UNIVERSITI PUTRA MALAYSIA

MOVEMENT PATTERN RECOGNITION ABILITIES AMONG EXPERT AND NON-EXPERT MALAYSIAN RHYTHMIC GYMNASTS

TEH LAH HOONG

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By

TEH LAH HOONG

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of the Requirements for the Degree of Master of Science

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Specially Dedicated
To
Choon, Shawn, Wayne and Joy

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science.

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TEH LAH HOONG

May 2003

Chairman: Mohd. Khairi Zawi, Ph.D.

Faculty: Educational Studies

The superior performance of experts over novices has been attributed to specific hardware and/or software differences in the past. Recent sport research has also indicated the prominence of cognition differences in the performance of athletes. Using the expert-nonexpert paradigm, this study examined the movement pattern recognition abilities of eighteen trained Malaysian rhythmic gymnasts who were ranked accordingly to their performance in the recent National Junior Championship, and nine girls who make up the control group. Research participants performed a resequencing task within a specific time frame on a set of five rhythmic gymnastic movement sequences involving pirouttes and rotations. The data was collected from the trained gymnasts of the seven rhythmic gymnastics training centres where they were attached. The main statistical procedure used was the one-way ANOVA with the Bonferroni procedure used for post-hoc analyses. ANOVA was used to verify the hypothesis. Primary findings showed that there are significant differences in the

movement pattern recognition abilities among the expert and non-expert Malaysian rhythmic gymnasts.

In sum, the findings indicated significant differences between the expert gymnasts and nonexpert gymnasts in the hoop, clubs and ribbon movement sequences used. However, no significant differences were found between the nonexpert gymnasts and the control group in the movement pattern recognition abilities assigned in this experiment. The results demonstrated evidence of a significant difference in terms of movement pattern recognition abilities among the expert and non-expert Malaysian rhythmic gymnasts from the seven training centres.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KEUPAYAAN MENGENAL PASTI CORAK PERGERAKAN DI KALANGAN ATLET GIMRAMA PAKAR DAN BUKAN PAKAR MALAYSIA

Oleh

TEH LAH HOONG

Mei 2003

Pengerusi: Mohd. Khairi Zawi, Ph.D.

Fakulti: Pengajian Pendidikan

Prestasi pakar yang lebih baik daripada novis sering diatribusi kepada sama ada perbezaan 'hardware' dan/atau perbezaan 'software'. Kajian sukan semasa juga menunjukkan perbezaan kognitif yang ketara dalam prestasi atlet. Dengan menggunakan paradigma pakar-bukan pakar, kajian ini memeriksa keupayaan mengenal pasti corak pergerakan lapan belas orang atlet sukan gimrama Malaysia yang telah bertanding dalam kejohanan kebangsaan baru-baru ini serta lapan orang murid perempuan yang membentuk kumpulan kawalan. Peserta-peserta kajian melakukan tugasan menyusun semula set kad gambar yang terdiri daripada lima siri pergerakan dalam tempoh masa yang ditetapkan. Pergerakan-pergerakan tersebut terdiri daripada pergerakan pangsi dan rotasi. Data dikumpulkan daripada para atlet gimrama dari tujuh pusat latihan serta peserta kumpulan kawalan. Prosedur statistik utama yang digunakan adalah statistik ANOVA satu-hala. Prosedur Bonferroni digunakan untuk analisis 'post-hoc'.

Dapatan awalan menunjukkan perbezaan keupayaan mengenal pasti corak pergerakan di antara atlet gimrama pakar dan bukan pakar.

Sebagai kesimpulan, dapatan eksperimen menunjukkan perbezaan yang signifikan antara atlet pakar dan atlet bukan pakar untuk keupayaan mengenal pasti corak pergerakan dalam siri pergerakan gelung, belantan dan riben yang digunakan. Walau bagaimanapun, tidak terdapat perbezaan yang signifikan antara atlet bukan pakar dengan peserta kumpulan kawalan untuk keupayaan mengenal pasti corak pergerakan yang dikaji dalam eksperimen ini. Keputusan ini memberi bukti perbezaan yang signifikan dari aspek keupayaan mengenal pasti corak pergerakan di kalangan atlet gimrama pakar dan bukan pakar dari tujuh pusat latihan gimrama.

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I certify that an Examination Committee met on 10 th May 2003 to conduct the final examination of Teh Lah Hoong on her Master of Science thesis entitled "Movement Pattern Recognition Abilities Among Expert and Non-Expert Malaysian Rhythmic Gymnasts" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

PROFESOR MADYA DR. MOHD. IBRAHIM NAZRI
Faculty of Educational Studies
Universiti Putra Malaysia.
(Chairman)

MOHD KHAIRI BIN ZAWI, Ph.D.
Faculty of Educational Studies
Universiti Putra Malaysia.
(Member)

SHAHARUDIN BIN ABD. AZIZ, Ph.D.
Faculty of Cognitive Science and Human Development
Universiti Perguruan Sultan Idris.
(Member)

SOAIB BIN ASIMIRAN
Faculty of Educational Studies
Universiti Putra Malaysia.
(Member)

SHAMSHER MOHAMAD RAMADILI, Ph.D.
Professor/ Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia.

Date: 09 SEP 2003

This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfilment of the requirement for the degree of Master of Science.

MOHD KHAIRI BIN ZAWI, Ph.D.
Faculty of Educational Studies
Universiti Putra Malaysia.
(Chairman)

SHAHARUDIN BIN ABD. AZIZ, Ph.D.
Faculty of Cognitive Science and Human Development
Universiti Perguruan Sultan Idris.
(Member)

SOAIB BIN ASIMIRAN
Faculty of Educational Studies
Universiti Putra Malaysia.
(Member)

AINI IDERIS, Ph.D.
Professor / Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 16 SEP 2003

DECL R TION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

TEH LAH HOONG

Date: 09.9.2003

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CHAPTER 1

INTRODUCTION

A primary interest among sport practitioners is to identify the characteristics and behavioural patterns which distinguish highly skilled athletes from their lesser skilled counterparts. These behaivoural patterns, extensively researched via skill acquisition studies that specify characteristics which discriminate athletes in accordance to their level of proficiency can be derived through the expert-novice literature. Expert is characterised as possessing exceptional levels of performance on the task of interest whereas a novice is on the lower end of this taxonomy, exhibiting poor performance levels. The literature attempts to determine performance variables responsible for this difference in expertise to account for superior performance. Comparisons have been made with the expert-novice groups in the search for visual, perceptual or cognitive factors that may underpin skilled behaviours.

Research on expertise in music, mathematics, chess and physics reveal some interesting consistencies regarding the characteristics of experts. Most of the findings were mainly about the manner information is structured in the minds of experts as in comparison to that of novices. Pattern-recognition paradigms and knowledge paradigms were earlier developed models to address issues surrounding the expertise phenomenon. These models which were based on

cognitive tasks, have been applied in a diverse range of field studies including sports, triggering the development of a systematic and concentrated body of sport expertise research (Abernethy & Russell, 1987; Allard, Graham & Paarsalu, 1980; French & Thomas, 1987; Starkes, 1987). Findings of these research revealed distinguishing pattern-recognition characteristics and knowledge patterns of the experts. Recent scientific developments in sports projected the cognitive attributes as a better determinator of sport expertise as opposed to the traditional physical characteristics indicators (Thomas & Thomas, 1994). These attributes point to specific innate perceptual or cognitive abilities which are directly related to skilled athletic performance.

Current research in sports expertise adopt a cognitive approach to determine the variables that underline expert-novice performance differences. Starkes and Deakin (1984) used the computer analogy to depict the expert-novice differences as to be largely *software* rather than *hardware.* Here, the human biological system is viewed as a sophisticated processor of information. In a computer, the processing capacity, its operating speed and memory capacity depends on the physical makeup of the computer (hardware) and the computer programs loaded into its memory (software). Similarly, the quality and diversity of the human motor output is limited by the two interacting factors; the *hardware*, which comprises of the physical variables such as the anthropomorphic features and from the motor ability and the *software* which comprises of the cognitive attributes and perceptual skills. There are robust findings that hardware

attributes do not discriminate between experts and novices whereas evidence supporting the premise that skilled performers are characterised by superior software is extensive.

Using an expert-novice paradigm, researchers have examined differences in cognition between experts and novices in various sports including basketball, baseball, diving, gymnastics, racquet sports and hockey. These studies examined sport-specific performance and the role of such cognitive aspects such as knowledge base and development , knowledge structure and problem solving, perception and information processing speed, recall for representative structured stimuli and other cognitive functions. The findings revealed consistent evidence that experts possess certain superior software qualities that provide them an advantage over the novices. The body of available literature supported the notion that the locus of the expert advantage in sport lies primarily in the software and not the hardware attributes.

Exceptional levels of performance on the task of interest are usually employed as the criterion for the identification of expertise. While some expert-novice literature suggested that possession of accessible and usable knowledge forms a major component of expertise, physical characteristics and abilities are commonly employed by coaches to detect and gauge sport expertise. Rhythmic gymnastics is an artistic sport which involves the performance of body and apparatus movements incorporated into a routine with musical accompaniment.

The performance of the routine is then judged basically on how closely the movements adhere to the specifications in the rules book known as the Code of Points. It is undeniable that the physical attributes determine the threshold of a performance. Therefore, the gymnasts strive to attain the uncompromising ideals in the physical attributes of an expert gymnast. The attributes are highly regarded as an indicator of expertise. Therefore, the possibility of cognitive capabilities (software) as a more critical factor than the physical makeup of an athlete (hardware) either for determining expertise or predicting success will certainly challenge the traditional practices of rhythmic gymnastic coaches in talent identification.

Very often, rhythmic gymnasts with superior physical attributes fail to deliver when it matters most; in competitions. In line with the contemporary approach to expertise, the role of cognition in the performance of rhythmic gymnastics needs to be examined. Two recipient paradigms in the motor expertise field imported from the field of cognitive psychology are the pattern recognition paradigm and the knowledge-based paradigm. The pattern recognition paradigm was first introduced in the chess studies (de Groot, 1966; Chase and Simon, 1973) and since applied to a range of sport experts (Allard, Graham & Paarsalu, 1980; Vickers, 1986; Starkes, 1987; Starkes, Deakin, Lindley & Crisp, 1987). Pattern recognition requires that one organise existing knowledge around meaningful patterns and develop procedures for relating new information to the patterns (Anderson, 1983). In professional practice, recognition of a particular pattern of

information becomes the stimulus for carrying out a series of subsequent actions. Anderson (1983) suggested that pattern recognition is developed through repeated representations of examples with varying degrees of similarity. Deliberate practice of this nature strengthens one's ability to recognise and discriminate meaningful patterns and enhances the generalisation of pattern recognition skills to new situations. The pattern recognition paradigm of de Groot and Chase and Simon is used to highlight the differential recall and recognition performance of experts and novices for perceptual information varying in its degree of task structure. The paradigm has been widely used to examine expertise in team sports with slides of structured games offences or defenses and slides of unstructured player movements utilised as direct analogues to the normal and random placement of pieces on a chess board. The expert players are able to recall significantly better than non-experts for the structured games slides but no difference was detected for the unstructured games slides. The expert advantage is revealed as found on the cognitive task. However, this finding holds predominantly for expert athletes in team ball sports (Allard et al., 1980; Starkes, 1987; Williams, Davids, Burwitz & Williams, 1993) whereas in closed skills sports such as gymnastics, figure skating, dance and ballet, there were contradicting findings. Starkes, Deakin, Lindley and Crisp (1987) found that experts reproduced more movements than novices when the movement sequence was structured but the two groups could not be differentiated when the sequence was not structured, similar to the chess studies. However, Starkes, Caicco, Boutilier and Sevsek (1990) and Smyth and Pendleton (1994) have

demonstrated that dance experts can reproduce more movements than novices even when the routines are unstructured. The results suggested that unlike experts in other fields, dancers are more efficient encoders of movement than novices, even when the movements are not meaningful in their domain of expertise. As the sport of rhythmic gymnastics has many similar movement characteristics with dance, some similarities can be drawn about the application of the pattern-recognition paradigm here.

The knowledge-based approaches to expertise are based on the common premise that though experts and novices may possess similar 'hardware', experts differ from novices in terms of what they know and how they utilise that knowledge (Anderson, 1982; Chi, Glaser & Farr, 1988). A number of taxonomies on types of knowledge currently exist in the literature but most draw a distinction between declarative knowledge and procedural knowledge. Declarative knowledge is factual information and refers to the 'what to do' whereas procedural knowledge is used to generate action or 'how to do something' (Thomas & Thomas, 1994). The former would include, for example, knowledge about rules, player positions and scoring. Procedural knowledge involves decision-making and the selection of an appropriate action given certain conditions. In both cognitive (Chi, 1981) and motor tasks (French & Thomas, 1987; French, Nevett, Spurgeon, Graham, Rink & McPherson, 1996; Huber, 1997; Boyd & Yin, 1999; French & McPherson, 1999) experts have been shown to possess a more robust and highly differentiated store of both declarative and

procedural knowledge than novices. Experts have been consistently reported to be able to see and represent problems at a deeper, more principled level than novices, solving problems through the use of concepts, semantics and abstract principles rather than relying upon superficial literal features of the problem (Chi, Glaser & Farr, 1988; Huber, 1997). Chi, Feltovich and Glaser (1994) reported that the expert's problem representation contain a great deal of procedural knowledge, with explicit conditions for applicability whereas novices' problem representation is characterized as containing sufficiently elaborate declarative knowledge but lacking abstracted solution methods.

In rhythmic gymnastics, the role of knowledge-based approaches in expertise has often been disputed based on the nature of the sport. A competitive rhythmic gymnastics routine is choreographed way ahead and it is repeated numerous times in deliberate practice leaving no room for the organisation or application of knowledge. Abernethy, Thomas and Thomas (1993) suggest that motor tasks which demand a high cognitive component as in open-skilled sports, are expected to exhibit similar characteristics which differentiate experts from novices in cognitive tasks. For instance, experts in high strategy ball sports have shown to demonstrate most of the perceptual and knowledge characteristics as the experts in purely cognitive activities (Allard, Graham & Paarsalu, 1980; French & Thomas, 1987). In contrast, motor tasks as in closed skill sports, strategic decision-making is not crucial. This is because in closed skill sports, the level of performance is apparently determined primarily by the quality of the

execution of over learned, automated movement patterns like in rhythmic gymnastics. Experts of closed skills sport are expected to be discriminated from novices by characteristics different from those tasks with dominant cognitive component. However, studies involving closed skills sport like diving (Huber, 1997), gymnastics (Vickers, 1988; Ille & Cadopi, 1999) and dance (Poon & Rodgers, 2000) demonstrated the existence of cognitive differences as in cognitive tasks. It will be significant to this study to find out how this will apply to rhythmic gymnastics.

The findings on expert-novice differences possess a common theme: many cognitive processes, including pattern recognition are affected within the domain. Rhythmic gymnastics which has long maintained its traditional emphasis on physical attributes needs to address this issue in line with the contemporary sport developments. This research hopes to place the role of cognition in its correct perspective and provide some insight, applying the pattern-recognition paradigm, into the characterisation of rhythmic gymnastics expertise.

Problem Statement

The search for variables that discriminate the performance of experts from novices is of importance because it might explicate how the different mechanisms underlying performance evolve with practice. However, differences which arise in the typical expert-novice comparison, are inevitably attributed

causal status with respect to expertise. These differences are not reliably distinguished from those caused by familarity differences as the typical expert group differs from the novice group not only in terms of attained level of task performance but also in task familarity due to difference in the amount of practice on the task. Hence, in this research, comparison is made with the non-expert group with equal practice but poorer performance than the expert group.

Based on the statements mentioned, the research question of interest is whether there are differences in the movement pattern recognition abilities of the trained Malaysian rhythmic gymnasts from the seven training centres in relation to their level of expertise.

Research Purpose

The primary purpose of this research is to establish the existence of differences in the movement pattern recognition abilities of trained Malaysian rhythmic gymnasts in relation to their level of expertise. Specifically, the purpose of this study is to ascertain whether there exist a significant difference in the movement pattern recognition abilities of the expert and non-expert Malaysian rhythmic gymnasts from the seven training centres.