

DEVELOPMENTAL PRACTICE ACTIVITIES OF ELITE YOUTH SWIMMERS

Angelina Tan Li San
Jeffrey Low Fook Lee

Faculty of Sports Science and Coaching
Sultan Idris Education University

ABSTRACT

The purpose of the study was to examine the developmental pathways of elite youth swimmers. Swim-related developmental activities of elite and sub-elite youth swimmers were examined. Fifteen elite (8 males; 7 females) and 15 sub-elite (5 males; 10 females) youth swimmers were recruited for the study. A semi-structured questionnaire was used to record retrospectively the hours engaged in swim-related activities (i.e., structured and unstructured activities) from beginning of career. No significant differences were found for swim-related developmental milestones for both elite and sub-elite swimmers. Overall, the elite swimmers accumulated more hours in swim-related activities than the sub-elites between 6-15 years of age. Although the former accumulated more hours in both structured and unstructured swimming activities between 6-12 years of age, no significant differences were found between the groups. However, the elite swimmers accumulated significantly more hours in structured swimming activities between 13-15 years of age. Both groups had analogous developmental pathways during childhood but the onset of adolescence led to different outcomes. The increased hours in structured practice during adolescence is suggested to have influenced the level of attainment in swimmers. Incremental amount of training at certain age period is critical in developing optimum performance in sports.

Keywords: *expertise, specializing, practice history, swimming*

INTRODUCTION

The role of nature versus nurture in developing elite individuals in various domains has generated much debate among scholars (Starkes, 2000). An *expert* is generally defined as an individual who has displayed consistent high level of proficiency in his/her domain over an extended period of time (Starkes, 1993). *Nature* refers to the genetic predispositions of an individual that contribute to the individual's potential in a particular domain (Singer & Janelle, 1999) whereas *nurture* refers to environmental factors such as dedicated practice and supportive resources that develop an individual's skill in a domain (Bloom, 1985; Davids & Baker, 2007). The role of genetic endowment has been generally accepted as the primary contributor towards elite performance in various domains until challenged by the seminal study on musicians in an academy by Ericsson, Krampe and Tesch-Römer (1993). The researchers have instead proposed how the musicians were

nurtured influenced their achievement. The study showed that the type and amount of specific practice activities differentiated the expert musicians from their lesser skilled counterparts.

Ericsson et al. (1993) termed these activities as *deliberate practice*. Deliberate practice is a highly structured, purposeful form of practice undertaken with the aim of improving performance. This activity requires concentration, feedback and is not inherently enjoyable. Ericsson and Lehmann (1996) argued that these practices differed from ordinary practice activities. Normally, in the early stages of practice rapid improvements are experienced but plateaus in the later stages (Ericsson, 2003). Deliberate practice is designed to constantly improve performance beyond a plateau by causing positive adaptation to the performer and the underlying mechanisms of their performance (Ericsson, Nandagopal, & Roring, 2009). Ericsson et al. (1993) advocate that an adequate amount of high quality training is fundamental to achieve expert performance.

The deliberate practice theory in sport was first examined by Hodges and Starkes (1996) in wrestling. The researchers chose the individual sport as it provided a comparable study to Ericsson et al.'s (1993) original research. The amount of time engaged in sparring-with-others differentiated the most skilled wrestlers from lesser skilled groups. Subsequent studies on figure skaters (Starkes, Deakin, Allard, Hodges & Hayes, 1996) and karate (Hodge & Deakin, 1998) yielded similar results.

The application of deliberate practice on team sports found similar results to the individual sports. Soccer and field hockey players (Helsen, Starkes & Hodges, 1998) showed that practice and performance was directly related but also found practice to be enjoyable.

Similarly, Côté and colleagues (Côté & Hay, 2002, Côté, Baker & Abernethy, 2003) identified fun activities contributed to the development of expert performance in sport. The researchers termed the activities as *deliberate play*. These activities, engaged significantly during childhood, with the purpose of inherent and immediate enjoyment, with adapted rules from the normal sports. Contrasting deliberate play and deliberate practice, three stages of sport participation were identified in the development of talent in sport (Côté, 1999, Côté & Hay, 2002, Côté, Baker & Abernethy, 2003). The first stage of development, termed *sampling* stage, appears between 6 to 12 years of age. Children participated in various sports and engaged in unstructured play and enjoyable activities. In the *specializing* stage, between 13-15 years of age, adolescents began to reduce the number of other sports and began to concentrate on some structured practice while still engaged in some unstructured play activities. The later stage of *investment* is where training and competition becomes the main element, focusing on improving performance. Côté, Baker, and Abernethy (2003) termed the stages as the Developmental Model of Sport Participation (DMSP), set the pathway of early diversification in the progress of expertise in sport. The theory of deliberate practice charts the way towards early specialization, at the other end of the spectrum.

Sports with an early age for peak performance, such as gymnastics or figure skating, have been known to benefit from early specialization (Côté, Lidor & Hackfort, 2009). Following the early specialization pathway, Olympic gymnasts started to compete at the regional level significantly earlier than the International gymnasts, but they also reported more injuries and less enjoyment (Law, Côté & Ericsson, 2007). The early start of specialized training before puberty increases the likelihood of injury and do not affirmatively produce success (Gonçalves, Rama, & Figueiredo, 2012). On the contrary, studies have reported that early specialization may not be a prerequisite for expertise in individual sport (e.g., triathlon, Baker, Côté & Deakin, 2005; golf, Hayman,

Polman, Taylor, Hemmings & Borkoles, 2011; basketball, netball and field hockey, Baker, Côté & Abernethy, 2003). Although other studies supported the tenets of the DMSP such as cricket (Ford, Low, McRobert & Williams, 2010) and ice hockey (Soberlak & Côté, 2003), further investigations are warranted in other sports and countries.

Equivocal findings continued to be reported in studies investigating whether a child should specialize or diversify early. For example, the study by Strachan, Côté and Deakin (2009) compared “samplers” and “specializers” showed the former reported more positive sport experiences in the context of the family and community whilst the latter have more positive sports experiences in the context of peer groups. Similarly, Baker, Cobley and Fraser-Thomas (2009), found that neither early specialization nor diversification had a distinct advantage over the development of elite athletes. The researchers suggested that specialization and diversification should be viewed as continuum pathway towards expertise. However, early sampling and deliberate play during childhood have been brought to the fore to encourage continuous involvement and elite performance in sport, as opposed to early specialization and deliberate practice (Côté, Lidor, & Hackfort, 2009). Moesch, Elbe, Hauge and Wikman (2011) examined objectively measureable performance sports based on centimeters, grams or seconds (cgs), found that the elite athletes specialized at a later age and trained less before entering the specializing stage.

Whilst corroborating a few positive influences to develop young talented swimmers, Light (2012) noted that the DMSP might need to look at swimming as an early specialization pathway for some children. The DMSP may be suited for some sports but there are challenges involved in adapting it as a model for all sports. For example, the Long Term Athlete Development (LTAD) model adopted to train elite UK swimmers, was criticized as it required higher frequency of training, without adhering to the correct swimming technique, in addition to some conflict with the local swimming regulations (Lang & Light, 2010).

Competitive swimming provides a valid medium for studies of this nature as it can furnish objective training and performance measures. The career span of elite swimmers are considerably short as they have been reported to achieve peak performance in their late teens (Schulz & Carnow, 1988), thus making the recall of their practice histories much easier. Kalinowski (1985) argued that the process of becoming a swimmer commences from childhood. The sampling stage can be considered as the most impactful phase, as without this phase, there may not be a specializing or investment phase. Similarly, the sampling years are critical for the development of physical competence, enabling and encouraging individuals to be a part of an active society (Kirk, 2005). Even more so for swimmers as the peak performance age for swimming is between 17 to 19 years old (Schulz & Carnow, 1988). Johnson, Tenenbaum, Edmonds and Castillo (2008) compared the developmental histories of elite and sub-elite swimmers between 19-28 years of age. The early years of participation (up to 10/11 years of age) showed involvement in various sports, all of which were enjoyable for both elite and sub-elite swimmers. The middle years (ages 10/11-14 years) showed the shift between play and practice where the elite swimmers placed more focus on training to become a swimmer, instead of just being a person that swims. In the later years (ages 15 years and beyond) all the elite swimmers were solely and highly focussed on their swimming development. In contrast, swimmers that undergo analogous training may not necessarily gain the same level of performance (Hodges, Kerr, Starkes, Weir & Nananidou, 2004). The researchers examined the type and manner in which practice was attained by 14-24 years of age swimmers of various skill levels found the relationship between practice amount per year and years of participation increased in a linear fashion for

all swimmers, suggesting that practice was attained due to participation, but not an indicator of performance. Despite showing a comparable increase in practice, it did not determine how well the swimmers would perform.

There is a need to objectively examine the practice activities of swimmers based on their performance indicators (Hodges et al., 2004). Therefore, this study attempted to examine the amount and type of training activities of successful swimmers (i.e., won medals at national level) and compare with other competitive swimmers who did not. Moreover, research on the development of elite athletes in Malaysia is sparse and warranted. Findings from this research could be peculiar from previous studies as the cultural and socio-economic factors may influence the development of elite athletes.

The current study implemented the retrospective interview procedure, which has been validated in past studies (e.g., Côté, Ericsson & Law, 2005, Cumming, Hall & Starkes, 2005). The duration and type of a person's training-related activities could differentiate elite from an average performer (Ericsson, Nandagopal & Roring, 2005). This study sought to investigate whether swimmers, subsequently categorized as either elite or sub-elite, differed in their sporting development by identifying and comparing the type and amount of swim-related activities undertaken. This study predicted the elite swimmers would commence all swimming related activities earlier, accumulated more swimming hours compared to sub-elite swimmers and engaged in fewer other sports. Finally, from the analysed data, it was predicted that the elite swimmers would satisfy the tenets of early specialization pathway.

METHOD

Participants

Two groups of swimmers (N = 30) aged 12-18 years of age participated in the study. The elite swimmers (n=15) were state swimmers that have won at least a medal in one of the two highest national level swimming competitions (i.e., Malaysian Open Swimming Championship or the Malaysian Games (SUKMA). The sub-elite swimmers (n=15) were swimmers that represented their respective states but have not won medals in either of the above two mentioned events. The level of achievement and participation were based on their current involvement; within the past one year.

The mean age of the elite swimmers was 15.7 years of age (SD = 1.4), and the mean age of the sub-elite swimmers was 14.5 years of age (SD = 1.6). The majority of the respondents in this study were recruited from the highest-ranked state swimming team in the country. A few swimmers were recruited from other states. As the swimmers were still schooling, permission was requested and granted from the Ministry of Education to conduct the research. The swimmers were contacted through their swimming coaches and school teachers and the interview was conducted at either in their respective schools or swimming centres.

Procedure

The Participation History Questionnaire (PHQ; Ford, Low, McRobert & Williams, 2010) was adapted to obtain swim related activities undertaken by the participants throughout their career. Two swim coaches were consulted on the relevance of the activities listed. The PHQ was found

to be valid and reliable (ref. Ford et al, 2010, 2009; Ward, Hodges, Starkes, & Williams, 2007). The questionnaire contained four sections. The first section was designed to gather information on swimming-specific milestones. Participants were asked to record the age when they first started swimming (not in an organized structure), trained regularly, participated in a swimming competition, and age when first competed at club/state/national/international level. The second section focused on engagement in swimming-related activities. Four swimming-related activities were listed: competition (organized competition), coach-led practice (organized practice by coach/adult to improve performance), individual practice (self-initiated practice to improve performance), and peer-led play (fun swimming activities with peers). Participants provided the number of hours per weeks and months per year that they were involved in those activities. They were also asked to provide the number of weeks per year that they were injured and unable to engage in the activities. This information was completed by starting from their current year of swimming, working backwards until the year they first started swimming. The third section required the participants to record the major swimming competitions (highest level competition or best performing event) that they have participated in, as well as their event, and placing. This was done for each year that they competed from the current year, working backwards until the year they first started competing. The fourth section was designed to obtain information on engagement in other sport activities. Participants were provided with a list of sports (with space to add the ones not listed), and asked to state the ones they have engaged in, recording the age when they started and ended (even if they are still engaged in it), and the number of hours per week and months per year spent on the activity. Participants were to record other sport activities that they have engaged in for a period of three months or more.

Prior to data collection, informed consent was requested and granted from the participant's parent, coach or teacher. The purpose of the study and each section of the interview were explained to the swimmers. Each swimmer participated in an in-depth semi-structured interview based on the Côté, Ericsson and Law (2005) retrospective recall methodology, which was intended to assess the sporting and related practice histories of elite athletes. This method was based on the assumption that the participants would be more precise and consistent when answering questions based on recall of past episodic experiences rather than being asked general questions. Participants completed the questionnaire within an hour. Any unclear answers or discrepancies were clarified with the participant and his /her coach.

Data from the PHQ of both groups were analysed. The swimming-specific milestones and mean total of swimming hours of the elite and sub-elite swimmers were compared using independent t-tests. Hours engaged in competition and coach-led practice were combined into one category termed as 'structured activity' whilst the individual practice and peer-led play was categorised as 'unstructured activity'. The data were analysed separately for the 6 -12 years of age and 13-15 years of age using 2 Group (elite, sub-elite) x 2 Activities (structured, unstructured) ANOVAs with repeated measures on the last factor. Mann-Whitney U test was used to compare the number of other-sports participated by the two groups. All statistical tests were conducted using the Statistical Package for the Social Sciences (version 18). The alpha level required for significance for all tests was set at $p < .05$.

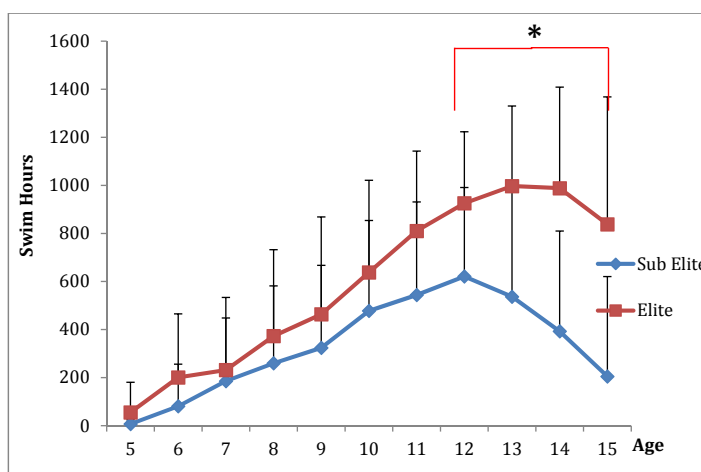
RESULTS

Developmental Milestones

There was a significant difference in chronological age between the elite ($M = 15.7$ years of age, $SD = 1.4$) and sub-elite swimmers ($M = 14.5$ years of age, $SD = 1.6$), $t(28) = 2.30, P = .03$. The elite swimmers were about a year older than the sub-elites. However, no differences were found for swim related developmental milestones between the groups; age first commenced swimming; elite ($M = 5.9$ years of age, $SD = 2.0$) sub-elite ($M = 6.3$ years of age, $SD = 2.5$), $t(28) = 0.49, P = .49$; age engaged in supervised swimming with an adult; elite ($M = 7.7$ years of age, $SD = 2.2$), sub-elite ($M = 7.8$ years of age, $SD = 1.8$), $t(28) = 0.00, P = 1.0$; started swimming regularly, elite ($M = 9.3$ years of age, $SD = 2.4$), sub-elite ($M = 8.9$ years of age, $SD = 2.1$) groups, $t(28) = 0.49, P = .63$; and age started participating in swimming competition, elite ($M = 8.6$ years, $SD = 2.1$), sub-elite group ($M = 8.9$ years, $SD = 1.7$), $t(28) = 0.38, P = .70$.

Hours Accumulated in Swimming

The average hours per year engaged in swimming activities from five to 15 years of age for the elite swimmers and the sub-elite swimmers were shown in Figure 1. According to Shapiro-Wilk $W_{15} = .962, p > 0.05$, $W_{15} = .956, P > 0.05$; the data for total swim hours for the elite and sub-elite swimmers were normally distributed. Both groups showed continuous increment, until 12 years of age, where the sub-elite swimmers showed a decline in number of hours after the age. Between 6-15 years of age, the elite swimmers accumulated significantly higher average swimming hours ($M = 6466.6$ hours, $SD = 2515.3$) than the sub-elite swimmers ($M = 3628.1$ hours, $SD = 2285.4$); $t(28) = 3.24, P = .03$. The average hours engaged in swimming activities at 6-12 years of age by the elite swimmers are ($M = 3643.1$ hours, $SD = 2014.4$) and sub-elite swimmers are ($M = 2493.3$ hours, $SD = 1892.5$). The average hours engaged in swimming activities at 13-15 years of age by the elite swimmers were ($M = 2823.5$ hours, $SD = 1033.7$) and sub-elite swimmers were ($M = 1134.8$ hours, $SD = 996.0$).



* Significantly different from sub-elite swimmers, $p < .05$.

Figure 1. Average hours per year spent by the elite and sub-elite swimmers in swimming activities across each age group.

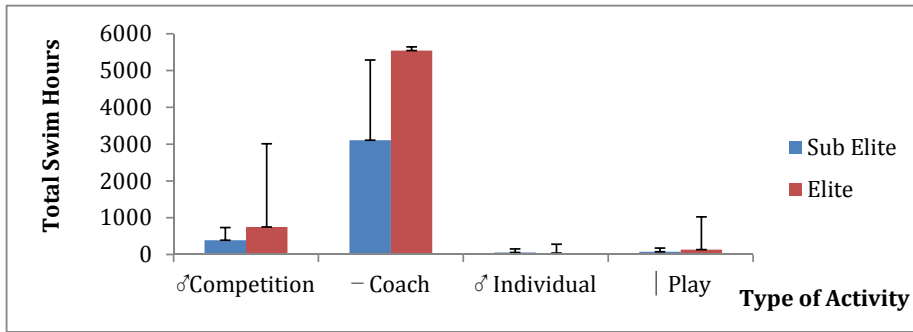


Figure 2. Average hours of swimming in competition, coach-led practice, individual practice and peer-led play between elite and sub-elite swimmers.

The elite swimmers accumulated more hours on both play and practice; competition, coach-led practice, and play; whereas the sub-elite swimmers accumulated more hours on individual practice (Figure 2). There was no significant difference in the total number of hours accumulated during the sampling phase (6-12 years) between the elite ($M = 3643.1$ hours, $SD = 2014.4$) and sub-elite swimmers ($M = 2493.3$ hours, $SD = 1892.5$), $t(28) = 1.61$, $P = .12$. However, the elite swimmers accumulated significantly more hours during the specializing phase (13-15 years) ($M = 2823.5$ hours, $SD = 1033.7$) than the sub-elite swimmers ($M = 1134.8$ hours, $SD = 996.0$), $t(28) = 4.56$, $P = .001$.

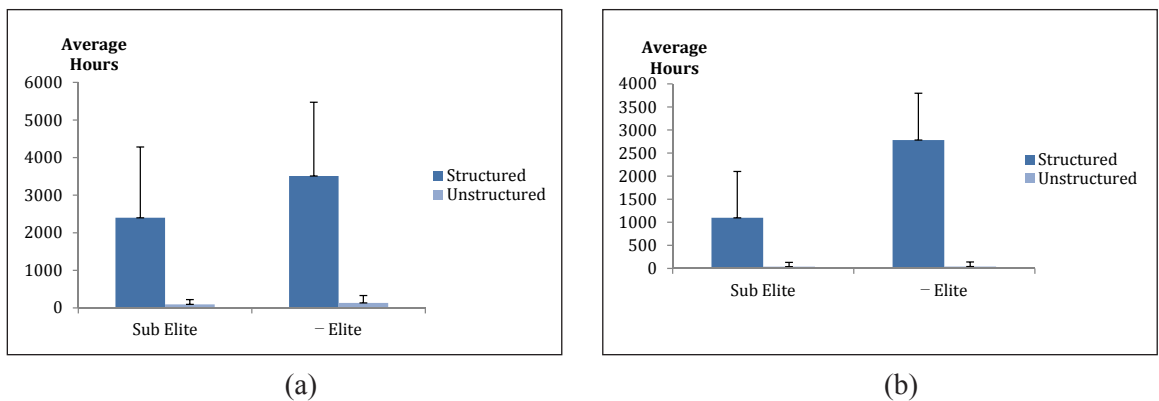


Figure 3. The average hours accumulated in structured and unstructured swimming activity by elite and sub-elite swimmers between (a) 6-12 years of age and (b) 13-15 years of age.

The swim activities were categorized into two types, structured and unstructured. At 6-12 years of age (Figure 3a), the elite swimmers engaged in more hours than the sub-elite swimmers in structured swim activities; elite ($M = 3509.9$ hours, $SD = 1961.8$), sub-elite ($M = 2399.1$ hours, $SD = 1882.6$); and unstructured swim activities; elite ($M = 133.2$ hours, $SD = 196.7$), sub-elite ($M = 94.2$ hours, $SD = 127.5$). There was no interaction between group and activity, $F_{1,28} = 2.38$, $P = .14$. However, at 13-15 years of age (Figure 3b), there was a significant interaction between group and activity, $F_{1,28} = 20.67$, $P = .001$. The elite swimmers engaged in significantly more hours in structured swim activities ($M = 2782.7$, $SD = 1015.6$) compared to the sub-elite ($M = 1096.6$, $SD = 1004.7$). However, no significant difference was found for unstructured activity between both elite ($M = 40.8$, $SD = 98.1$) and sub-elite swimmers ($M = 38.2$, $SD = 90.9$).

Other Sports

Between 6-15 years of age, elite swimmers ($M = 1.5$, $SD = 1.5$) engaged in significantly fewer other-sports than the sub-elite swimmers ($M = 6.5$, $SD = 2.3$), $U = 57.0$, $z = -2.3$, $P = .02$.

DISCUSSION

The study examined the developmental milestones, type and amount of swim related activities of the elite and sub-elite swimmers in order to identify the developmental pathways of the athletes. The hypothesis that elite swimmers commenced early in their swimming career was rejected as both elite and sub-elite swimmers started all swimming related activities about the same time. There were no significant differences for all swim related developmental milestones for both groups.

As predicted, the elite swimmers accumulated more swimming hours between 6-15 years of age. Although no significant difference was found between groups during the sampling years (i.e., 6-12 years of age), the elite swimmers engaged in significantly more hours compared to the sub-elite swimmers during the specializing years (13-15 years of age). The findings suggest that the increased hours in structured training activities during this age group contributed to the attainment of better performance in swimming. The results supported the findings of Ford et al.'s (2010) study on elite youth cricket batters.

The third hypothesis proposed that elite swimmers followed an early specialization pathway. Results partially supported the hypothesis. Elite swimmers seemed to follow an early specialization pathway. Although both elite and sub-elite swimmers started all swimming related activities at about the same age, the elite swimmers engaged more hours in structured practice. The DMSP pathway was not supported. For the elite swimmers, a big portion of swim activities was allotted on coach-led practice (averaging more than 5000 hours) compared to other activities (i.e., competition, individual practice and peer-led play) with each activity averaging less than 1000 hours. This finding suggests that the elite swimmers did not spend much time on swimming activities that were voluntary and intrinsically motivating. Hence, the elite youth swimmers did not fit into the deliberate play category (Côté et al., 2002; 2003). Instead, their practice activities conformed more to Ericsson et al.'s theory of deliberate practice. During both the sampling and specializing stage, the bulk of swimming activities by the elite swimmers was focused on coach-led practice. The principal goal for coach-led practice was to improve swimming skills, structured, not leisure by nature, and it may not provide immediate rewards or satisfaction, thus satisfying the criteria of deliberate practice (Ericsson et al., 1993). Concurrently, the elite swimmers participated in an average of 1.5 other sports, which indicated early specialization, as compared to the average of 6.5 other sports engaged by the sub-elite swimmers (Côté et al., 2002; 2003).

In summary, both elite and sub-elite swimmers have similar developmental pathways at the early stages of their career but differed significantly towards the adolescent years. The elite swimmers accumulated more swimming hours compared to the sub-elite swimmers. This increase in hours was suggested to have contributed to the performance of the elite swimmers. At the same time, the elite swimmers participated in fewer other sports than the sub-elite swimmers. The elite swimmers followed an early specialization pathway, albeit not in entirety. Further investigation into the details of specific practice activities that leads to expert performance in sports is merited for future studies. Performance measures of a specific event could be correlated with the amount of hours engaged in certain activities. Further examination into the microstructure of the swimmers' practice session could further validate the types of activities that contributed to the attainment of expert performance.

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