Original Article

Expert-novice differences in procedural knowledge in young soccer players from local to international level

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ABSTRACT

García-López LM, Gutiérrez D, Abellán J, González-Víllora S, Webb LA. Expert-novice differences in procedural knowledge in young soccer players from local to international level. *J. Hum. Sport Exerc.* Vol. 5, No. 3, pp. 444-452, 2010. Expert and novice soccer players (N=140) from five different competition levels (inexperienced, provincial, regional, national and international levels) were examined for differences in procedural knowledge. A video-based test was developed recording four matches of the under-16 Spanish football final play-off. Ten sequences, seven offensive and three defensive, were finally selected for the video test. Analysis of variance indicated that no significant differences were found in procedural knowledge among the different competition levels but when combined, subjects belonging to the national and international level had a significantly higher rate of procedural knowledge than regional, provincial and inexperienced soccer players. Experts were less homogeneous as a group when compared to novices. No differences were found between defenders and midfielders in any category, although midfielders have to perform in more varied and tactically complex contexts than defenders. **Key words:** SOCCER, EXPERTISE, PROCEDURAL KNOWLEDGE, VIDEO ASSESSMENT.

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INTRODUCTION

Motor expertise is a relatively recent line of research which is worthy for its intrinsic interest and for its potential to improve and maximise human movement (Abernethy, 1993). As being an expert is a result of a complex interaction of many variables (Abernethy, 1993), the research on this topic has many areas of focus. Athletes must excel in no less than four domains to obtain expert status (Janelle & Hillman, 2003): physiological, technical, cognitive, and emotional. Janelle and Hillman (2003) consider cognitive expertise can be broken down into two subdomains: tactical/strategic knowledge, which comprises an athlete's global approach to a particular sport, and perceptual/decision-making skills, which focuses more on an athlete's ability to make in-the-moment decisions.

Alexander and Judy (1988) defined domain specific knowledge as "declarative, procedural, or conditional knowledge one possesses relative to a particular field of study" (p. 376). Declarative knowledge refers to factual information (knowing what), whereas procedural knowledge is the compilation of declarative knowledge into functional units that incorporates domain specific strategies (knowing how), and conditional knowledge implies the understanding of when and where to access certain facts or employ particular procedures (Alexander & Judy, 1988). Strategic knowledge is a special type of procedural knowledge which involves goal directed procedures that may be used before, during or after task performance, and is used across specific domains in performing, regulating, and evaluating the execution of a task (Alexander & Judy, 1988; Dodds, Griffin, & Placek, 2001).

Procedural knowledge has received different definitions by different authors. In this research procedural knowledge is studied as French and Thomas (1987), Turner and Martinek (1995, 1999) and Contreras Jordán, García López, and Cervelló (2004) did, that is, conceptualizing it in terms of productions systems (Anderson, 1976). Productions are generalized stimulus-response pairs. Each production consists of a condition side and an action side and may be viewed as `if = then´ pairs. If the condition side matches the contents of the short memory, then the action is executed. It is considered that video sequences represent individual productions or procedural knowledge in the form of `if = then´ scenarios.

Researchers interested in examining differences among individuals of different skill level adopt the Expert-Novice paradigm (Wrisberg, 2001). Studies of this nature typically involve comparisons of above mentioned domains. Declarative, procedural, conditional and strategic knowledge differ between experts and novices (Abernethy, Thomas, & Thomas, 1993; Glaser & Chi, 1988). Experts have more nodes in their knowledge domains and more links among these nodes and their structures are more easily accessible and more hierarchical (Glaser & Chi, 1988; Stenberg & Horvath, 1995). Additionally, the cognitive processing of experts is faster, more accurate and more automatic, and they are more likely to provide appropriate and creative solutions to problems (Stenberg & Horvath, 1995). Whereas novices respond to surface features, experts attend more to deep structural features of problems. In the process, experts represent problems more abstractly and use different productions in solving them (Abernethy et al., 1993; Sternberg & Horvath, 1995).

Studying the nature and development of expertise in sports requires the analysis of knowledge and performance. French and McPherson (1999) described how researchers have attempted to describe the changes in sport skill and knowledge development. At the beginning, researchers designed investigations to establish that response selection was a salient component of performance. Observational instruments were used to measure performance, and scores on knowledge tests were correlated with the accuracy of decisions during game play (French & Thomas, 1987; McPherson & Thomas, 1989) and only provided a

behavioural measure of decision making accuracy, but no information about what knowledge was used or how knowledge was used in decision making (French & McPherson, 1999). Following this correlation, the focus of researchers' work was on trying to understand what the knowledge base is for given sports, how the knowledge base develops, and the way knowledge is used during performance (French & McPherson, 1999).

Knowledge base includes not only the traditional propositional networks for conceptual knowledge, but also other specific memory adaptations and structures such as action plan profiles, current events profiles, game situation stereotypes, scripts for competition, and sport specific strategies that are stored and accessible from long term memory (French & McPherson, 1999). A new tool was developed to investigate problem representation via verbal reports, creating a model of protocol structure for tennis which conceptualized players' verbal reports in terms of conditions, actions, goals, do, and regulatory concepts (McPherson, 1994; McPherson & Thomas, 1989). Verbal data from these and later studies (French et al., 1996; McPherson, 1993; McPherson, 1999a; McPherson, 1999b) indicated that collegiate sport experts access complex tactical problem representations which guide their encoding of critical environmental cues.

These representations also guide their retrieval of pertinent goal concepts plus patterns of detailed and forceful action concepts from their long-term memory relevant to the current sport concept. Collegiate experts also use environmental and conceptual information to make tactical decisions or plans about response selections and their problem representations include specialized support strategies to plan, monitor, and regulate specific game-related events to make accurate response selections and modify response executions. Finally, experts make more sophisticated decisions during competition than novices. On the contrary, novices exhibit a weak knowledge representation of the task and are mainly interested in accomplishing basic execution goals.

Competition becomes an important variable, as higher levels of competitive play rather than age were associated with higher levels of sophisticated problem representations (McPherson, 1994). Competition is linked with extended practice, another common denominator of experts. This practice requires effort and concentration, with no necessary rewards and joy (Janelle & Hillman, 2003). Accumulation of intensive deliberate practice is the best predictor of elite performance (Ericsson, 2003; Ericsson et al., 1993; Starkes, 2000; Starkes et al., 2001). Helsen, Starkes, & Hodges (1998), who conducted retrospective interviews of international, national and provincial level team sport participants, found that international level players engaged in much more practice of the individual skills with a team at the age of 15 or 16-years.

Studies with child and youth experts and novices in sports of different tactical complexity (tennis, basketball, baseball) support that experts have a higher rate of procedural knowledge, regardless of age (Blomqvist et al., 2000; Del Villar Álvarez et al., 2004; González Víllora, 2008; McPherson, 1993; McPherson, 1999a; McPherson & Thomas, 1989). Experts have also accumulated more years of practice and more hours of practice, and have engaged in a higher level of competitive play. Differences have also been found between the groups of several levels of experience (Del Villar Álvarez et al., 2004; Helsen et al., 1998). The higher level players are, the higher rate of procedural knowledge they have.

The purpose of this investigation was to analyze procedural knowledge in players of the same age but of different level of experience and competition in soccer. International, national, regional, provincial and inexperienced players have been tested. No other studies before compared so many different levels of competition in soccer. Another aim of the investigation was to determine if procedural knowledge increases uniformly with experience and competitive level or not. The question to be answered is to know if there is a

level of experience related to competition in which procedural knowledge is significantly higher than in the previous level. And last, this study intends to analyse if procedural knowledge depends on the position of the player during the games.

MATERIAL AND METHODS

Participants

140 participants aged 15 years from five different competitive soccer levels participated in this investigation. The most experienced players (n=16) were members of the Under 16 Spanish national team (international level). The second level was national, and participants (n=28) were from two Portuguese and Spanish first division teams. In the third level players (n=23) belonged to two teams from Spanish regional level. The fourth level was composed by participants (n=48) from two Spanish cities and played at provincial level (in Spain, a region has several provinces). And at the fifth and lowest level participants (n=25) had no competitive experience. All the subjects were classified by their coaches depending on the field position were they used to play: defenders, midfielders and forwards.

Knowledge measure and procedure

The assessing instrument was a video-based test developed recording four matches of the under-16 Spanish football final play-off. 41 sequences were first selected by three experts. The role of the player (offensive and defensive actions with and off the ball) and his field position (defence, midfielder, and forward) were the criteria used to choose the videos in this first selection. Ten sequences, seven offensive and three defensive, were finally selected for the video test. The experts based their decisions for this second selection on attack tactical principles (maintaining the possession of the ball, advancing and attacking the goal) or defence tactical principles (winning the ball, preventing advancing and defending the goal) (Bayer, 1992). The sequences were filmed from a position behind (20 m) and slightly above (10 m) the mid line using a video camera, 8-mm focal length lens. One of the goals and between eight and ten players were visible onscreen. Each video of the match situation sequence was 6-10 seconds long; this was followed by a still frame (five seconds) on which they had to decide what to do in less than five seconds. The test began after three training sequences; video sequences were shown on a large screen (2 m x 1.2 m) and subjets were sitting four meters away; all responses were noted down. All correct responses summed up to one point for every sequence. The experts determined one best response for every sequence which had double value than the rest of the correct responses. Each incorrect response was valued negatively as much as a positive response for each sequence. Each player received a total score (TS) from the video-based test. These scores were related to experience and position in the field during the play.

Validity and Reliability

Three experts who were soccer coaches at national level selected the content of the test from extensive video material. So, it could be argued test items were essential for the game. Forty subjects performed a test-retest, with a time interval in the test-re-test situation of one week. Cronchbach's Alpha was applied to evaluate internal consistency reliability, and the result was α=.75.

RESULTS

Procedural Knowledge and Competition Level

Descriptive statistics show subjects from provincial and regional competition level groups have similar results in the test. They are even higher in total scores (M=4.46, SD=1.36) for the provincial group than for the regional group (total scores, M=4.32, SD=1.19). Similar results have been also found between the national and international competition level groups. Inexperienced players have the lowest procedural knowledge level. No considerable variability was found in video-based tests among the groups in TS. One-way ANOVA was conducted on procedural knowledge video-based test and results indicate that no significant differences were found in total scores (F=1.991, p=0.099) among the different competition level (Table 1).

Table 1. *Means, standard deviations and results of one-way ANOVA.*

Variable	Inexperienced		Provincial		Regional		National		International		F	p
	M	SD	M	SD	M	SD	M	SD	M	SD		
TS	3.85	1.43	4.46	1.36	4.32	1.19	5.30	0.87	5.49	1.35	1.991	0.099

In order to explain these contradictory results, Tuckey's post-hoc analysis for competition level was conducted (Table 2). No significant differences were found among inexperienced and provincial competition level (SE=0.31, p=0.286), between inexperienced and regional competition level (SE=.36, p=.406), nor provincial and regional competition level (SE=0.32, p=0.990), for total scores. Significant differences were not found either between national and international level for total scores (SE=0.39, p=0.989). Therefore, significant differences in procedural knowledge for total scores ($p<0.05$) were only found when players reach the national competition level, indicating the similarity between the national and the international players.

Procedural Knowledge and Field Position

A Kolmogorov-Smirnov test showed that the variables did not conform to parametric assumptions. Therefore a Mann-Whitney test was conducted to compare unrelated samples of defenders and midfielders. The number of subjects who were forwards was too low to be compared to the previous categories. No significant differences were found between defenders and midfielders at any competition level. Therefore, players of the same competition level who had different field position had similar procedural knowledge.

Table 2. *Tuckey's post-hoc analysis for competition level.*

Variable	(I) Grupo	(J) Grupo	Means Differences (I-J)	Standard error	p
TS	Inexperienced	Provincial	-0.61	0.31	0.286
		Regional	-0.46	0.36	0.706
		National	-1.45	0.35	0.000
		International	-1.64	.040	0.001
	Provincial	Inexperienced	0.61	0.31	0.286
		Regional	0.15	0.32	0.990
		National	-0.84	0.30	0.046
		International	-1.03	0.36	0.042
	Regional	Inexperienced	0.46	0.36	0.706
		Provincial	-0.15	0.32	0.990
		National	-.099	0.35	0.048
		International	-1.18	0.41	0.038
	National	Inexperienced	1.45	0.35	0.000
		Provincial	0.84	0.30	0.046
		Regional	0.99	0.35	0.048
		International	-0.19	0.39	0.989
	International	Inexperienced	1.64	0.40	0.001
		Provincial	1.03	0.36	0.042
		Regional	1.18	0.41	0.038
		National	0.19	0.39	0.989

DISCUSSION AND CONCLUSIONS

One of the purposes of this study was to analyze the differences in procedural knowledge of soccer players from five different competition levels in order to describe how this kind of knowledge evolves with competition level, and subsequently with experience and practice. Participants belonging to the national and international level had a significantly higher rate of procedural knowledge than regional, provincial and inexperienced soccer players. This finding is consistent with those of French and Thomas (1987, basketball), Blomqvist et al. (2000, badminton), McPherson (1993, 1994, 1999a, 1999b, tennis) and Del Villar et al. (2004, basketball).

However, no significant differences were found among inexperienced, provincial and regional groups or between national and international groups. This result is also consistent with those obtained by Del Villar et al. (2004), who found that there were significant differences in procedural knowledge between low and high experienced subjects. What is more, the increase of procedural knowledge is not a continuum regarding to competition level, but differences only were found when comparing high performance players with any other category.

The fact that considerable variability was not found in the most experienced groups is not consistent with the results obtained by Blomqvist et al. (2000, badminton), who found that experts were less homogeneous as a group when compared to novices. Blomqvist et al. (2000) stated that the experts in their investigation could have played different number of tournaments, or had different coaches who made them practice in different conditions.

The second aim of this investigation was to establish what kind of relationship there is between procedural knowledge and the position of the field where subjects play. No significant differences were found at any category between midfielders and defenders in any variable. This indicates that although midfielders have to perform in more varied and tactically complex contexts than defenders they start from similar conditions of procedural knowledge.

Future research should analyze intact, real-life sports. Multiple measures of video-based tests, verbal reports and game performance should be used to have a complete view of this kind of research. More longitudinal studies which trace the development of expertise will provide the quality of information necessary to explain expertise and enhance sport performance (Thomas & Thomas, 1994).

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