

Transfer of Pattern Recall Skills May Contribute to the Development of Sport Expertise

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SUMMARY

Superior recall of domain-specific patterns is well established as a defining attribute of expert performers. Recent studies on the developmental histories of expert team ball sport players (e.g. Baker, Côté, & Abernethy, 2003a) also suggest that experts characteristically receive exposure to a wide range of sports in their developing years and that this related sports experience may reduce the amount of sport-specific training needed to become an expert. This study examined whether the facilitation of expertise associated with other sport experience might arise from positive transfer of pattern recall skills from one sport to another. Expert netball, basketball and field hockey players and experienced non-experts performed a recall task for patterns of play derived from each of these sports. Experts from sports different to those shown in the presented pattern consistently outperformed non-experts in their recall of defensive player positions, suggesting some selective transfer of pattern recall skills may indeed be possible. Copyright © 2005 John Wiley & Sons, Ltd.

Compared to the situation 20 years ago, much is now known about the defining characteristics and components of expert sports performers (Starkes, 2003). A significant body of literature has emerged over the past two or more decades comparing the performance of expert, lesser skilled and novice athletes on a range of standard cognitive psychology measures and sport-specific derivatives. Collectively, this accumulated evidence has helped distinguish those attributes that are systematically and reliably related to skill level from those that are not. The distinguishing attributes of expert sports performers appear to be predominantly domain-specific rather than general (Abernethy, Neal, & Koning, 1994; Helsen & Starkes, 1999; Starkes, 1987) and include such attributes as the capability to recognize and recall complex patterns (e.g. Allard & Burnett, 1985), the capability to anticipate forthcoming events early and effectively on the basis of advance information (e.g. Abernethy & Russell, 1987), the capability to produce movement patterns that are both consistent and adaptable (e.g. Sakurai & Ohtsuki, 2000) and the capability to control movement in a more automatic, less effortful way, as evidenced by

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superior performance of concurrent tasks (e.g. Rowe & McKenna, 2001). (See Abernethy, Wann, & Parks, 1998 and Williams, Davids, & Williams, 1999 for detailed reviews.)

The ability of experts to 'read' patterns from within their domain of expertise in a superior manner to individuals of lesser skill appears to be as strong a defining attribute of expertise in the sports environment as it is in other performance domains such as chess (e.g. Chase & Simon, 1973) and bridge (e.g. Charness, 1979) playing, medical diagnosis (e.g. Patel, Groen, & Arocha, 1990), computer programming (e.g. Barfield, 1986) and map reading (e.g. Howard & Kerst, 1981). In tasks in which sports experts have been briefly presented with patterns drawn from their own sport and then asked to recall the pattern (in terms of its component elements) their recall performance is consistently and markedly superior to that of less skilled individuals. This advantage appears to hold true regardless of whether the patterns presented are static (e.g. Allard, Graham, & Paarsulu, 1980) or dynamic (e.g. Borgeaud & Abernethy, 1987), whether the mode of presentation is visual (e.g. Starkes, 1987) or auditory (e.g. Weber & Brewer, 2003), and whether the elements to be recalled are opposing player positions in a team sport (e.g. Allard & Burnett, 1985), self-positions in a performance routine such as in figure skating (e.g. Deakin & Allard, 1991), or external layouts such as the configuration of balls on the table in snooker (e.g. Abernethy et al., 1994). This recall superiority for experts holds consistently for situations containing domain-specific structure but is either diminished or completely lost in situations where the usual domain-specificity is disrupted.

The experts' advantage in pattern recall also appears to be reproduced in their capacity to recognize previously encountered patterns—sport experts, like those in other domains (e.g. Charness, 1979), characteristically outperform lesser skilled individuals in their capacity to differentiate previously encountered patterns from new patterns (e.g. Abernethy et al., 1994; Williams & Davids, 1995). Using a change-blindness paradigm, Werner and Thies (2000) have demonstrated directly the enhanced capability of expert athletes to detect meaningful changes in images derived from their domain of expertise—a capability that may well partially explain the experts' superior recognition task performance. Expert performance on both pattern recall and recognition tasks is typically explained in terms of skill-based theories of memory derived either from cognitive psychology (e.g. Ericsson & Kintsch, 1995; Gobet & Simon, 1996) or from ecological psychology (e.g. Vicente & Wang, 1998).

While it is now well established that superior recall and recognition of domain-specific patterns is a defining attribute of the expert sports performer, much less is known about how such skills develop. Information to address this question is not easily obtained—it cannot be gleaned readily from prospective studies (because it is exceedingly difficult to know in advance who will become an expert) and conventional training/learning studies are of limited utility because of the long time scale of commitment (~10 years or 10,000 hours of deliberate practice; Simon & Chase, 1973; Ericsson, Krampe, & Tesch-Römer, 1993) needed for expertise to appear. One approach which does appear to offer some insight into the development of expert attributes involves using retrospective accounts to trace the detailed life histories of selected experts. Heavily influenced by the work of Benjamin Bloom (1985) and others (e.g. Csikszentmihalyi, Rathunde, & Whalen, 1993), this alternative approach to the study of expertise focuses upon examining the developmental backgrounds to expert performance, seeking out commonalities between experts in the type of practice and contextual environments they have experienced.

While there are still relatively few studies of the developmental histories of sports experts there already appear to be the emerging of a number of key contextual factors that

may strongly influence the development (or not) of expert performance. Unsurprisingly, one key factor influencing the emergence of expertise appears to be both the quantity and type of practice undertaken by an individual (e.g. Ericsson et al., 1993; Helsen, Starkes, & Hodges, 1998; Hodges & Starkes, 1996). Perhaps more surprisingly, a second key factor that correlates strongly with expertise in both sporting and academic domains is *relative age*. The older one is relative to peers in the same classroom grouping or junior sport team, the greater is the probability of being labelled as gifted (Helsen, Hodges, Van Winckel, & Starkes, 2000; Maddux, Stacey, & Scott, 1981) and the greater is the probability of eventually becoming an expert (Barnsley & Thompson, 1988; Dudink, 1994). A consistent finding is that early successes and positive experiences are critical in setting the drive and direction for specialization, with experts reporting from an early age having superior skill levels to their peers.

In a recent series of studies (Baker, Côté, & Abernethy, 2003a, 2003b; Côté, Baker, & Abernethy, 2003) the detailed developmental histories of 15 world-class players from three different team ball sports (field hockey, basketball and netball) have been examined for commonalities and contrasted with those of experienced but non-expert players. Among other things, these studies revealed that the experts typically experienced a broader range of sports experiences, both structured and unstructured, in their developing years than the non-experts. These other sports experiences included primarily related team sports (especially soccer and other forms of football, softball and cricket) plus some individual sports (especially athletics, racquet sports and golf). The number of hours of practice needed to become an expert (operationally defined as initial selection in the open-age national team) was found to be inversely related to the breadth of the initial sporting experience—in other words, the greater the number of activities the athletes experienced and practised in their developing years (0–12 years) the less deliberate, domain-specific practice that was necessary to acquire expertise within their sport of specialization. This suggests the interesting proposition that the other experiences during the developing/sampling years are in some way an active, functional contributor to the subsequent attainment of domain-specific expertise. If this is indeed the case, an obvious follow-on question relates to the mechanism through which positive transfer may occur from other sports activities to the acquisition of expertise in team ball sports, such as field hockey, basketball and netball. Given that the recall and recognition of patterns is a defining characteristic of expertise in these activities (e.g. Allard et al., 1980; Starkes, 1987) is it possible that this attribute can be transferred from one sport to another?

Evidence currently exists for some transfer of perceptual learning for simple, artificially-generated patterns, although previously experienced patterns are consistently recognized with greater speed and accuracy than ones derived from the same template or rule set but not previously encountered (e.g. Allen & Brooks, 1991; Goldstone, 1998). There is also evidence for some transfer of forms of cognitive knowledge across the same domain (e.g. Gott, Parker-Hall, Pokrny, & Dibble, 1992), and for some transfer from perceptual-motor simulations to more natural situations (e.g. Lee, Chamberlin, & Hodges, 2001). In the motor domain evidence for transfer has been limited and historical notions of specificity have dominated (Barnett, Ross, Schmidt, & Todd, 1973; Henry, 1968). Reviewers of the motor transfer literature typically conclude that transfer between motor tasks, where it exists at all, is positive but small unless the two tasks are so similar as to be practically identical (Schmidt & Young, 1987).

With respect to the specific transfer of pattern reading skills from one sport to another, Allard and Starkes (1992) examined the pattern recall performance of varsity level ice

hockey and basketball players shown patterns of play from both sports. Unsurprisingly, the ice hockey players outperformed the basketball players on the recall of patterns from ice hockey and the basketball players outperformed the ice hockey players on recall of basketball slides. The observation of potentially greatest interest, however, was that the recall performance of the players on the patterns drawn from outside their domain of expertise, while inferior to the that of the domain-specific experts, was still relatively good although how good was impossible to determine in the absence of novice control groups. More recently, Smeeton, Ward, and Williams (2004) used a recognition paradigm to examine the potential transferability of pattern recognition skills between the sports of soccer, field hockey and volleyball. Some evidence was accrued for transfer between field hockey and soccer pattern recognition for skilled players although the data were difficult to interpret because the task used permitted variable trade-off between speed and accuracy in responding between the different groups. Weber and Brewer (2003) noted the possibility of transfer of pattern recall capability from one sport to another but did not examine the question directly.

The purpose of this study was to examine directly the possibility of transfer of pattern recall skills from expertise in one domain of sport to another. The same 15 field hockey, basketball and netball experts examined in the studies by Baker et al. (2003a, 2003b) were asked to recall briefly presented patterns of play from each of their sports and their task performance was compared to each other and to non-experts. This group of experts provided a convenient and advantageous sample from which to examine transfer given that their detailed developmental and practice histories, including the extent of their cross-sport experiences, were already well established. It was predicted that if aspects of pattern recall skill are indeed transferable, and a possible mechanism for the contribution of other sport experiences to the facilitated acquisition of expertise reported by Baker et al. (2003a), then the experts would significantly outperform the non-experts in their recall performance, even when the patterns to be recalled were derived from sports other than those in which they were experts.

METHOD

Participants

A total of 25 athletes participated in this study as part of a broader study examining expert decision-making in team sports (Baker et al., 2003a, 2003b). Fifteen of the participants were experts—current Australian national team sport players widely acknowledged by their peers as representing the very best decision-makers in their particular sport. The experts consisted of three female netball players, four male field hockey players, four female field hockey players, and four male basketball players. These players were ones unanimously nominated by all members of the national team coaching staff in their sport as being amongst the very best decision-makers in their sport world-wide. At the time of data collection, each of the teams from which the participants were drawn was highly ranked internationally. The women's netball and field hockey teams were world champions, while the men's field hockey and basketball teams were ranked second and fourth in the world respectively. The experts sampled had a mean age of 27.6 years ($SD = 4.3$) and had been playing their sport for an average of 20.7 years ($SD = 5.3$) (Table 1). While all the experts had a broad range of sports experiences prior to specializing, their experience of the other sports targeted in this study was relatively limited. In terms of netball none of

Table 1. Career milestone characteristics (mean and *SD* in years of age) for the expert and non-expert groups

Characteristics	Group	
	Experts	Non-experts
Age	27.6 (4.3)	22.7 (4.1)
Years playing	20.7 (5.3)	11.4 (2.6)
Started playing	6.9 (2.1)	10.1 (4.6)
First organized game play	7.3 (1.8)	10.1 (4.6)
First supervised training	7.9 (1.8)	11.4 (7.8)
First training with team	9.2 (2.9)	12.1 (3.4)
First unsupervised training	11.2 (3.6)	12.0 (4.4)
First non-sport specific training	15.9 (1.8)	15.8 (4.2)
First off season training	15.5 (2.4)	16.7 (4.0)
First club level involvement	7.3 (1.9)	12.6 (3.4)
Recognized top 5 club level	9.3 (2.1)	12.7 (2.9)
Recognized best club level	11.7 (2.6)	13.8 (2.1)
First regional level involvement	10.9 (1.9)	13.2 (2.5)
Recognized top 5 regional level	11.3 (1.4)	13.3 (2.2)
Recognized best regional level	12.9 (1.6)	17.0 (4.4) <i>n</i> = 2
First state level involvement	13.2 (2.7)	15.7 (1.5) <i>n</i> = 3
Recognized top 5 state level	13.9 (2.8)	NA
Recognized best state level	14.9 (2.9)	NA
First national level involvement	18.6 (2.4)	NA
Recognized top 5 national level	19.4 (5.7)	NA
Recognized best national level	21.2 (4.1)	NA
First international level involvement	20.7 (2.6)	NA
Recognized top 5 international level	23.1 (2.9) <i>n</i> = 12	NA
Recognized best international level	26.2 (2.4) <i>n</i> = 5	NA
When relocated for sport training	18.2 (2.5)	NA
When had idea to become elite athlete	14.1 (3.7)	13.6 (2.5)
When made decision to become elite athlete	16.4 (2.6)	NA
All leisure time spent training	16.6 (3.4)	17.8 (5.5)
When reach potential in sport	27.7(2.8)	24.8 (0.9)
When plan to retire	32.1 (1.9)	34.5 (4.9)

Note: NA = Not Applicable. *n* signifies the number of participants responding to an item.

the four basketball players and only one of the eight hockey players had any prior playing experience. The one hockey player with netball experience (a female) had played netball for 5 years as a junior. All three of the netball players and four of the eight hockey players (three female and one male) had some basketball experience. For those with basketball experience this ranged from as little as 1 year of experience to as much as 16 years of experience for one of the netball players. None of the three netball or four basketball players had any prior hockey experience.

In addition to the expert players 10 other lesser skilled players also participated in this specific study. This non-expert group consisted of individuals with significant experience in one of basketball, netball or hockey but who had not reached national level. These non-expert participants were drawn from men's basketball (*n* = 3), women's netball (*n* = 2), men's field hockey (*n* = 3), and women's field hockey (*n* = 2). The specific cross-sport experience of the non-experts was quite limited—one of the netball players had 1 year of playing experience in basketball and the other 2 years of experience in hockey while two of the women's hockey players had netball playing experience (of 1 and 2 years

respectively) with one of these also having 6 years of basketball playing experience. The average age for this non-expert group was 22.7 years ($SD = 4.1$) and the players in this group had been involved in their sport for an average of 11.4 years ($SD = 2.6$). Some additional information on the age at reaching different career milestones of the expert and non-expert groups are provided in Table 1.

All participants in the study provided informed consent prior to the beginning of data collection.

Procedures

All participants completed a pattern recall task that was designed to examine the respective capability of the players of different skill levels and domain-specific expertise to recall structured patterns of play from different sports. Video footage depicting segments of structured play from basketball, netball and field hockey were used as the stimuli for this task. The video segments were extracted from existing footage of various international-level matches in men's basketball and field hockey and women's netball and field hockey. None of the video segments included vision of any of the players who were participants in the study. There were six video clips from each sport with each clip having a duration of 15–22 s. Each segment was shown twice to the participants. The first time the player viewed the first 15–17 s which contained at least 10 s of structured offensive or defensive play. The second viewing consisted of a further 5 s of structured offence or defence. At the end of each viewing, the video was occluded and the participants' task was to reproduce the position of each of the offensive and defensive players shown in the clip. This was done by marking their respective positions (offensive players with an 'X' and defensive players with an 'O') on a scaled diagram of the court or field, with a different diagram used for each trial. The use of two viewings, with the second one providing extended vision and a different end pattern, permitted multiple examinations of pattern recall skill to be derived from game situations in which the contextual information related to the pattern's development was essentially constant. Participants were given one practice trial for each sport (i.e. a total of three trials) before beginning the task.

Analysis of data

Analysis of the pattern recall data followed a procedure similar to that presented by Abernethy et al. (1994) and utilized primarily manual matching techniques. Templates indicating the correct player position as well as offensive and defensive patterns were created for each of the 18 video segments. Overhead transparencies were then created showing the correct location with a circular error band drawn at a distance equivalent to 1% of the total field or court area. This template was then placed over each of the completed response diagrams and measurement of the participant's placement of each of the players shown on the video was taken from the centre of each of their marking symbols. The response templates of the participants were then manipulated or rotated so that the maximum number of correct responses was identified. The advantage of this method is that it emphasizes the importance of correct patterns rather than absolute positional coordinates by treating as correct those instances in which participants recall correctly the structural relationships between the different elements in the pattern (in this case players) but have either translated or rotated the pattern in some way during the transposition to the scaled representation.

The percentages of offensive and defensive player positions correctly recalled were compared between groups using a series of analyses of variance. Separate two-way (group \times element) analyses of variance were conducted for the patterns drawn from each different sport. Three groups were formed for each of these analyses—a group consisting of domain experts (e.g. the netball players for the netball patterns), a group consisting of other, non-domain experts (e.g. the expert hockey and basketball players for the netball patterns) and the control group of the 10 non-experts. The element factor in each of the analyses was a repeated measures factor allowing comparison of the recall accuracies for the offensive players and the defensive players shown in the clips. Because the expert group for this study is by definition small the power in the inferential comparisons was necessarily limited. In light of this, effect sizes were also calculated for each of the key comparisons in the experiment. Each effect size was calculated following the procedures outlined in Thomas and Nelson (2001) with pooled standard deviations rather than control group standard deviations selected as the most appropriate denominator. Following the convention of Cohen (1969), effect sizes less than 0.2 were treated as small, greater than 0.8 as large and intermediate values as moderate (Thomas, Salazar, & Landers, 1991).

RESULTS

Netball patterns

In terms of overall recall performance for all players shown in the netball clips (both offensive and defensive) the best performance is provided by the netball experts ($M = 69.48$, $SD = 10.59$) and the poorest performance by the non-experts ($M = 64.09$, $SD = 13.42$). The group composed of experts from other sports performs in an intermediate fashion ($M = 66.61$, $SD = 9.00$). The main effect for group was not significant [$F(2, 22) = 0.71$, $p > 0.05$] although the effect size differences between the netball experts and the non-experts and between the netball experts and the other experts of 0.42 and 0.31 respectively were in the moderate range (see Table 2). A significant main effect was obtained for the element factor [$F(1, 22) = 84.43$, $p < 0.01$] due to greater mean recall accuracy within the clips for the positions of offensive players ($M = 73.27$, $SD = 7.80$) than defensive players ($M = 58.63$, $SD = 8.81$).

Table 2. Effect size comparisons between different groups

Sport	Pattern element	Group comparisons		
		Experts v. non-experts	Experts v. other experts	Other experts v. non-experts
Netball	Overall	0.42	0.31	0.23
	Offence	0.47	0.68	-0.01
	Defence	0.62	0.20	0.59
Basketball	Overall	0.46	0.66	0.07
	Offence	0.47	0.90	-0.19
	Defence	0.49	0.47	0.29
Hockey	Overall	0.77	0.44	0.41
	Offence	0.83	1.20	-0.11
	Defence	0.95	-0.17	1.03

Note: According to Cohen (1969) $ES < 0.2$ are small, > 0.8 are large and those approximating 0.5 are moderate.

Figure 1a displays the mean accuracy for the recall of offensive and defensive player positions by each group. While there is no significant interaction obtained between the group membership and the display element to be recalled [$F(2, 22) = 0.34, p > 0.05$], the patterns evident in the data and some of the effect sizes obtained are nevertheless of interest. The overriding impression from Figure 1a is that the group consisting of experts from other sports is non-expert-like in their recall of offensive player positions but much more expert-like in their recall of defensive player positions within the clips. This impression is supported by examination of the effect sizes. The effect size difference between the netball experts and the other experts is moderate for the offensive patterns ($ES = 0.68$) but only small (0.20) for the defensive patterns. Similarly, the effect size difference between the other experts and the non-experts is moderate for the comparison based on recall of defensive players but negligible for the comparison based on recall of offensive players (see Table 2). Only one of the other experts (a hockey player) had any direct prior playing experience in netball. Her recall performance was indistinguishable from that of the remainder of the group of other experts who lacked direct netball experience being 72.36% for recall of offensive player positions (cf. 72.6% for the remaining other experts) and 57.50% for defensive player positions (cf. 60.77% for the remaining other experts).

Basketball patterns

As was the case with the netball patterns, overall recall of basketball patterns was performed best by the basketball experts ($M = 69.05, SD = 9.21$) and poorest by the non-experts ($M = 63.90, SD = 11.80$) with the group composed of other team sport experts performing to an intermediate level ($M = 64.53, SD = 5.71$). The group main effect did not obtain statistical significance [$F(2, 22) = 0.58, p > 0.05$] although moderate effect sizes were obtained for the comparisons between the expert basketball group and the other two groups (Table 2). A significant main effect was again obtained for the display element factor [$F(1, 22) = 26.83, p < 0.01$] with recall accuracy for offensive players ($M = 68.07, SD = 8.23$) superior to that for defensive players ($M = 61.93, SD = 9.10$). The interaction between the group and element factors failed to reach significance levels [$F(2, 22) = 1.41, p > 0.05$], however a similar trend pattern was observed for the basketball patterns as had been noted previously for the netball patterns. As Figure 1b reveals, the group consisting of other experts was at a level comparable to or even poorer than non-experts for the recall of offensive player positions but superior to the non-experts and approaching more that of the basketball experts for defensive player position recall.

Seven of the 11 participants within the other experts group had some prior direct basketball playing experience; however comparison of their recall performance with that of the four other experts who had never played basketball revealed only small differences in recall performance. Those other experts who had played basketball at some time had a mean recall accuracy of 67.32% for offensive player positions and 63.81% for defensive player positions compared to 65.04% and 60.42% respectively for the other experts with no prior basketball experience. There was no obvious relationship between years of specific basketball experience for the other experts and recall performance—indeed the best recall performance amongst the group of other experts came from a participant who had only 1 year of basketball playing experience and the poorest performance came from a player who had 10 years of basketball experience.

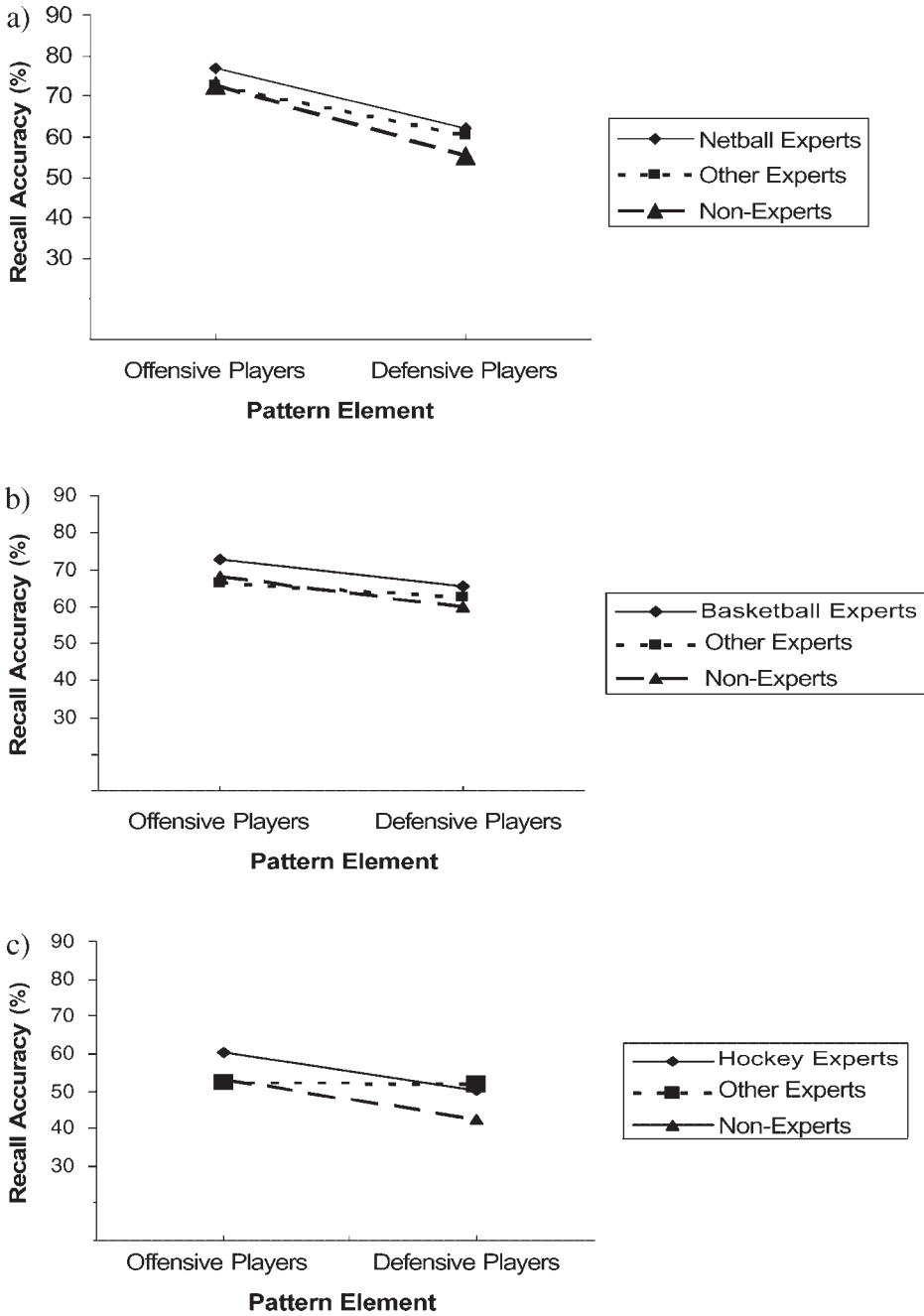


Figure 1. Accuracy in recalling the position of offensive and defensive players within (a) netball patterns, (b) basketball patterns and (c) field hockey patterns by sport-specific experts, experts from other team ball sports, and non-experts

Hockey patterns

Overall recall of hockey patterns was also most accurate for the expert hockey players ($M = 55.35$, $SD = 7.91$), least accurate for the non-experts ($M = 47.94$, $SD = 10.83$) and of intermediate accuracy for the group composed of other team sport experts ($M = 51.93$, $SD = 7.80$). As was the case with the other sport-specific patterns, the group main effect did not obtain statistical significance [$F(2, 22) = 2.31$, $p > 0.05$] although moderate effect sizes were obtained for the comparisons between the expert hockey group and the other two groups, and between the other experts and the non-experts (Table 2). The overall pattern recall percentages were lower for hockey than for netball and basketball but this is unsurprising when consideration is given to the greater number of players on the hockey field compared to the basketball or netball court and consequently the larger number of players that need to be correctly positioned in order to sustain the same percentage of correct recall. Overall recall accuracy for offensive players ($M = 55.19$, $SD = 8.77$) in the hockey clips was significantly superior to that for defensive players ($M = 47.66$, $SD = 8.88$) [$F(1, 22) = 23.78$, $p < 0.01$] mirroring the findings also evident in the other sports. The interaction between group membership and offensive-defensive player recall was significant for the hockey patterns [$F(2, 22) = 4.07$, $p < 0.05$] due to the differential relationship between the group of other experts and the other two groups. On the recall of offensive player positions the performance of the group of non-hockey experts was comparable to that of the non-experts whereas for the recall of the defensive player positions the recall performance was comparable to that of the hockey experts and clearly superior to that of the non-experts (Figure 1c). Large effect size differences (1.20 and 1.03 respectively) exist between the hockey experts and the non-hockey experts on offensive player recall and between the non-hockey experts and the non-experts on the defensive player recall whereas the counter comparisons (hockey experts v. other experts on defensive player recall and other experts v. non-experts on offensive player recall) are small and slightly negative (Table 2).

DISCUSSION

This study was designed to examine the possible positive transfer of pattern reading skills between different team ball sports. The comparative performance of three skill groups was examined—a group of specific sport experts, a group of experts from related sports and a group of experienced but non-expert players. The recall of patterns derived from three different sports was assessed using some video clips derived from within the participants' specific sport of expertise and some derived from other sports.

The findings from the pattern recall task were remarkably consistent across the three different sports examined. Across all three sports, and in keeping with the existing evidence on sport expertise and pattern recall (e.g. Allard et al., 1980), the sport-specific experts consistently recalled the patterns from their domain with greater accuracy than did the non-experts. While the small numbers of experts—an inherent, definitional constraint in examining world-class players—precluded the attainment of statistical significance on the skill group comparisons the effect size observations were certainly in keeping with the prior literature in suggesting clear expertise-related effects on pattern recall. Consistent with the previous literature, effect size differences in the moderate range were found for the overall expert-non-expert comparisons; values obtained were 0.42, 0.46 and 0.77 for the netball, basketball and hockey patterns respectively (Table 2).

For all three sports that were examined the mean overall recall performance of the group composed of experts from related sports was inferior to that of the specific sports experts but superior to that of the non-experts suggesting some positive transfer of pattern recall skill may be taking place. The effect sizes for the comparisons between the group of other experts and the group of non-experts while positive were only in the small range for netball and basketball (0.23 and 0.07 respectively) but were moderate (0.41) for hockey (Table 2). However, as inspection of Figure 1 reveals, assessment of possible transfer effects is complicated by the observation that skill group effects may be moderated by whether it is the recall of offensive or defensive player positions that is being considered.

Regardless of whether it is a pattern from netball (Figure 1a), basketball (Figure 1b) or hockey (Figure 1c) that must be recalled, the performance of the expert group drawn from other sports is most like, and indistinguishable from, that of the non-experts for recall of offensive player positions and most like, and generally indistinguishable from, that of the sport-specific experts for recall of defensive player positions. For the recall of offensive player positions the effect sizes for the comparisons between the sport-specific expert group and the other two groups are all in the moderate to high range (0.47–1.20; Table 2). The effect sizes for the comparison between the other experts and the non-experts are all small and slightly negative (–0.01 to –0.19) indicating no positive transfer of pattern recall of offensive player positions from expertise in one sport to another. In contrast, for the recall of defensive player positions, the effect sizes for the comparisons between the other experts and the non-experts are all in the moderate to high range (0.29–1.03) indicating positive transfer (Table 2). These differences result in a significant group \times element interaction for the hockey clips, even given the constraint of the small numbers of experts it is possible to include within the inferential analysis.

The observation that experts from other sports (e.g. basketball and hockey), in some cases without any direct experience in the particular team ball sport from which the patterns were derived, could perform at or near the level of domain-specific experts on the recall of defensive player positions on these pattern recall tasks and could outperform non-experts who, in a number of cases, had significant experience in the particular sport from which the patterns were derived, clearly suggests that at least some aspects of pattern recall skill may be generic and transferable between some sports. The superior performance of the other experts over the non-experts cannot be simply attributable to any sport-specific experience that the other experts may have obtained during their developing years as (i) similar findings were obtained for the sports where the other experts had no direct experience (e.g. hockey, Figure 1c) as for sports in which the majority of other experts had some direct playing experience (e.g. basketball, Figure 1b); (ii) the performance of the other experts with and without sport-specific experience was comparable; and (iii) there was no relationship evident between the amount of direct experience other experts had in the sport of interest and their recall performance. The transfer of recall capability that exists between different team sports is clearly selective and does not apply to all aspects of pattern recall—most obviously not the recall of offensive player positions.

That any transfer is possible runs contrary to many of the traditional notions about the specificity of training that have dominated the motor skills literature although it is not inconsistent with some prevailing notions from the perceptual learning and perceptual training literature (Goldstone, 1998; Smeeton et al., 2004). With respect to this particular cohort of sports experts it is plausible that it is the broad base of sport experience that this group experienced during their developing (sampling) years (Côté et al., 2003) that laid the foundation for the development of these generic pattern recognition skills and that

provides, at least, part of the mechanism through which time spent in other sports can reduce the number of hours of sport-specific training needed to reach the expert level of performance (Baker et al., 2003a).

A particularly powerful, systematic and unanticipated effect, that emerged across all three sports patterns, was superior recall by participants of the position of offensive players within the video clips compared to the position of defensive players. To our knowledge, this effect has not been previously reported within the literature on pattern recognition in sports. The origin of the effect is unclear but may possibly be a product of the tendency of the participants to view the clips from the perspective of being the player in possession of the ball (even though this was not an explicit part of the instructional set). An allied observation is that positive transfer from other sports expertise appears to occur on that aspect of pattern recall (the recall of defensive player positions) that is most poorly performed by most participants, with the experts from the other sports being able to maintain approximately equal recall performance across both offensive and defensive player positions in a manner unmatched by both the domain-specific experts and the non-experts (cf. Figure 1). Visual search analyses of other team sports like soccer (Helsen & Starkes, 1999) have indicated that much greater priority is given by both expert and less experienced players to the monitoring of movements of the ball carrier and team mates than to the position and movements of defenders. Collectively, this suggests the intriguing, but speculative, notion that it may be the unattended or less attended elements of the pattern (the defensive player positions) that may actively promote transfer of expertise effects.

The evidence for transfer of pattern recall skills from one sport to another that is presented here is obviously preliminary and in need of replication and strengthening through designs that permit larger sample numbers and more precisely matched control groups to be included. Given the inherent constraint/contradiction in assembling large samples of true experts an essential next step may be to examine, using a learning paradigm with less skilled participants, the capacity for transfer of pattern recall skills to occur from repeated exposure to patterns of the type used as test stimuli in this study. The existing literature on perceptual training in sport, while suggesting promising new avenues for the facilitated acquisition of the perceptual skills that distinguish the expert (Abernethy, Wood, & Parks, 1999; Williams & Ward, 2003), has not typically included training materials from outside the specific sport/domain within which expertise is sought. One possible inference from the findings of the current study is that the inclusion of such exposure may be of value given the indications that positive transfer of pattern recall skill between at least some sports may be possible.

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