CHAPTER FIVE

DISCUSSION

In this chapter, the discussion of the key findings is structured by statements responding to the major research questions of the study. First, the changing contributions of AMC and PMC to physical activity will be discussed along with other possible influences on the development of young children's physical activity levels. Further examination of gender differences within the key variables, the relationship between AMC and PMC, and levels of AMC and PMC in relation to level of physical activity, will follow. The final section will present a revision of the conceptual framework based on the research findings.

Contributions of Perceived Motor Competence and Actual Motor Competence to Physical Activity.

The significance of the current study lies in the examination of both perceived and actual motor competence and their roles with respect to young children's physical activity levels. Previous researchers have studied the relationship between physical activity and AMC and PMC in children separately, but have not considered that the relationships might differ with age and between genders (Stodden et al., 2008).

It was initially hypothesised that AMC, PMC, age and gender would contribute to physical activity levels. The multiple regression models were conducted independently for boys and girls in each age group to investigate patterns in predictive strength of specific contribution of perceived and actual competence to physical activity. A linear mixed model then investigated covariates within the study design that influenced physical activity levels over time. From the regression models for boys and the oldest girls in the sample, results revealed that AMC, not PMC, is making a significant contribution to physical activity levels. The linear mixed model analysis revealed that Gender, AMC and School were significant predictors of physical activity over time and there were no significant Gender-Actual Motor Competence, Gender-School, School-Actual Motor Competence interactions (Refer to Table 9). The importance of gender and the significant contribution of AMC to physical activity will be firstly discussed.

The multiple regression results showed that in 6-, 7- and 8-year-old girls, neither AMC nor PMC made a significant contribution to physical activity levels (Refer Table 6). However in 9-year-old girls, AMC explained 9% of the variance in physical activity levels. In comparison, AMC made a statistically significant contribution to physical activity levels for boys from as young as 7 years to 9 years. Overall, the modest contribution of AMC to physical activity continued to increase with age.

Generally, results from previous cross sectional studies reported a significant relationship between motor competency and physical activity in children and adolescents (Saakslahati et al., 1999; Okely et al., 2001a; 2001b; McKenzie et al., 2002; Fisher et al., 2005). However, the strength of this relationship between movement skills and physical activity appears weaker in younger children, compared to older children. Saakslahati et al. (1999) reported that physical activity was significantly linked to fundamental motor skills in 3- to 4-year-old children, yet the correlation coefficients were low (r = .05 - .21). Similarly, in another group of preschool children, Fisher et al. (2005) found a significant but small relationship (r = .18) that revealed children who spent more time in moderate-vigorous physical activity had higher fundamental motor skills.

In older children, Raudsepp and Pall (2006) investigated the association between AMC development and various outside-school physical activities in 7-year-olds. Time spent in skill-specific physical activities accounted for 20% of the variance in overhand throwing and 17% of the variance in jumping performance. However, the overall physical activity of children, measured via accelerometers and direct observation during two school days, was not related to motor competence in the overhand throw or jumping proficiency. Castelli and Valley (2007) also explored the influence of physical fitness, AMC, gender, age and ethnicity on physical activity engagement and level in 7- to 12-year-olds. A two-step hierarchical regression revealed AMC influenced both the level of physical activity engagement (41% of the variance) and step counts (34%) during the children's participation in a summer program. Both Castelli and Valley (2007) and Raudsepp and Pall's (2006) findings lend support for the significant influence of AMC to physical activity from as young as 7 years old. Unfortunately neither study examined the influence of AMC on

physical activity for boys compared to girls, and whether the effect was evident earlier in boys than girls as the current study showed. As there is limited, previous research that considered determinants of physical activity for girls and boys separately, and neither AMC nor PMC influenced physical activity in 6- to 8-year-old girls in the current study, future research might examine what are some of the other influences that could be contributing to physical activity levels in young girls.

The multiple regression findings also revealed that in both boys and girls PMC does not make a significant contribution to physical activity at any age (Refer to Table 6 and 7). Although the current study found that PMC did not influence physical activity in young children, past cross sectional research has noted the contributions of particular physical self perceptions to physical activity in older children and adolescents 10 to 14 years old (Crocker et al., 2000; Raudsepp et al., 2002). Crocker et al. (2000) used structural equation modelling to test physical self perception models and they were able to predict 27% to 29% of the variance of the physical activity in both boys and girls. Raudsepp et al. (2002) found that perceived sport/athletic competence, physical self worth and perceived strength competence were the best predictors of moderate to vigorous physical activity and physical fitness (21% of the variance for boys physical activity, 14% of the variance for girls physical activity). In a longitudinal study, Davison, Symons-Downs and Birch (2006) used path analysis to determine that PMC explained 27% of the variance in physical activity among 9- and 11-year-old girls. From these findings, it appears that in older children perceived competence begins to play a more prominent and significant role. It is also important to note that in the regression models for the current study, AMC and PMC were placed in the models together, firstly to see if they were jointly contributing to physical activity levels and then to establish which variable was making a more significant independent contribution.

Wrotniak et al. (2006) has also examined the relationship between perceived motor competence, actual motor competence and physical activity in a cross sectional study. They used the Bruiniks-Oseretsky Test of Motor Proficiency (BOTMP) to assess AMC and its relationship to children's self-perceptions of adequacy and desire to participate in physical activity and actual physical activity level (using accelerometers) in 8-, 9- and 10-year-olds. Motor competence explained 8.7% of the

variance in physical activity while controlling for various variables, including perceived competence. However, there was no significant relationship present between physical activity and perceived competence.

The original conceptual framework for the study was proposed to determine the contribution of AMC and PMC to young children's physical activity levels, as informed by the models of Welk (1999) and Stodden et al. (2008). Welk (1999) proposed that the most common determinants of physical activity were self efficacy, perceived competence, enjoyment, parental influence and access to appropriate environment. Physical skills and fitness acted as 'enabling' factors that were promoted by physical activity, leading to increased persistence in physical activity and enhancement of perceived competence. He found that evidence from cross sectional studies indicated that children's PMC may be more important than AMC. On the other hand, Stodden et al. (2008) hypothesised that younger children would demonstrate variable levels of physical activity and motor skill competence that were weakly related. They proposed that as children transition into middle and late childhood, the relationship between physical activity and AMC would strengthen.

The results from this present study support some components of Stodden et al.'s (2008) developmental framework. AMC, not PMC, was shown to be a significant contributor to physical activity levels in young children. The strengthening relationship between AMC and physical activity with age, especially among boys, also supports their model. However, the significant contribution of AMC to physical activity is apparent much earlier for boys than for girls, an important gender difference that has yet to be accounted for in developmental literature and models involving motor competence and physical activity. These findings have resulted in a modification of the initial conceptual framework developed in this study which will be revisited at the end of this chapter.

The role of physical literacy

Although this research was not primarily involved with school physical education, concepts raised by Whitehead (2001) and Tinning (2007) on how young people learn about their bodies, health, physical activity and sport may assist in explaining why boys AMC impacts on physical activity two years earlier than girls. Whitehead's

(2001) notion of physical literacy includes dimensions of physical competence (to do certain movement tasks or skills), spatial awareness (reading our own physical space and/or in relation to others) and sport/movement literacy (enables a person to understand games and sports with regards to tactics, rules, values etc.). Expanding this view, Tinning (2007) argued that physical education provides an opportunity for young people to develop certain physical competencies that are valued by young people themselves, and the development of these physical competencies provides some understanding of what engages and sustains young people's participation in physical activity.

Tinning (2007) considered how physical literacies impact on young people and consequently influence physical activity behaviour. He suggested that some of the experiences developed through the world of computers, x-box and playstations, television and DVDs, might be useful in indirectly developing spatial awareness and sport/movement literacy that can then influence participation and competencies in certain forms of physical activity. With respect to this study, the development of such literacies may be associated with gender and the social and cultural contexts in which we learn them. The influence of AMC at an earlier age in boys than girls might be linked to not only the development of physical competence, but also the other dimensions of physical literacy that may well be developed differently across gender as a result of diverse experiences and even culturally biased expectancies.

However, specifying certain skills as important may also privilege one gender, particularly as most of these skills form the basis of male competitive sports (Wright, 1997). Yet some secondary physical education teachers express frustration that a number of students come from primary schools without having developed what they consider the necessary physical competencies (Tinning, 2007). Whilst the assessment of AMC in this study through fundamental movement skills performance could possibly be seen to advantage certain competencies, such as throwing, valued by boys rather than girls, further investigation into physical competencies valued by girls may assist in explaining the developmental differences in contributions to physical activity behaviour. In the perceived competence questionnaire, the open ended questions asked of the children about the type of play and activities they valued most, and revealed that a significant percentage of boys favoured

competitive/organised sports over informal play and sedentary activities. In comparison, a greater percentage of girls preferred informal play and sedentary activities (Refer to Table 2). These differences in percentage of boys and girls for type of play choices were significant in 6-, 7-, 8- and 9-year-olds. The activities boys and girls choose or value may not only develop physical literacy, but also influence self perceptions in terms of the social comparisons, and contexts in which they are learning. With more girls preferring informal play in the current study, there may be less chance for them to develop accurate self perceptions of their competence through peer comparisons compared to a more competitive context of organised sports which the boys seem to favour. The difference in the activities valued by boys and girls might explain the earlier development of the relationship between actual and perceived competence, and the contribution of AMC to physical activity. This is certainly a starting point for future research.

The role of perceived motor competence

Although PMC did not make a statistically significant contribution to physical activity in the young children in this study, Stodden et al. (2008) considered PMC played a critical role in the developing relationship between motor skill competence and physical activity. They suggested that PMC will not be strongly correlated with AMC or physical activity in early childhood as a result of high and inaccurate levels of self perceptions. The high self perception scores and insignificant contribution of PMC to physical activity reported in this study adds weight to this idea.

Barnett et al. (2008) used a longitudinal design to investigate whether sports competence acted as a mediator between childhood motor proficiency and adolescent physical activity and fitness. They found that adolescent perceived sports competence explained 18% of the variance of adolescent physical activity. Importantly, a relationship between childhood object control proficiency and adolescent perceived sports competence was found, suggesting that early competency in object control skills may be critical in building positive self perceptions in sports, and thereby increasing physical activity engagement in adolescence. Similarly, a significant relationship between PMC and AMC in the older age groups of the current study's sample, which will be discussed later in this chapter, may also point to the role perceived competence plays in the development of

physical activity levels in middle to late childhood. Stodden et al. (2008) also proposed that more highly skilled children will have higher perceived competence, and engage in more mastery attempts, thus a stronger relationship will emerge between PMC, AMC and physical activity. However, there is currently no evidence to suggest that these relationships will have an opportunity to grow merely from the development of motor competency. Now with a greater understanding of AMC's role in young children's development of physical activity, future research may explore if different pathways exist for highly skilled versus less skilled children.

The effect of school on physical activity.

The influences of gender and AMC, and the lack of involvement of PMC to physical activity, have been discussed previously. However, the results from the linear mixed model indicated that school was a key determinant to physical activity.

The impact of a child's school on the development of physical activity levels has been recognised as part of the environmental determinants in several conceptual models (Welk, 1999; Stodden et al., 2008). Ridgers, Stratton and Fairclough (2006) and Ferreira, van der Horst, Wendel-Vos, Kremers, van Lenthe, and Brug (2006) also noted the limited investigations into the relationship between specific features of school environments and physical activity. However of the studies undertaken in the last decade, Sallis and Owen (1999) and Sallis et al. (2000) have reported on the positive association between physical environment variables (access to facilities, programs, time, opportunities to exercise) and child and adolescent physical activity, with school identified as an important setting in which to promote physical activity (McKenzie, 1999). In addition, McKenzie (1999) acknowledged that schools were already established within the community, had trained staff, housed facilities and equipment for physical activity and required physical education classes for most children up to a certain grade.

In a study on Western Australian schools environments and physical activity, Martin, Bremner, Giles-Corti, Salmon and Rosenberg (2006) found that children attending schools that provided supportive environments, such as higher amounts of grassed area per child and apparatus to support sport, were more likely to participate in significantly increased MVPA during class time. Having an appointed Physical

Education coordinator within school was also significantly associated with children's MVPA during class time. In an American study, McKenzie et al. (1995) observed that classes of children taught by physical education specialists (compared to generalist teachers) received longer and more active lessons, leading to higher energy expenditure. In 24 Californian middle schools, Sallis et al. (2001) reported that environmental characteristics, such as area size, equipment, adult supervision, and organised activities, explained 42% of the variance in the proportion of girls, and 59% of boys who were physically active. Cohen, Scott, Zhen Wang, McKenzie and Porter (2008) also found small but significant associations between the number of active outdoor facilities and physical activity among sixth grade girls.

Other specific school factors have been reported as affecting children's activity behaviours. Zask, van Beurden, Barnett, Brooks and Dietrich (2001) identified school size, length of recess and the availability of balls in the playground in Australian primary schools as correlates of higher engagement in physical activity. In addition to this, playground markings have a positive effect on children's physical activity levels (Stratton, 2000; Stratton & Mullan, 2005). Stratton (2000) found that the introduction of playground markings increased MVPA in primary school children by 18 minutes per day. This was also observed among children in infant and junior schools (40% and 60% increase respectively) (Stratton & Mullan, 2005). Other factors such as the encouragement of physical activity by supervisors, management and organisation of the playground, and the individual school's playground regulations may also positively influence physical activity levels (Ridgers et al., 2006).

In exploring the extent to which children's intuitive interest in physical activity was predicted by personal, school and family/home factors, Chen and Zhu (2005) suggested that influences from school and family played a significantly more important role than a child's personal factors. Corbin (2002) also argued that schools may offer a more structured environment for learning physical skills through physical education lessons and instruction, which can be effective in stimulating children's interest in physical activity, and even their future participation in sport and games. Since the current study has identified the significant impact of school, yet limited research into school-based factors, it is suggested future studies should use

evidence based interventions to investigate which characteristics within school settings influence interest and physical activity behaviour. Ferreira et al. (2006) also suggested that there is a need for future studies with clear, possibly standardised, objective methods of environmental attributes and physical activity assessment. As school provides an important setting within which to develop physical competencies and influence behaviour, increasing teachers and physical educators' awareness of the relationship between AMC and physical activity may be valuable in supporting children to develop skills and become physically active. However, there also should be consideration of developmental gender differences and the impact such differences will have on performance outcomes when planning school based programs.

Age and Gender Differences for Physical Activity, Perceived Motor Competence and Actual Motor Competence.

Physical activity in children

Initial descriptive statistics examined age and gender differences among the key variables, physical activity, AMC and PMC. It was hypothesised that boys would have higher physical activity levels than girls across all ages. From the findings, boys did have significantly higher mean daily step counts than girls at every age from 6 to 9 years of age. The magnitude of these significant differences between boys and girls were moderate in the younger age groups (6- and 7-year-olds) and large in the older age groups (8- and 9-year-olds). The boys' mean daily step counts also increased with age, whilst girls' step counts remained relatively stable over the three year age span. The trends in physical activity levels will be firstly examined before discussing gender differences.

Previous research has reported that physical activity levels decrease with age in childhood, with the greatest decline being evident in the teenage years and the rate of decline being greater in females than males (Sallis, et al., 2000; Trost et al., 2000, Hands et al., 2004; Hands & Parker, 2008; Nader et al., 2008). However, most research examining age-related trends of physical activity has involved children older than 9 years old using subjective measures of physical activity. Thompson et al. (2003) administered a physical activity questionnaire biannually or triannually to Canadian children 9 to 18 years old in a longitudinal study. They reported that

physical activity levels were decreasing with increasing age in both boys and girls. Riddoch et al. (2004) also investigated physical activity with accelerometers in European children aged 9 and 15 years. The majority of boys (97.4%) and girls (97.6%) achieved the recommended guidelines of 60 minutes of daily moderate-intensity physical activity at age 9. By age 15, fewer children achieved these guidelines. One study involving young children also used accelerometers to record physical activity (Trost et al., 2002), and they reported a decline of physical activity in childhood and adolescence. Interestingly, they observed the greatest age-related decline occurred during primary school from grades 1 - 3 (6- to 9-year-olds) to grades 4 - 6 (10- to 12-year-olds).

The current study reported an increase in physical activity step counts with age (Refer to Figure 4), with the increase greater among the boys than the girls. These current data support other Western Australian studies also using pedometers that showed increasing activity levels from 7 years old which peaked at 14.3 years for males and 12.8 years for females before gradually declining (Hands et al., 2004). There was no decline in the current findings which suggests a reduction in physical activity is not currently a concern in this group of young children since they are sufficiently active. The average daily counts for 6-year-olds to 9-year-olds are all above the President Council on Fitness and Sport's (2002) recommended daily step counts of 11,000 for girls and 13,000 for boys.

Gender differences in physical activity have been a focal point of previous research for years. Many studies have shown that boys are more physically active than girls from an early age (Garcia, et al. 1995; Sarkin, MacKenzie & Sallis, 1997). The current findings support these previous results with boys having significantly higher physical activity levels than girls at every age. Hands and Parker (2008) also used pedometers to assess physical activity and reported boys took significantly more steps per day than girls from 7 years to 16 years. Telford et al. (2005) also observed gender differences in physical activity levels in Australian children as young as 5 and 6 years old, particularly for vigorous-intensity activity. Even though the physical activity measurement tools differed between studies, both highlight the activity differences in boys and girls even from a young age.

Boys have not only been reported as being physically active for longer and more often but also at a higher intensity. Several studies have found that girls participate in significantly less MVPA in comparison to boys (Trost et al., 1996; Trost et al., 2002; Sherar et al., 2007; Commonwealth Department of Health and Ageing, 2007). Trost et al. (2002) proposed that gender differences are perhaps evident because boys participate in greater intensity activity, therefore their overall activity levels are higher than girls.

Although significant differences between male and female step counts is a key finding, and gender differences have certainly been a focus for earlier research, it is important to note that that these young boys and girls both exceed physical activity benchmarks (President Council on Fitness & Sport, 2002). However, the current study has emphasised that boys and girls are developmentally different, therefore perhaps for a change in future research and direction, there is a need to cease comparisons of girls to boys and produce outcomes and pathways for girls that are distinctive, rather than discussing them as inferior based on their level and intensity of activity when evaluated against boys. On the other hand, it may also be important to focus on AMC and PMC's changing contribution to physical activity and in determining gender differences in later childhood and adolescence where declines in physical activity below sufficient levels evidently becomes a more serious problem.

Actual motor competence in children

For AMC, the key finding was boys had significantly higher AMC than girls at every age (Refer to Figure 7). This confirmed the initial hypothesis proposing that boys would record higher AMC scores in comparison to girls. The magnitude of these differences between boys and girls were large in the youngest (6 years) and oldest ages (8 and 9 years), and moderate in 7-year-olds. In previous cross sectional and meta-analysis research, boys were found to be more skilful than girls in childhood. This difference increased into the adolescent years (Branta, Haubenstricker & Seefeldt, 1984; Thomas & French, 1985; Ulrich, 1987; Eaton, 1989; Raudsepp & Pasuuke, 1995; Hands & Larkin, 1997). However, whilst previous research support the current findings in that gender differences were apparent, most previous research has focused on gender differences within different fundamental motor skills, rather than differences between boys and girls in overall motor competence. It is also

difficult to compare due to researchers using a variety of measures to assess skill competence. Although developmental change in individual skills was not a focus of this study, the following section provides a brief overview of previously reported gender differences in specific skills.

Reported gender differences in performance of locomotor tasks, such as running and jumping, favouring either boys or girls are not consistent. For example, some studies reported boys out performing girls on most locomotor tasks (Morris et al., 1982; Thomas & French, 1985; Keogh & Sugden, 1985), with exception of the hop and skip. However, Branta et al. (1984) found no gender differences for the run and standing broad jump. These studies were all based on quantitative results, generally emphasising speed or strength. Cratty (1986) and Roberton (1984) suggested that boys were better on quantitative, force production tasks like the jump, but girls were better performers on qualitative testing of balance and the hop and the skip. Using qualitative assessment in 1- to 8-year-old children to score patterns of motor skills from stages 1 (immature form) to 5 (mature form), Haubenstricker, Branta and Seefeldt (1999) found that girls mastered each stage of hopping and skipping earlier than boys. Dynamic balance is most commonly tested by a line or beam walking task, as used in the current study. However, few studies have investigated gender differences for these tasks with Plimpton and Regimbal (1992) reporting no significant gender differences for walking forward on a balance beam.

For object control tasks, such as throwing and catching, researchers have consistently reported results favouring boys. From Haubenstricker, Branta and Seefeldt's (1999) qualitative assessment, boys attained each stage of the overhand throw and kicking at an earlier age than girls. In other qualitative studies, boys were also reported as more proficient in their throwing action than girls (Raudsepp & Paasuke, 1995; Raudsepp & Pall, 2006; Wrotniak et al., 2006). Using throwing distance as a quantitative measure, boys outperformed girls in the overarm throw (Halverson, Roberton & Langendorfer, 1982; Morris et al., 1982; Thomas & French, 1985; Nelson, Thomas, Nelson & Abraham, 1986; Goodway & Rudisill, 1996). McKenzie et al. (2002) also used quantitative assessment to measure catching skills in children 4 to 6 years old, and found that boys scored significantly higher than girls on the number of successful catches from six attempts. Other previous research on catching skills has

also reported results favouring boys using both quantitative (Thomas & French, 1985) and qualitative (Kelly, Reuschlein & Haubenstricker, 1990) assessments. Measures of overall actual motor competence vary in the literature. In the current study AMC was measured by deriving a composite score from a criterion-based assessment of the run, throw, jump and line walk using a methodology adapted from previous assessments of movement skills in Australian adolescents (Okely et al., 2001a; 2001b). Raudsepp and Liblik (2002) and Rudisill, Mahar and Meaney (1993) both investigated age and gender differences of AMC in cross sectional studies. Rudsill et al. (1993) measured AMC on a series of gross motor tests including 50 metre run, shuttle run, standing broad jump, and over arm throw. Raudsepp and Liblik (2002) assessed AMC through fitness measures including shuttle run, sit-ups and the sum of five skinfolds. Both reported boys having significantly higher motor competence than girls between the ages of 9 to 13 years old. Actual motor competence scores within the current sample suggest gender differences are apparent from an early age.

It is most likely that both biological and environmental factors ultimately contribute to gender differences (Nelson et al., 1986). Yet, not all studies reported skill performances favouring boys, and this could be partly attributed to differences in measurement protocol (quantitative measures or qualitative observations), or age-related biological differences. Sarkin et al. (1997) proposed that gender differences in motor performance were related to higher levels of physical activity among boys in free time. This concept is based on an understanding that they develop greater skill levels from being more physically active. However, this assumption was based on correlation data, and the question still remains whether motor skill enhances activity level, or whether the time spent in activity enhances motor competence (Butcher & Eaton, 1989). Consideration must also be given to the variation in measures of both motor competency and physical activity. Differences in research design, the operational definition of motor competence and the method of assessing and reporting physical activity and actual motor competence have contributed to the equivocal findings in this research area (Okely et al., 2001a). However despite variations in measures of physical activity and AMC, the common findings to emerge are that boys are, in general, more active and have higher proficiency in the early years.

Perceived motor competence in children

Overall, the PMC scores in the current sample were shown to be high. Across the three year age span, the boys' scores remained consistently high, although the girls' scores decreased slightly from 6 to 9 years old.

Harter and Pike (1984) suggested children's perceptions of competence in various domains (academic, physical ability, appearance) are clearly differentiated by around 5 years of age. Though children can distinguish between particular domains, on entry into school most children's self perceptions are very positive but potentially unrealistic as they often do not match their actual competence (Wigfield, 1994). In middle childhood, previous results are inconsistent regarding age-related trends in self perceptions for the physical /sport domain. In their longitudinal study, Wigfield et al. (1997) reported no age differences in competence perceptions across middle childhood, whereas Marsh et al.'s (1984) cross sectional research reported age related declines in children from 7 to 10 years old. More recently, Jacobs et al. (2002) investigated self perceptions of children across grades 1 to 12 in the sports domain as part of a longitudinal study. They found minimal changes in perceived competence in the first years of school and then a steep decline through the primary and high school years, with the competency measures of both boys and girls declining at the same rate.

Harter (1982), Nicholls (1984) and Rudisill et al. (1993) all found no differences in PMC scores for 9- to 11-year-old children. These investigators argued that age differences do not exist at these ages because of similarities in cognitive functioning. According to Piaget (1955), it is not until ages 11 or 12 years that children advance into the formal operational intelligence stage in which children are capable of problem solving and performing logical and abstract thinking. With the advancement of cognitive processing abilities, a child is more critical in their self-evaluation and begins to develop the ability to differentiate the "real" self from the "ideal" self (Horn, 2004). Despite the inconsistency of previous findings about when self perceptions become more accurate, developmental trends are still evident. For early childhood, the current study supports some of the previous findings of Eccles and Harold (1991) and Wigfield (1994) that self perceptions are unrealistically high in

the early primary years and the scores remain relatively consistent up to 9 years of age, especially for boys.

There were also no significant gender differences at any age in this study, therefore, the null hypothesis is accepted. Girls' recorded higher perception scores at 6 and 7 years old compared to the boys who recorded higher scores at 8 and 9 years old. However, previous cross sectional Australian research by Marsh et al. (1983; 1984; 1991) with the Self Description Questionnaire, which reported large sex differences in self concept for physical ability with boys having significantly higher perceptions than girls in 5- to 10-year-old children. Significant gender differences have also been reported in 8- to 13-year-olds, boys had higher levels of perceived competence than girls (Harter, 1982; Harter & Connell, 1984; Harter & Pike, 1984; Ulrich, 1987; Raudsepp et al., 2002). Rudisill et al. (1993) suggested that the higher PMC in boys may be related to the fact that boys' AMC is higher than girls, although it appeared the significant differences in actual competence for boys and girls in the current study did not reflect significant differences in self perceptions.

Other studies have also indicated that boys are more accurate than girls in assessing their own physical competence (Horn & Hasbrook, 1987; McKiddie & Maynard, 1997). This question of gender and congruency is addressed further in the next section on the development of the relationship between perceived and actual motor competence in young boys and girls.

Relationship between Actual Motor Competence and Perceived Motor Competence

One of the key research questions in the current study addressed the nature of the relationship between actual and perceived motor competence in young children. A direct relationship was proposed between AMC and PMC in boys and girls. Although no significant relationship was evident in the 6-year-olds for either boys or girls, a moderately positive and significant relationship became apparent in the older age groups. For boys, this significant relationship was evident at an earlier age (7-year-olds) than girls (8-year-olds). Interestingly, 9-year-old girls showed a stronger positive relationship whilst for boys the relationship remained constant with a moderate significant relationship (Refer to Table 3).

The current study is one of the few that has looked at developmental changes in this relationship in children younger than 9 years. Although earlier research has investigated determinants of physical activity, previous studies into the relationship between perceived and actual motor competence have focused on children 9 to 13 years old. Of interest, findings from the present sample of young children are similar to those with slightly older children.

According to Roberts (1984), the correlation between children's PMC and AMC increases with age. This is comparable to the significant relationship that emerged with age in the current study, particularly with girls from 8 to 9 years of age. Harter (1982), when developing her scale for measuring children's perceived competence, also noted that accuracy of children's perceptions improved until about 8 years, and then showed no further improvement in accuracy until 12 years. Both Rudisill et al. (1993) and Raudsepp and Liblik (2002) examined the cross-sectional relationship between perceived and actual motor competence in 9- to 13-year-old children, however they used different measures than the current study to examine perceived and actual motor competence. Raudsepp and Liblik (2002) used fitness measures only as an assessment of AMC (shuttle run, 30 seconds sit-up test, sum of five skinfolds) and measured PMC with Motor Skill Perceived Competence Scale. Rudisill et al. (1993) derived an upper and lower body factor for AMC from a motor test battery including shuttle run and 50 yard dash, standing long jump and two ball throws. They assessed PMC through the Children's Physical Self Perception Profile (CPSPP). Both studies found that these 9- to 13-year-old children were only moderately accurate at perceiving their AMC. This moderate correlation was also evident in the current sample for children younger than 9 years old, though the correlation is increasing particularly in girls, whilst boys tended to level off at 9 years.

Overall, Rudisill et al. (1993) found that the correlation between perceived and actual motor competence increased significantly when age was added to the regression model ($r = .48$ increased to $r = .51$, $p < .03$). They also found that older children had significantly higher actual motor competence scores than younger children, yet there were no significant differences between the two age groups perceptions of motor competence. Therefore, as the ages of the children increased, AMC increased but

PMC remained the same. However, Harter (1982) and Rudisill et al. (1993) reported that despite these changes, the AMC and PMC of 9- to 11-year-olds' did not become more congruent, as there were no significant changes in correlations with age.

In comparison, in the current sample, whilst significant differences between correlations in each age group were not found, a stronger relationship emerged with age, particularly for the girls. Both boys and girls had high PMC scores across all ages but whilst boys' PMC scores remained relatively stable, the girls' self perceptions decreased at 8- and 9-year-olds whilst AMC increased. The fact that boys had significantly higher AMC scores than girls at an earlier age, may also explain why a significant correlation between perceived and actual competence was clear earlier in boys than girls. Therefore, it might not be a case of young children becoming more accurate, instead AMC just increases so a greater association between perceptions and actual skill is evident.

Sources of information that can influence perceived competence change as children age. Previous explanations by Rudisill et al. (1993) and Raudsepp and Liblik, (2002) as to why 9- to 13-year-olds are only moderate assessors of their actual motor competence have proposed four psychological constructs which contribute to the development of accurate perceived motor competence proposed by Harter (1978). The four constructs, (1) past experience, (2) difficulty or challenge associated with outcome, (3) reinforcement and personal interactions with significant others, and (4) intrinsic motivation, are all evaluated by the individual in forming self perceptions of competence. Piaget (1955) found that by approximately 12 years of age, children reach the operational stage of cognitive development and become more competent at combining all the information (the four psychological constructs) into an accurate assessment of their own competence. At younger ages, children do not have the cognitive capacity to differentiate between the four constructs and develop accurate perceptions about their performance. However, Raudsepp and Liblik (2002) found that 12 and 13-year-old boys and girls were still not highly accurate in their perceptions of competence, leading them to speculate that perhaps the development of accurate self-perceptions continues through adolescence. McKiddie and Maynard (1997) also reported a relatively weak association between perceptions and actual

competence in 11- and 12-year-olds but a stronger association for 14- and 15-year-olds.

Previous authors investigating congruency between competencies have also focused on the sources of information chosen by children for judging their competence. Potential sources available to children include game outcome, parent's evaluation, coaches' evaluation, internal criteria (improvement, ease of skill learning), affect, and peer comparison (Horn & Hasbrook, 1986; Horn & Weiss, 1991; Weiss, Ebbeck & Horn, 1997; Horn & Amorose, 1998, Weiss & Amorose, 2005). According to Horn (2004) younger children rely more on parental feedback, simple task mastery, and effort, whilst older children and early adolescents rely on peer comparison, and evaluation and teacher/coach feedback.

More recently, Weiss and Amorose (2005) measured both level and accuracy of perceived competence in 8- to 14-year-old children. Cluster analysis revealed five profiles of children who varied in age, actual and perceived competence and accuracy, and by the importance they placed on information sources. However, profiles were not separated according to gender. Two of the profiles, Pretenders (high in self perceptions) and Optimists (lower in self perceptions), were both inaccurate in their perceptions of sport ability and in rating below average importance the subjective performance/improvement or feedback by coaches and parents for judging their sport ability. This finding supports Harter's (1978) contentions that children with varying profiles of level, accuracy and sources of perceived competence will differ in related behaviours such as anxiety, motivational orientation and effort. The greater percentage of girls in the present study who preferred informal games and sport, compared to boys who preferred organised and competitive sport may relate to the different sources of information that boys and girls use to form their self perceptions. Boys prefer sports within a more competitive context, which may contribute to them forming perceptions based on peer comparisons and may explain the significant relationship between AMC and PMC developing earlier in boys than girls.

Future research should examine these sources of information with regards to the relationship between perceived and actual motor competence, not only with level,

age and accuracy, but also with gender. The current findings suggest that boys and girls may use different sources of information that could be contributing to accuracy of self perceptions across the primary years.

Levels of Actual Motor Competence and Perceived Motor Competence and Level of Physical Activity.

The children's continuous scores for physical activity, PMC, and AMC were grouped into low, middle and high categories based on tertiles. These data were analysed for matching groupings of males and females within low and high tertiles of physical activity corresponding with low and high tertiles of perceived and actual motor competence. Overall, more boys than girls were in the high physical activity and high AMC tertiles and also high PMC and physical activity tertiles. More girls than boys were in the low physical activity and AMC groups, and low physical activity and PMC groups (Refer to Table 4 and 5).

Few studies have compared the congruency between males and females who are high or low active, and their levels of PMC and AMC. However, Hands et al. (2004) classified Western Australian children and adolescents into high, medium, low activity groups based on mean daily step counts. They found that twice as many females as males were represented in the lowest active group, while the reverse was apparent in the high active group. Also, the high active, primary-aged group participated in slightly more vigorous sports activities and active transport bouts that the low active groups. For younger children, Butcher and Eaton (1989) investigated levels of gross and fine motor proficiency in association with free play behaviour and activity level in 5-year-old preschoolers. They reported that whilst girls had better visual motor control, they spent significantly more time in low active play, whereas boys had better running scores and spent more time in high active play. Children who participated in high active, gross motor play were more likely to have good running skills, while children who participated in low active, fine motor play were more likely to have good visual motor control and balance. However, Butcher and Eaton (1989) caution that causal direction is not determinable from correlational data, and whether proficiency in gross motor tasks helps activity level and tasks, or whether time spent in practice and activity produces proficiency remains an open question.

More recently, Fisher et al. (2005) examined the relationship between movement skills scores and habitual physical activity levels in young children 4 years old. Physical activity was measured over 6 days via accelerometers and 15 movement skills were assessed using the Movement Assessment Battery (Smits-Engelmen, Henderson & Michels, 1998). Movement skill level was classified by quartiles and compared with total physical activity and intensity levels of physical activity. The levels of physical activity intensity were classified as sedentary, light-intensity, and moderate-vigorous (MVPA) intensity physical activity based on cut off points for accelerometer counts per minute. Whilst there was no significant association between movement skills level and total physical activity for the children, there was a significant association between quartiles of movement scores and the percentage of time spent in moderate-vigorous physical activity. In both boys and girls, those in the upper quartile of movement skills spent significantly more time in MVPA compared to those children in the lower quartile of movement skills. Children with the most limited engagement in MVPA also had the poorest performance in the motor skills assessment. Fisher et al (2005) suggested a two-way interaction is possible, that limited performance in MVPA might hinder the opportunity for motor skill development or that limited motor skill development might restrict participation in MVPA.

As previously mentioned in this chapter, Wrotniak et al. (2006) also found that in 8- to 10-year-old children, motor proficiency was positively associated with physical activity and negatively related to percentage of time in sedentary activity. Motor proficiency was measured by BOTMP and when separated into quartiles of motor proficiency, children in the highest quartile were the most physically active compared with children in the lower quartiles who had lower levels of physical activity. However, they found that there was no association between level of self perceptions and level of physical activity. Li and Dunham (1993) also reported in physical education classes, children with movement difficulties were engaged in MVPA for less time compared with children with moderate or high competence levels.

Children with motor coordination difficulties engaged in significantly less time in vigorous activities than well-coordinated children (Bouffard et al., 1996). Despite the

lack of gender comparisons in previous work, evidence suggests that overall the level of AMC is linked to both level and intensity of physical activity in children. However, there are no clear findings that the level of perceived competence is related to level of physical activity.

It was originally hypothesised that girls and boys with higher levels of both AMC and PMC would have higher levels of physical activity. However, even though there was a greater percentage of boys than girls with both high AMC and physical activity levels, and also high PMC and physical activity levels, the percentage of boys within these high tertile groups were still only moderate, suggesting that there is still a lack of congruency between actual and perceived competence levels in these young children and the direct link to physical activity levels is still not clear.

Revised Conceptual Framework

Initially, the conceptual framework for this mixed-longitudinal study was based on the Welk (1999) and Stodden et al.'s (2008) models of the relationship of AMC and PMC to physical activity across age and gender. The results of the study have clarified some of the developmental differences between boys and girls and the conceptual framework can now be re-evaluated. The revised model is more specific for boys and girls in the early primary years and takes account of the significant contribution of AMC at any earlier age in boys than girls, the significant relationship between AMC and PMC earlier in boys than girls, the lack of input from PMC, the influence of contextual factors such as type of play choices at different ages, and the significant contribution of school to physical activity levels. Boys' and girls' preferences for competitive sport or informal play have been included given their links to the development of PMC and AMC.

The conceptual model has now been changed to distinguish between boys and girls at each age and specify emerging relationships based on the empirical evidence. Figures 9 to 12 represent the building relationships between AMC, PMC and physical activity. The significant contribution of AMC from 7 years of age in boys (Figure 10) and 9 years of age in girls (Figure 12) is represented, as is the significant relationship between AMC and PMC evident firstly in 7-year-old boys (Figure 10) and then in 8-year-old girls (Figure 11). Preferred types of play choices and the

influence of school are also displayed. For boys and girls at different ages, the distinct lines within the Figures represent the strength of the relationships between AMC, PMC and contributions to physical activity. The weak relationship line in the legend represents AMC and PMC correlation values ≤ .2 and within the regression models ≤ 5% physical activity variance explained. The moderate relationship line represents correlation values between .2 - .5 and between 5 - 30% variance explained. The strong relationship line represents correlation values ≥ .5 and ≥ 30% variance explained.

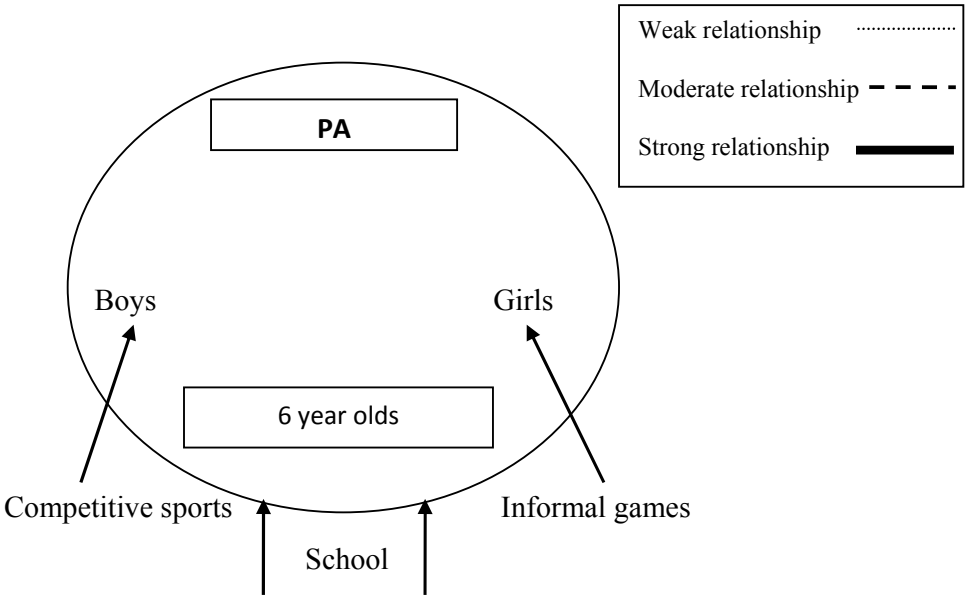

Figure 9. Conceptual model for 6-year-old boys and girls. There were no significant contributions from AMC or PMC to physical activity in either boys or girls. The influence of different play choices for boys and girls and school is displayed in all Figures

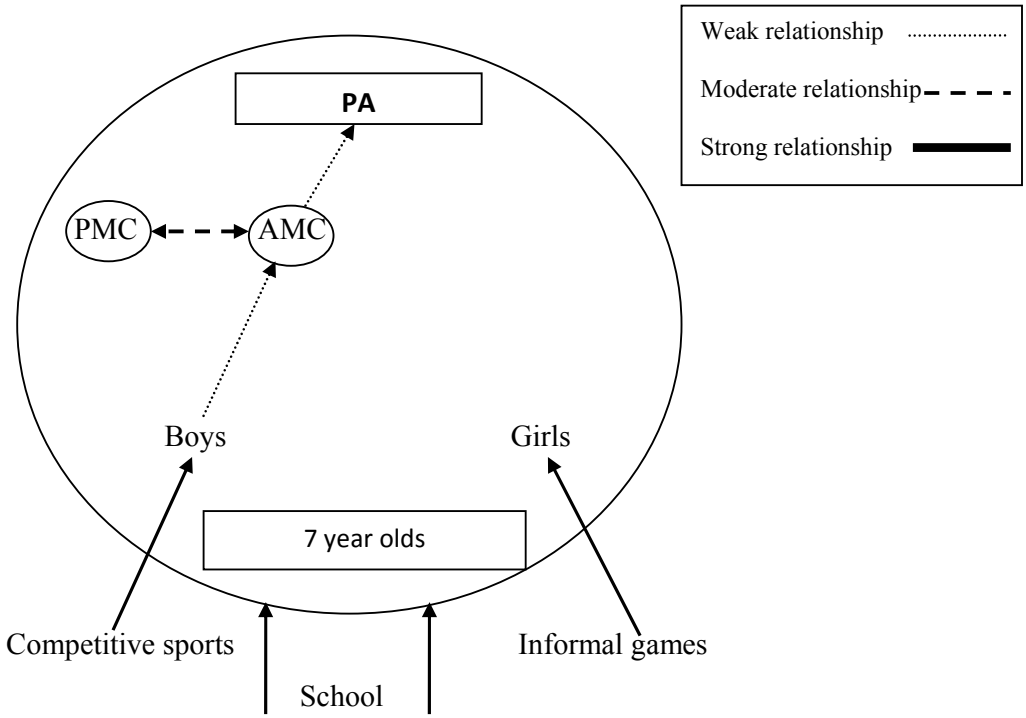

Figure 10. Conceptual model for 7-year-old boys and girls. The significant contribution of AMC to physical activity and relationship between AMC and PMC is evident in boys only.

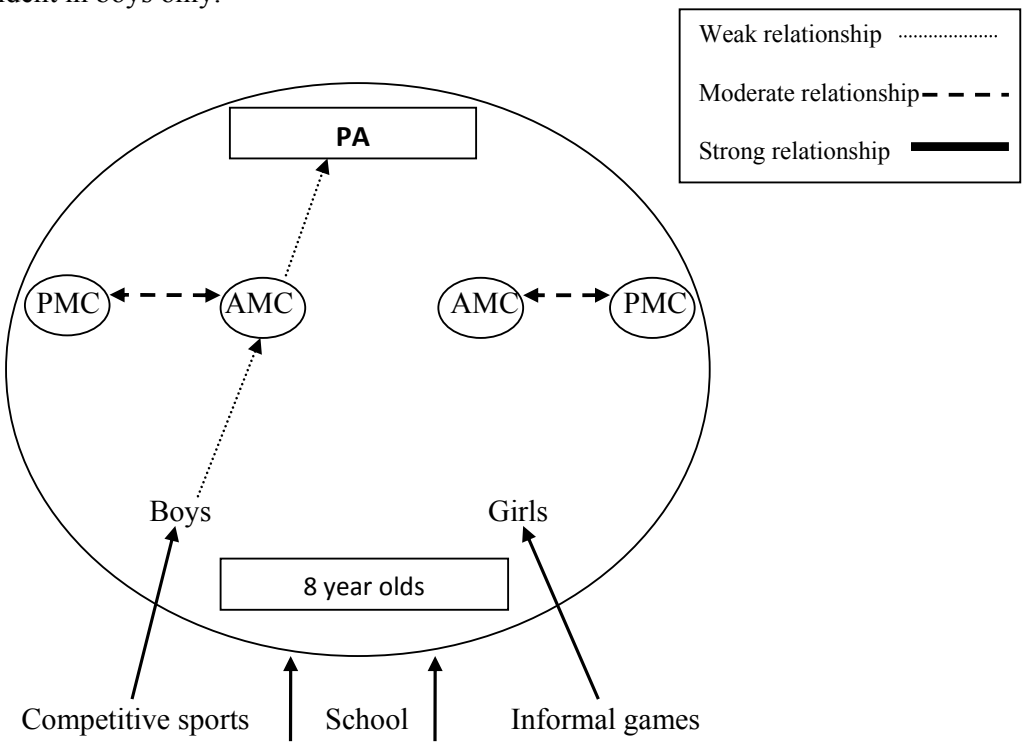

Figure 11. Conceptual model for 8-year-old boys and girls. The continuing significant contribution of AMC to physical activity in boys is represented. A significant relationship between AMC and PMC is evident in both boys and girls.

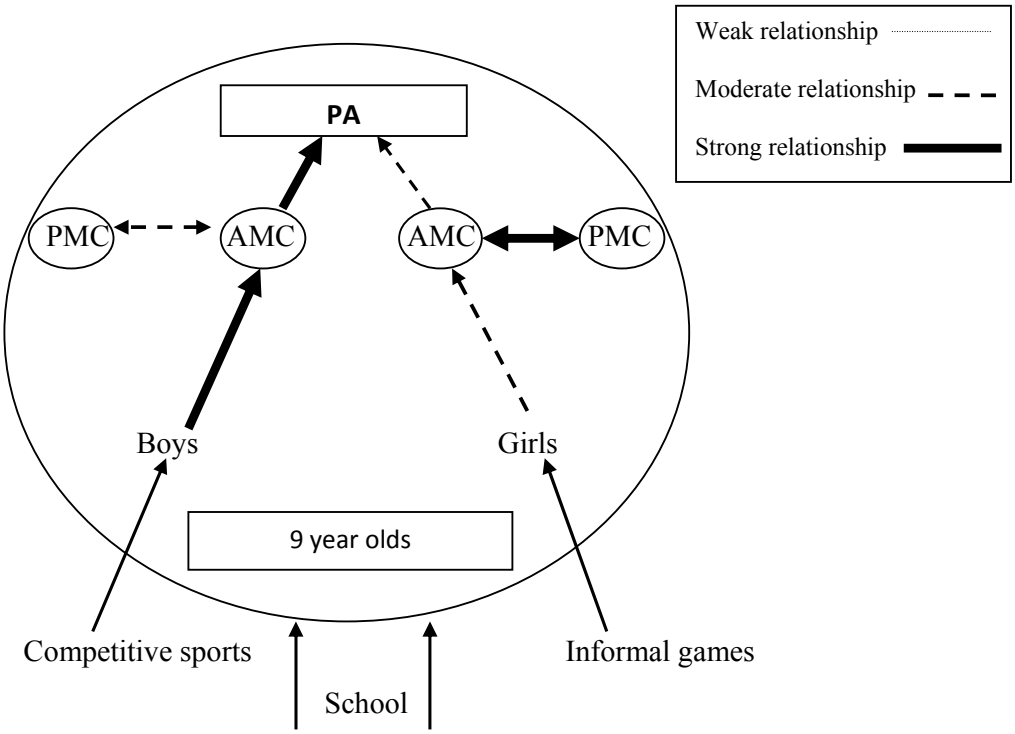

Figure 12. Conceptual model for 9-year-old boys and girls. The significant contribution of AMC to physical activity in both 9-year-old girls and boys is evident. A significant relationship between AMC and PMC was found for boys and girls.

Conclusion

Given the value of physical activity to a developing child's health, the current study has provided insight into the contribution of perceived and actual competence to physical activity behaviour. For the young children in this study, actual motor competence is important in influencing physical activity level, particularly with age. Additionally, school was revealed as having an important effect on physical activity in young children. This poses questions for future research into what specific characteristics within schools may positively influence physical activity. The diversity between boys and girls that emerged also demonstrates the need for a greater understanding of the influences and activities in young children that may explain the different developmental pathways of physical activity behaviour. Ultimately, these relationships are influenced by contextual factors , such as play choices, environment, peers, family and culture, that impact on an individual's opportunity to be active (Stodden, et al., 2008). Our knowledge of these influences in young children will enable us to provide better direction and greater opportunities for physical activity at an early age.