ANTICIPATION AND TRANSFER OF EXPERT PATTERN PERCEPTION

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INTRODUCTION: When an observer views a moving object that is abruptly halted, the human perceptual system continues to extrapolate the object's movement, predicting it's likely pathway and misrepresenting the final stopping point as being further along the original trajectory (Freyd & Johnson, 1987). This extrapolation of the temporal features is typically referred to as "representational momentum" (Freyd, 1987; Freyd & Finke, 1984; Intraub, 2002). It has been suggested that this phenomenon occurs because participants anticipate the trajectory of the object and remember that object by integrating its predicted motion with perceptions of its implied acceleration and velocity (Didierjean & Marmèche, 2005; Finke, Freyd, & Shyi, 1986). This anticipatory trace is then stored in memory and can be accessed for subsequent recall and recognition tasks (Didierjean & Marmèche). A recent study by Didierjean and Marmèche (2005) further examined this phenomenon by applying a pattern recognition paradigm using participants of varying skill levels from the sport of basketball. Participants were required to differentiate between pairs of patterns that were either the same or different. Half of the different patterns were presented in the normal chronological order of a game, and the other half were presented in the reverse order. Based upon previous research, it was predicted that individuals with extensive experience in the sport would be more likely to apply their knowledge of strategic expectations and this would bias their perceptions of the image, causing them to encode the first pattern in each pair with more anticipatory features. In essence, the experts were expected to anticipate the temporal evolution of the first pattern presented, and to store this "next likely state" in memory as an anticipatory trace, rather than storing the actual pattern that was displayed. Therefore, when shown a pair of patterns in the normal chronological order of a game, where the second pattern in the pair was in fact the next likely state of the first, the experts would have greater difficulty in accurately differentiating between the two, compared to when those same patterns were shown in the reverse order. The results supported their predictions and showed that expert players were slower and less accurate than lesser skilled players at differentiating the second configuration from the first, but only when the second configuration was the next likely state of the first, rather than a possible previous state. The opposite was observed for lesser skilled participants. Despite the positive findings, there are two limitations of the research conducted by Didierjean and Marmèche (2005). The first limitation is the use of static schematics to represent what would ordinarily be a dynamic team sport environment. Schematic images may accurately represent the spatial locations of players and the basic court markings, but they remove, or severely diminish, many of the other display features that are typically present in the natural setting. The addition of implied or actual movement through the use of more realistic static or dynamic stimuli could significantly alter the nature of the anticipatory trace and therefore influence the effects of representational momentum on pattern perception. Studies have indicated that the effects of representational momentum may be proportional to the implied velocity of the object: Increased velocities produce a greater displacement of the object along it's predicted pathway (Freyd & Finke, 1985; Finke et al., 1986). In addition, the effects of representational momentum can be reduced if the stimulus does not portray the necessary qualities of a moveable or animated object or creature (Freyd & Miller, 1992; Reed & Vinson, 1996). The second limitation concerns the way in which the patterns were constructed. A professional basketball coach generated the patterns and provided the next movement in the playing sequence. Whilst this procedure may represent what *should* happen in the play, it may not always provide an accurate representation of the dynamic and interactive nature of a typical pattern of play from a team sport environment. In any given pattern, and in any given time period, several players are likely to move over the course of the time interval and those movements may not always be in a logical and highly predictable manner. Finally, an interesting component of pattern perception research is the finding that some degree of transfer may be possible when patterns share similar organisational, structural, and tactical elements. For example, Smeeton, Ward, and Williams (2004) used a recognition paradigm to investigate the transfer of pattern perception skills across soccer, field hockey, and volleyball players. Given that the soccer and hockey patterns shared a number of common relational, structural, and tactical similarities, it was predicted that the recognition performance would be greater between these sports compared to volleyball, which had a distinct lack of commonality. The results provided additional support for positive transfer with the soccer and hockey players performing equally well on both the soccer and field hockey tests. In contrast, the volleyball players performed better on the volleyball tasks but failed to transfer this ability to the patterns from the other two sports. Whilst this avenue of research has a number of practical and theoretical implications, it is yet to be applied to the phenomenon of representational momentum. The purpose of the current experiment was to extend the research of Didierjean and Marmèche (2005) by including matched static and dynamic basketball patterns and comparing these with schematic patterns similar to those used in the original experiments. A group of skilled soccer players ("other experts") was also included to examine the extent to which representational momentum transfers across sports. It was expected that the group of basketball experts would encode the first pattern in each pair as an anticipatory trace and therefore suffer a greater performance decrement, compared to the lesser skilled groups, when differentiating the two patterns, but only if the second configuration was the next likely state of the first, rather than a possible previous state. However, the magnitude of the effect was expected to be greater when dynamic video footage was used, compared to static schematics or static video clips, because the increased contextual information, combined with the motion from the video footage, would encourage the experts to encode the pattern with a greater anticipatory component (Freyd & Finke, 1985; Finke et al., 1986). Finally, based on the findings of previous research, it was also predicted that the group of other experts would be able to transfer some components of their pattern perception skills to the sport of basketball. Since this was likely to involve a similar anticipatory component to that used by the expert basketball group, it was expected that this group would also demonstrate a decline in performance for patterns presented in a chronological order. METHOD: *Participants* A total of 48 participants were recruited for the experiment and allocated into one of four groups including an expert group (n = 12); a recreational group (n = 12); an other expert group (n = 12); and a novice group (n = 12). *Materials* A total of 120 pairs of structured basketball patterns were created. Forty pairs were created from dynamic video footage (dynamic video) of an actual 5-on-5 game showing highly skilled basketball players. Another 40 pairs were matching still images (static video) created from the final frame of the video footage used for the dynamic pairs. The final 40 pairs were matching schematic representations (static schematics) of the configurations used in the static and dynamic pairs. For the schematic pairs, the offensive players were depicted as an "O" while defenders were displayed as an "X". The player holding the ball was shown as an "O" that was completely filled in black. For both the static and schematic pairs, the first image in each pair showed a structured pattern of a typical basketball game at a particular point in time (e.g., C1). The second image in the pair was a situation that was the next actual progression of the first image (i.e., C1 + 1) and was the C1 pattern a further 240 ms into the future. A similar procedure was used to create the dynamic pairs except only the first clip in each pair was a moving video image. The second image was a static slide that was a further 240 ms in advance of the final finishing point of the dynamic video clip. The final frame of the video was at an identical temporal location to the matched schematic and static images. Three separate tests were created using 40 pairs of patterns that were comprised entirely of schematic diagrams, dynamic video footage, or static video scenes. Display durations were standardised across conditions. *Procedure* The procedure for this experiment replicated and extended the immediate recognition task in Experiment 1A of the research conducted by Didierjean and Marmèche (2005). *Familiarisation phase.* Participants were shown an example of each of the different types of images to familiarise them with the task. The meanings of the symbols used in the schematic patterns were also explained. *Comparison task.* In each of the three test conditions, participants were shown pairs of patterns projected onto a large screen (1.43 m high and 1.93 m wide). The first pattern in each pair was presented for 5 s and then removed from view. A white screen then appeared for 1 s before the second pattern in the pair was presented for 5 s and then removed from view. Participants were asked to indicate whether the second pattern was the same as the first by pressing one of two buttons on a computer keyboard. A series of planned comparisons were used to analyse the results and each display type (static schematic, static video, and dynamic video) was analysed separately. A significance level of $p < .05$ was used with Bonferroni adjustments used to follow-up significant interactions. RESULTS: *Static schematics.* A one-way ANOVA revealed a significant difference between the groups for the same configurations, $F(3, 44) = 4.00$, $p = .01$, partial $\eta^2 = .21$. Bonferroni post hoc analyses showed that the other experts (89.17%) were significantly more accurate than the recreational basketball players (75.83%). *Static videos.* A one-way ANOVA revealed a significant difference between the groups for the same configurations, $F(3, 44) = 3.53$, $p = .02$, partial $\eta^2 = .19$. Bonferroni post hoc analyses showed that the experts (94.17%) and other experts (94.17%) were significantly more accurate than the novices (86.23%). *Dynamic videos.* One participant from the group of other experts was omitted from the analyses because he failed to correctly complete the task. For the different configuration pairs, a 4 x 2 (Group x Order) ANOVA with repeated measures on the last factor revealed a significant main effect for order, $F(1, 43) = 26.95$, $p = .00$, partial $\eta^2 = .39$, and a significant Group x Order interaction, $F(3, 43) = 3.26$, $p = .03$, partial $\eta^2 = .19$. Post hoc analyses for the main effect revealed that the combined score for reverse order pairs (63.91%) was significantly greater than that for the chronological order pairs (49.88%). Follow-up analyses for the significant interaction were completed using paired *t*tests with alpha adjusted to $p = .0125$ using a Bonferroni correction to control for inflated type I errors. The results showed that the expert, $t(11) = -7.04$, $p = .00$, $r = .90$, and recreational groups, $t(11) = -3.26$, $p = .01$, $r = .63$, were significantly more accurate for reverse order pairs (76% for experts and 66% for recreational) compared to chronological order pairs (51% for experts and 48% for recreational). DISCUSSION / CONCLUSIONS: The results indicated that the expert and recreational participants were better at differentiating reverse order pairs compared to chronological order pairs, but only when the first pattern in the pair was presented as a dynamic video from an actual basketball game. It appears that when both expert and recreational performers are provided with a dynamic visual pattern from their domain, they anticipate the next likely state of the pattern and encode it as an anticipatory trace, thus making it difficult to accurately differentiate between patterns when the second pattern is in fact the next likely state of the first. Given that the static schematic and static video images did not produce the same effects, it seems that the addition of movement is an important factor in eliciting representational momentum in expert pattern perception. The findings provide further evidence to suggest that the magnitude of the anticipatory response is increased when the velocity of the observed stimuli is also increased (Freyd & Finke, 1985; Finke, Freyd, & Shyi, 1986). In addition, the findings extend previous research by showing that the effects of velocity also apply to a complex teamsport environment. Given that the participants in the recreational group also exhibited a significant difference in performance between chronological and reverse order pairs, the results further suggest that only a limited amount of experience in the domain of interest is necessary to elicit the effect. This conclusion is consistent with previous research showing that a basic knowledge of gravity and friction, or an understanding of an object's typical contextual characteristics, can mediate the effects of representational momentum (Hubbard, 1994, 1995; Reed & Vinson, 1996; Vinson & Reed, 2002). The effect, however, was not replicated by the group of other experts, suggesting that the transfer of pattern perception skill may not necessarily include an anticipatory component. Additional research investigating the nature of representational momentum and the extent to which it transfers across sports is required to confirm this finding.

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