and consequently, bi-directional transfer may be possible between

these two sports (e.g., see Moore & Müller, 2014; Smeeton et al., 2004). A second theory that is somewhat analogous is "Transfer-Appropriate Processing". This theory argues that instead of skill elements, what is important to transfer is the similarity of the mental/cognitive operation processing elements shared by the skills (see Lee, 1988). In contrast, the specificity of learning hypothesis suggests that learning effects or the attributes acquired by a performer through previous practice or experience in one task or domain will not transfer to another (see Proteau, 1992). The concept of specificity is also integral to many theories of motor control (see Adams, 1971).

A few scientists have started to investigate the extent to which perceptual-cognitive skills in a particular sport can successfully transfer to another sport (e.g., Abernethy, Baker, & Côté, 2005; Rienhoff, Hopwood, Fischer, Strauss, Baker, & Schorer, 2013; Smeeton et al., 2004). Smeeton et al. (2004) used a recognition paradigm to examine whether pattern recognition skill (i.e., the ability to recognise task-specific patterns of play as they emerge) transfers between sports presumed to be structurally similar (soccer and field hockey) and another believed to be structurally dissimilar (volleyball). Players across the three sports viewed structured action sequences from each sport in a recognition phase and had to determine quickly and accurately whether these scenes had been shown in a previous viewing phase. There were no differences in response accuracy across sports, however, the response times of skilled soccer and hockey players were quicker than volleyball players at recognising both soccer and hockey clips, providing partial support for the notion that some aspects of pattern recognition transfer between these two sports.

Abernethy and colleagues (2005) used a recall task to examine the transfer of pattern recall skill in groups of expert netball, basketball, and field hockey players. Experts from other sports performed at or near the level of domain-specific experts on

the recall of player positions despite having no, or relatively limited experience, in the particular sport. Findings suggest that some aspects of recall skill may be generic and in part transferable between other similar sports. Some of the findings reviewed above should, however, be interpreted with caution as it has been suggested that successful performance on recall tests may be a by-product of experience in the domain rather than it being a measure of the perceptual-cognitive processes employed when making anticipation and decision-making judgements (Causer & Ford, 2014; Roca & Williams, 2016).

Müller, McLaren, Appleby, and Rosalie (2015) attempted to extend theoretical understanding of transfer of learning by investigating whether anticipation transfers to a dissimilar sport (i.e., from rugby to baseball). Participants watched temporally occluded video footage of an opponent performing rugby skills as well as sequences involving a baseball pitcher throwing different pitch types. Participants were asked to anticipate the expected final action. The expert and near-expert rugby players could anticipate rugby movements significantly better than novices, however, none of the skill groups were capable of transferring their skill across to the baseball task. Findings support the prediction that transfer of anticipation is expertise dependent and restricted to similar domains.

Previously, researchers examining the transfer of perceptual-cognitive expertise have mainly focused on anticipation, even though the ability to plan and select fast/appropriate decisions is central to expert performance in sport. Causer and Ford (2014) examined whether successful decision making transfers between sports or whether this ability is specific to a sport. Skilled soccer, invasion sport (e.g., basketball and rugby union), and other sport (e.g., tennis and golf) players completed a soccer (5 vs. 5) video-based temporal occlusion decision-making test. There was no difference in

response accuracy between the soccer players when compared to the other invasion sports groups providing support for positive transfer of decision making. Although the soccer players were not more accurate than the invasion sports group, these two groups outperformed the other sports group which, to some degree, provides partial evidence for the specificity of learning hypothesis. The lack of differences in soccer-specific decision-making accuracy between the soccer and other invasion sport players could be due to the decreased sensitivity and lower reliability of the test scoring system used in this experiment (i.e., correct-incorrect paradigm). Using a scoring system based on rating the quality of decisions being made has been shown to improve the reliability of performance testing (see, Lorains, Ball, & MacMahon, 2013). Therefore, research is required to confirm and extend previous findings and to examine in greater detail whether decision making transfers across similar (near transfer) and dissimilar (far transfer) sports.

In this study, we examine whether the decision-making judgements made by a group of skilled soccer is sport-specific or whether there is some element of transfer either to another sport that shares similar elements or one that does not. Based on the classical sports taxonomy (see, Griffin & Butler, 2005), soccer and basketball would be considered as similar sports (i.e., both invasion games), whereas tennis would be a dissimilar sport compared to the first two (i.e., racket/net sport). Participants completed a decision-making video test that included offensive sequences of play from soccer, basketball, and tennis. In line with the transfer of learning hypothesis, we predicted that the increased tactical and strategic similarities between soccer and basketball would promote greater response accuracy on the decision-making tests for these two sports in comparison with tennis. Furthermore, we expected that skilled soccer players would be

more accurate at decision making for the soccer-specific test when compared to the other two sport tests which would support the concept of specificity of learning.

Methods

Participants

Participants were 20 male soccer players (*M* age = 19.7 years, *SD* = 1.0) who all played in the British Universities and Colleges Sports (BUCS) league representing the University Men's Football 1st team as well as playing for semi-professional clubs in England. Participants had an average of 10.6 years (*SD* = 2.5) of playing experience and an average of 6.5 h (*SD* = 1.8) training per week. None of the participants had received coaching instruction in basketball and tennis and none had played these sports at any level. Informed consent was provided prior to participation and ethical approval was gained through the lead institution's Ethics Board.

Materials and procedure

Participants completed a soccer (11 vs. 11), basketball (5 vs. 5), and tennis (1 vs. 1) video-based temporal occlusion decision-making test in which they were required to decide on which action to execute at the end of each video clip. The video test stimuli were projected onto a large video screen (SMART Board SPNL-4070, Calgary, Canada; 1.65 m wide x 0.90 m high, 1.50 m from the floor) and participants stood at a distance of approximately 1.75 m from the screen. The video sequences comprised of open-play attacking situations extracted from existing footage of various top national and international-level men's matches across the three different sports. To guard against differences in task difficulty across the sport-specific decision-making tests, a panel of three qualified coaches for each sport independently rated each offensive video simulation clip on their respective sport. Only those sequences with reasonable difficulty levels (i.e., between .3 and .8 out of 1.0) were included in the video tests (as

recommended by Vaughn, Lee, & Kamata, 2012). The final video tests each consisted of 15 test and two practice trials involving structured offensive sequences of play. The sequences ranged in duration between 6-12 s and ended when a blank screen occluded the video on the frame in which the player in possession was about to execute an action. The blank screen remained on for 4 s (as employed by Causer & Ford, 2014) during which time participants were required to select a decision to make in response to the attacking situation at the moment of video occlusion. For the soccer and basketball action sequences, these options were passing to a particular teammate, shoot, or continue dribbling the ball. For the tennis clips these shot options were short left, short right, deep left, or deep (e.g., see Murphy, Jackson, Cooke, Roca, Benguigui, & Williams, 2016). The clips from different sports were presented in blocks, but the order of presentation of each sport-specific video test was counterbalanced across participants. Test sessions were carried out individually in a quiet room and were completed in approximately 30 min.

Data analysis

Decision-making accuracy was recorded as a measure of performance. The panel of coaches for each sport task (soccer, basketball, and tennis) independently assessed each sport-specific offensive simulation. Since there is more than one alternative to score a goal or point(s), it was decided not to use the correct-incorrect paradigm (as per Causer & Ford, 2014). A scoring system similar to that used by Vaeyens, Lenoir, Williams, Mazyn, and Philippaerts (2007) was employed in which responses given by participants for each trial were rated taking into account the following guidelines: *2 points* for an appropriate action, leading to a goal/point scoring opportunity; *1point* for an appropriate action, however, not leading to a goal/point scoring opportunity; *0 points* for a wrong decision (e.g., leading to loss of ball possession). The increased sensitivity

and spread of the scores improved reliability of the performance measure (cf. Vaughn et al., 2012). Rating scores were discussed within coaching panels and 100% agreement was reached for all possible decisions to be executed across trials.

A response accuracy score was calculated for each participant (for their decision-making performance in each sport-specific video test) and standardised using a percentile conversion in order to allow comparison across the three different sports. A one-way repeated-measures ANOVA was conducted to analyse response accuracy scores with sport task (soccer, basketball, and tennis) as the within-participants factor. To test our a priori predictions, we conducted planned comparisons between soccer and basketball (i.e., specificity hypothesis) and between soccer and tennis video tests (i.e., transfer hypothesis), as well as comparing performance between the basketball and tennis tests. Partial eta-squared (η_p^2) effect size values were calculated as appropriate. The alpha level for significance was set at $p < .05$.

Results and Discussion

The ANOVA showed a significant effect of sport task on the decision-making accuracy of soccer players, $F(2, 38) = 129.54$, $p < .001$, $\eta_p^2 = .87$. As hypothesised, planned contrasts revealed that response accuracy for the soccer players was significantly higher on the soccer decision-making task ($M = 85.2\%$, $SD = 6.1$) when compared with the basketball ($M = 76.0\%$, $SD = 7.8$) and tennis tasks ($M = 55.3\%$, $SD = 7.2$), $F(1, 19) = 150.23$, $p < .001$, $\eta_p^2 = .89$. Moreover, response accuracy for soccer players was significantly higher in the basketball decision-making task in comparison with the tennis task, $F(1, 19) = 111.35$, $p < .001$, $\eta_p^2 = .85$. These data are presented in Figure 1.

Insert Figure 1 about here

Our findings support the notion that there is some transfer between soccer and basketball given that the soccer players' accuracy scores were higher on the basketball sequences when compared to the tennis scenarios. These data support and extend the work of Abernethy et al. (2005), Smeeton et al. (2004), and Causer and Ford (2014), suggesting that there is some transfer of decision making between sports that are argued to share some similarly of processing and/or strategic/tactical elements (Moore & Müller, 2014). We speculate that skilled performers are able to adapt and integrate novel stimuli into existing encoding and retrieval structures in Long-Term Working Memory to facilitate decision-making transfer to a sport with similar elements or comparable processes (Ericsson & Kintsch, 1995). However, our data nonetheless, highlight the importance of specificity given that our participants performed significantly better on the soccer sequences (i.e., their main sport) when compared to both the similar and dissimilar sports. Our findings suggest that experts develop cognitive representations that are sport-specific, but that, at the same time, some of the perceptual-cognitive skills that underpin decision making in the primary sport may transfer across to sports considered to share some characteristics. The findings contradict those reported by Causer and Ford (2014) who found no differences in response accuracy between soccer players and other invasion sport players for the soccer-specific decision-making task. Nevertheless, as remarked earlier, one possible reason for the contrasting results may be associated with the decreased sensitivity of the scoring system employed by Causer and Ford (2014).

In this study, we have enhanced understanding of the critical phenomenon of transfer of learning and, in particular, the transfer of decision-making performance across sports. With respect to practical implications, our data support the proposal that some perceptual-cognitive skills can transfer across sports and, therefore, participation

in sports that share some common characteristics may augment the development of decision making in the target sport for the development of expertise (e.g., see Berry, Abernethy, & Côté, 2008; Côté, Horton, MacDonald, & Wilkes, 2009). However, care should be taken not to suggest that the amount of transfer that occurs between similar sports may out weight the benefits of sport-specific practice. Although engaging in many hours of practice in the primary/target sport for expertise may increase risks associated with burnout and overuse injury (Law, Côté, & Ericsson, 2007), it is at the same time apparent that the rate at which perceptual-cognitive skills may be acquired is likely to be far higher when engaging in sport-specific practice compared to spending a comparable amount of time practising a similar sport (e.g., see Roca, Williams, & Ford, 2012).

In future, researchers should attempt to better understand the mediating mechanisms that account for transfer effects by using, for example, process-tracing measures such as eye-movement recording and verbal reports of thoughts (see, Williams, Ford, Eccles, & Ward, 2011). If similar gaze behaviours or thought processes are employed when attempting to make decisions across sports, a modicum of support is provided for the similarity of processing argument (Lee, 1988; Smeeton et al., 2004). The recording of process-tracing measures during decision-making tasks across sports would certainly provide a more parsimonious method for classifying sports as being similar or dissimilar than currently employed. Another potentially useful approach would be to use performance analysis methods such as video-based coding to identify elements of performance that may be similar across sports. Our existing sport classifications systems are subjective and intuitive rather than being based on detailed, task analyses of sports. Finally, another interesting way to examine the potential for transfer would be to run interventions to determine whether perceptual-cognitive skills

training in a similar sport (e.g., basketball) actually leads to an improvement in performance in the target sport (i.e., soccer). The relative rate of improvement after a set amount of sport-specific perceptual-cognitive training in, for example, soccer could be compared with the relative improvement observed after the same amount of time engaging in training in a similar sport, such as basketball. Such experimental designs and the use of process-tracing measures would present a step forward for our field in providing stronger guidelines for practitioners interested in promoting skill development through transfer.

In conclusion, our findings suggest that there is some positive transfer of decision-making performance between soccer and basketball, suggesting that perceptual-cognitive skills may be somewhat generic and potentially transfer across sports that are similar in nature. However, at the same time, our data are supportive of the importance of accumulating sufficient practice time in the target sport for expertise, highlighting the significant role of specificity of learning in developing elite athletes.

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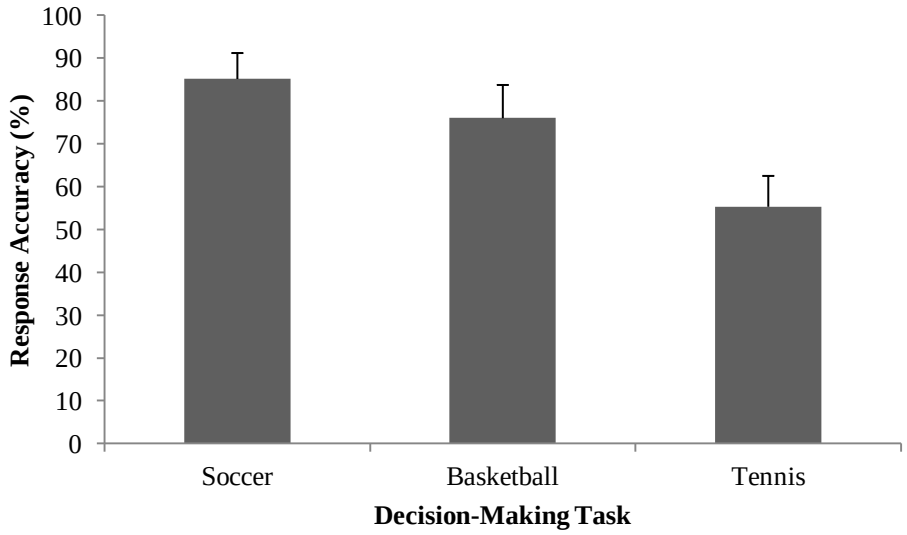

Figure 1. Mean (SD) response accuracy (%) in the soccer, basketball, and tennis decision-making tasks for skilled soccer players.