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Students' proficiency in three object control and three locomotor skills were assessed in 2000 (M age = 10.06 years, SD = 0.63) in New South Wales, Australia and in 2006–07 (M age = 16.44 years, SD = 0.64). In 2006–07, 266 students, 138 girls (51.9%) and 128 boys (48.1%), had at least one skill reassessed. Boys were more object control proficient than girls. Childhood object control proficiency significantly predicted (p = .001) adolescent object control proficiency (r^2 = .39), and, while gender was significant (p = .001), it did not affect the relationship between these variables (p = .53). Because childhood object control proficiency is predictive of subsequent object control proficiency, developing skills in childhood is important.

Key words: gross motor skills, locomotor, object control

Fundamental motor skill mastery is considered a prerequisite to the development of more specific sports and physical activity-related skills (Thomas, 1997; Wickstrom, 1983). The cumulative and sequential pattern of developing motor skills has been described as the mountain of motor development (Clark & Metcalfe, 2002). The fundamental period is when children achieve basic motor patterns, ideally then progressing "up the mountain" to obtain more specific skills (Clark & Metcalfe, 2002). Thus, motor skill proficiency is considered important to physical activity participation (Corbin, 1980; DeOreo & Keogh, 1980; Haubenstricker & Seefeldt, 1986) and has been linked to both sport participation (Ulrich, 1987) and physical activity behavior (Okely, Booth, & Patterson, 2001; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006) in youth. It has also been suggested that motor skill proficiency early in the lifespan may contribute to subsequent physical activity and fitness (Stodden et al., 2008). Recent evidence from the Physical Activity and Skills Study (PASS), a longitudinal cohort study, demonstrated that early motor skill proficiency predicted physical activity (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009) and fitness in adolescence (Barnett, van Beurden, Morgan, Brooks, & Beard, 2008).

In childhood and adolescence, boys are generally more proficient than girls in object control skill performance (i.e., object manipulation, such as in throwing, catching or kicking; Booth et al., 2006; Ehl, Roberton, & Langendorfer, 2005; Raudsepp & Paasuke, 1995; Runion, Roberton, & Langendorfer, 2003; van Beurden, Zask, Barnett, & Dietrich, 2002). Some studies reported no gender differences in locomotor skill (Goodway, Crowe, & Ward, 2003; Hume et al., 2008; Raudsepp & Paasuke, 1995; van Beurden et al., 2002), while others reported boys (Cratty, 1986; Haubenstricker, Wisner, Seefeldt, & Branta, 1997; Keogh & Sugden, 1985) or girls (van Beurden et al., 2002) as more proficient.

Product or process-oriented assessments can evaluate motor skills (Gabbard, 2008). Product (quantitative) motor skill assessments involve skill outcomes, such as time, distance, or number of successful attempts (Burton & Miller, 1998), whereas process (qualitative) assessments focus on how the skill is performed (Burton & Miller,

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1998). If size and strength are important in motor skill tasks, adolescent boys may have an advantage over girls due to their larger and more muscular physiques (Thomas & French, 1985). Thus, it may be assumed, then, that adolescent boys could have an advantage if an outcomes-based or product-oriented assessment is used. Thus, while both assessment modes are informative, process assessments may not favor the biological strength and size advantage of boys as much in adolescence.

Using product-oriented assessments, there is some evidence that motor skills track through childhood (Branta, Haubenstricker, & Seefeldt, 1984; Burton & Miller, 1998; Malina, 1990). Tracking has been defined as maintaining relative rank within a defined group over a period of time so that measurements tend to follow a pattern in which initial measurements predict later levels (Malina, 1996). Studies have also shown gender differences tracking to different degrees (Branta et al., 1984; Thomas & French, 1985), with the disparity between boys' and girls' performance in some skills widening over time (Burton & Rogerson, 2003; Cratty, 1986; Keogh & Sugden, 1985; Thomas & French, 1985). Understanding consistency or stability of motor skill performance across developmental time for boys and girls is important, as it can help determine how to intervene to improve motor skill proficiency. Despite this, there are few such longitudinal studies and even fewer that use process-oriented motor skill assessments. The purpose of this study was to: (a) examine whether gender differences exist in the mastery and near-mastery performance (MNM) of three object control and three locomotor skills at two time points, childhood and adolescence, (b) report the percentage of improvement from childhood to adolescence in children demonstrating MNM performance of these skills, (c) investigate the influence of gender on the relationship between childhood and adolescent object control proficiency, and (d) investigate the influence of gender on the relationship between childhood and adolescent locomotor proficiency. This study was part of a larger study known as the PASS, set in New South Wales (NSW), Australia.

Method

Participants

In 2000, the motor skill proficiency of 1,045 children from 18 randomly selected and stratified primary (elementary) schools in an area comprising 24,555 km^2 in NSW was assessed for the posttest of the Move It Groove It (MIGI) school-based physical activity intervention (van Beurden et al., 2003). Of these students, 1,021 had first and last initials noted on their motor skill assessments, and 929 records (91.0%) were matched by full name and gender to the class roll.

In 2006–07, the list of 929 original study participants was sent to 41 consenting high schools from the original study to identify adolescent students for follow-up as part of the PASS. One school did not consent to participate. Slightly more than half the original 928 (one student passed away prior to consent) participants (52%, n = 481/928) were located in 28 schools. Once identified, each student received a written invitation to participate, an information sheet, and a consent form. Students who returned a consent form (57%; n = 276/481) signed by themselves and their parents/guardian were included in the PASS sample. The overall follow-up rate then was 30% of the original participant sample. The University of Sydney, the NSW Department of Education, and the local Catholic Diocese provided ethic approval for this study.

Of the 276 students, 272 had a childhood composite object control score, and 266 had a composite locomotor score. In adolescence, 266 were assessed for at least one motor skill (10 were not assessed due to illness or injury), with 255 students having composite object control scores and 250 having composite locomotor scores. Of the 266 with at least one skill tested, 128 were boys (48.1%) and 138 (51.9%) were girls; 157 (59.0%) were in grade 10 and 109 (41.0%) were in grade 11. The mean age of the sample was 10.06 years (range: 7.92–11.92, SD = 0.63) in childhood (2000) and 16.44 years (range: 14.17–18.25 years, SD = 0.64) in adolescence (2006–07). All but one spoke English at home.

A number of statistical tests were conducted to determine how representative the follow-up sample was of the original sample; alpha = .05 was used to determine significance. The follow-up sample had a similar numbers of boys and girls, $\chi^2(4) = 2.40$, $p = .121$, but were significantly more likely to have been originally tested in grade 4 (61.5%) than grade 5 (38.5%), $\chi^2(4) = 22.67$, $p < .0001$, and had a significantly higher (17.5 compared to 16.5) mean composite childhood fundamental motor skill score, $t(1) = -2.60$, $p = .009$.

The motor skills of the 276 students recruited for the PASS study had been assessed in 2000 at MIGI posttest (van Beurden et al., 2003). These data were reanalyzed, and reported as baseline scores in the current study. Thus, the current study reports and refers to two time points: childhood (M age = 10 years in 2000) and adolescence (M age = 16 years in 2006–07).

Measurement

The Australian resource, Get Skilled Get Active (NSW Department of Education and Training, 2000) was used to assess students' motor skills. This process-oriented instrument has been used in population motor skill studies (Booth et al., 1997; Booth et al., 2006; Okely et al., 2001) and was developed through literature reviews, consultancy, and testing as a teaching resource and assessment tool for teachers. A team of 52 consultants reviewed each potential motor skill in terms of its importance in the overall motor skill development of elementary school-aged children and selected 11 skills (catch, overhand throw, kick, forehand strike, two-handed sidearm strike, ball bounce, punt, sprint run, leap, dodge, vertical jump); Department of Education Victoria, 1996). Test–retest reliability of these skills was reported for 42 primary school children over a 7-day cycle. Reliability estimates (alpha coefficient) for skills relevant to this paper were $\alpha = .92$ for the catch and overhand throw, $\alpha = .78$ for the kick, and $\alpha = .74$ for the vertical jump (Department of Education Victoria).

An updated resource (NSW Department of Education and Training, 2000) included 8 of the 11 skills (catch, overhand throw, kick, forehand strike, sprint run, leap, dodge, vertical jump) from the original resource (Department of Education Victoria, 1996) and four additions (hop, side gallop, skip and static balance). Test-retest reliability was assessed for students in grades 1–3 (equivalent to ages 6–9 years) for different combinations of six skills. Mean agreement percentage scores for skills relevant to this paper were reported as good (Okely & Booth, 2000) and ranged from 69% (range: 60–87%) for the hop (grade 1), to 84% (range: 70–96%) for the catch (grade 3; A. Okely, personal communication, April, 2008). Test-retest reliability was not assessed for older school groups.

Eight skills (catch, overhand throw, kick, vertical jump, hop, side gallop, sprint run, and static balance) were assessed in 2000 (van Beurden et al., 2003) using the updated Get Skilled Get Active assessment protocol (NSW Department of Education and Training, 2000). Interrater reliability for every observer pair was checked on sets of 48 scores from the childhood motor skill data and reported as $k = .61$ (van Beurden et al., 2003). This paper reports on six skills—three object control (kick, catch, and overhand throw) and three locomotor (vertical jump, hop, and side gallop)—that were reassessed in 2006–07 with the same instrument (NSW Department of Education and Training, 2000). This test battery included skills in which both boys and girls demonstrated proficiency (McKenzie, Sallis, Broyles, Zive, & Nader, 2002; Okely & Booth, 2004; van Beurden et al., 2002). A subsequent interrater reliability assessment, using the PASS adolescent sample, reported $k = .70$ (Barnett, van Beurden, Morgan, Lincoln, & Beard, 2009).

Each skill comprises features considered integral to proficient performance. Most skills have six features, except the hop and side gallop, which have five. For example, the vertical jump has six features:

1. Eyes focused forward or upward throughout.
2. Crouch with knees bent, arms behind the body.
3. Forceful forward and upward swing of arms.
4. Legs straighten in air.
5. Land on balls of feet, bend knees to absorb landing
6. Controlled landing with no more than one step in any direction.

Live observation was used to assess student motor skills during school. The testing procedure allowed a small group of students to observe a motor skill demonstration before being asked to perform the skill individually. Each skill feature was assessed as being present or absent; no verbal feedback was provided. The hop and side gallop skills were observed as students travelled back and forth once between two points 15 m apart. For the catch, kick, overhand throw, and vertical jump, students performed the skill five times, with a feature deemed to be present if the student performed it consistently (i.e., four out of five occasions; Department of Education Victoria, 1996). If there was any uncertainty about whether a feature was consistently present or not, it was checked as absent (Barnett, van Beurden, Morgan, Lincoln et al., 2009).

Data Collection

In 2000, 10 research assistants, who were trained for 3 days (van Beurden et al., 2003) by a tester from the Australian NSW Schools Fitness and Physical Activity Survey (Booth et al., 1997), collected the data. In 2006–07, an experienced tester from a separate study (Jones et al., 2007), with assistance from the study coordinator (who had rated children as part of the MIGI) also conducted the training. In both training sessions, each prospective tester rated a video of children performing each skill, which a panel of experts had previously rated. The required observer agreement rate was >85% for both 2000 (van Beurden et al., 2003) and 2006–07 (Barnett, van Beurden, Morgan, Lincoln et al., 2009). Most of the follow-up data (>94%) were collected over Term 4 in 2006, with the remainder done early in Term 1 2007 (both over the summer).

Data Management

The number of features rated correct for each skill performed in childhood and adolescence was summed for each participant. This meant that the catch, kick, overhand throw, and vertical jump had maximum scores of six each for proficient performance, with the hop and side gallop having maximum scores of five each. Composite object control (catch, kick, overhand throw: maximum score = 18) and locomotor (hop, side gallop, vertical jump: maximum score = 16) scores were calculated for students who had completed all three of the relevant skills. A yes/no binary variable, Mastery + Near Mastery (MNM), as per the MIGI study (van Beurden et al., 2002), was also created for each skill for students who had achieved mastery (all features correct) or near mastery (only one feature incorrect). This category has also been reported as "advanced skill proficiency" (Booth, Denney-Wilson, Okely, & Hardy, 2005).

Data Analysis

Chi-square tests were used to answer the first research question: whether there were gender differences in the MNM performance of three object control and three locomotor skills at two time points—childhood and adolescence. After a Bonferroni adjustment for multiple comparisons (calculated by dividing the number of tests—six in each age period—by the alpha of .05), the corrected alpha for these tests was $p < .0083$. To report on the second research question (i.e., the percentage of improvement from childhood to adolescence for boys and girls demonstrating MNM in three object control and three locomotor skills), the proportion achieving MNM for each skill in childhood was subtracted from those who achieved it in adolescence. A general linear model used composite object control scores to examine the third research question regarding the influence of gender on object control proficiency in childhood and adolescence. Childhood object control proficiency score and gender were included as main effects in that order (Type 1), followed by the two-way interaction of childhood object control proficiency by gender. This interaction was included to examine whether the relationship between childhood and adolescent skill proficiency differed between genders. Manual backward elimination was used to eliminate the interaction first (if nonsignificant), followed by nonsignificant main effects. Based on this model, the predicted object control score in adolescence was then calculated and plotted. To investigate the final research question regarding the influence of gender on the relationship between childhood and adolescent locomotor proficiency, a similar model was constructed. The dependent variable was adolescent locomotor proficiency, and childhood locomotor proficiency was substituted as a main effect. As gender was not significant in this model, predicted values were not plotted. The significance level was $p < .05$ for both general linear models. SPSS version 15.0 (SPSS, Inc.) was used for all analysis.

Results

Gender Differences in MNM Performance

As Table 1 indicates, significantly more boys than girls reached MNM in the object control skills in childhood and adolescence, respectively (kick: $p = .001$ and $p = .001$; overhand throw: $p = .001$ and $p = .001$; and catch: $p = .004$ and $p = .001$). Girls performed the kick and overhand throw particularly poorly in both childhood and adolescence. There were no significant gender differences in locomotor skill performance in either childhood or adolescence. By adolescence, over 80% of boys had reached MNM in five skills: the catch, side gallop, overhand throw, kick, and vertical jump; and over 80% of girls had reached MNM in three skills: the vertical jump, side gallop, and catch.

Percentage Improvement in MNM Performance

Table 1 also shows that the greatest change between childhood and adolescence was in the vertical jump, with a 58% increase in boys and a 51% increase in girls reaching MNM in adolescence compared to childhood. There was also a large change for the side gallop, with a 50% increase for boys and a 32% increase in girls reaching this standard. The skill with the least change was the kick, with a 27% increase for boys and a 12% increase for girls reaching this standard as adolescents.

Table 1. Longitudinal comparison of boys and girls who possessed mastery or near mastery in childhood and adolescence

Skills	MNM (M = 10 years)						MNM (M = 16 years)						Improvement	
	Boys		Girls		χ^2	p	Boys		Girls		χ^2	p	Boys	Girls
	n	%	n	%			n	%	n	%			%	%
Catch	132	62.1	143	44.8	8.31*	.004	126	95.2	138	81.9	11.33*	.001	33.1	37.1
Kick	132	56.8	143	13.3	57.82*	.001	126	83.3	136	25.7	87.20*	.001	26.5	12.4
Overhand throw	130	48.5	142	13.4	39.66*	.001	125	88.0	137	48.9	45.58*	.000	39.5	35.5
Side gallop	130	41.5	143	53.8	4.13	.052	120	91.7	135	85.9	2.08	.170	50.2	32.1
Vertical jump	129	23.3	139	35.3	4.63	.033	125	81.6	136	86.0	0.95	.400	58.3	50.7
Hop	132	12.1	142	16.9	1.25	.306	124	45.3	134	54.7	0.92	.337	33.2	37.8

Note. MNM = mastery or near mastery; $\alpha = .0083$ (Bonferroni corrected adjustment).
*$p < .0083$.

Influence of Gender on Object Control Skill

Table 2 shows the significant main effects for childhood object control motor skill and gender as a function of adolescent proficiency. The model explained 39% (adjusted $r^2 = .39$) of variance in adolescent proficiency. The interaction of gender and childhood object control proficiency was nonsignificant ($p = .53$) and, therefore, removed. The final equation, based on coefficients being β (SE), was: $_{adolescent\ object\ control\ skill} = 9.48$ ($SE = .36$) $+ .16$ ($SE = .04$)$_{childhood\ object\ control\ skill}$ $+ 1.98$ ($SE = .27$)$_{male}$. Figure 1 shows plots for the predicted values of adolescent boys' and girls' object control proficiency based on this model. The figure illustrates that boys and girls with higher childhood object control proficiency also had that proficiency in adolescence. While boys had higher scores overall, the relationship between childhood and adolescence did not vary by gender. When comparing the unique contributions of individual variables (adjusted r^2) to the final model, childhood object control proficiency accounted for 26% of variation (r^2=.26), with gender accounting for a further 13% ($r^2 = .13$).

Influence of Gender on Locomotor Skill

For childhood locomotor proficiency and gender as a function of adolescent locomotor skill, a simple model remained that included only childhood skill as a significant predictor, $F(1, 239) = 5.33$, $p = .02$. This model explained 1.8% of adolescent proficiency (adjusted $r^2 = .02$). The interaction between gender and childhood proficiency was nonsignificant ($p = .54$) and was removed, as was gender ($p = .999$).

Discussion

The purpose of this study was to explore potential differences in motor skill ability from childhood to adoles-

Table 2. Significant main effects for childhood object control motor skill proficiency and gender as a function of adolescent object control motor skill proficiency

Source	*df*	*F*	*p*
Childhood object control			
Proficiency	1	109.51*	.001
Gender	1	52.76*	.001
Error	248		
Total	250		

Note. $R^2 = .396$ (adjusted $R^2 = .391$); Type 1 sums of squares.
$^*p < .05$.

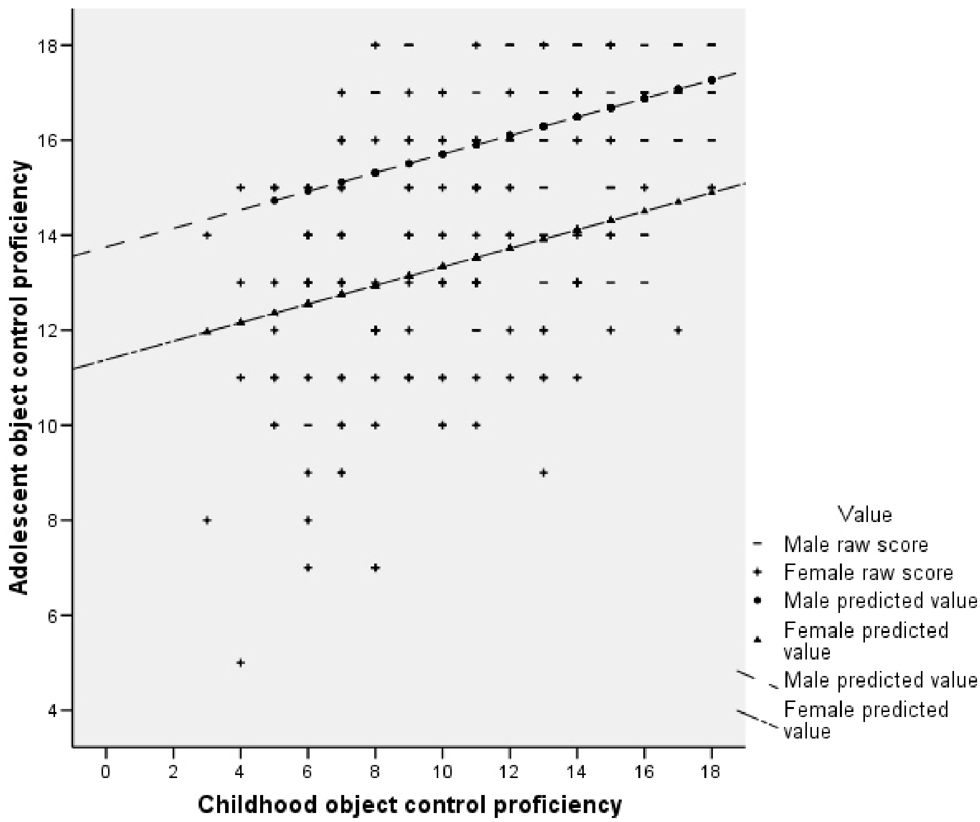

Figure 1. Predicted values of adolescent boys' and girls' object control proficiency.

cence, according to gender. This is one of few longitudinal studies to assess youth motor skill with a process-oriented assessment battery. It is worth noting that findings are contextualized within a proficiency approach to examining motor skill competence.

Gender Differences in Object Control Skills

In childhood, more boys in our study performed object control skills proficiently than girls, consistent with previous studies reporting gender differences in the kick, throw, or catch proficiency (DeOreo & Keogh, 1980; Hume et al., 2008; Thomas & French, 1985). By adolescence, gender differences remained in the percentage of adolescents demonstrating MNM in the kick, throw, and catch. Other studies using both product and process-oriented assessments (Booth et al., 2006; Keogh & Sugden, 1985; Thomas & French, 1985) also confirmed this finding. Booth et al. (2006) found that few adolescent girls were proficient in object control skills (only 20% reached MNM in the kick and overhand throw). These skills are considered fundamental; yet, by late adolescence only one in two girls in our sample could perform the overhand throw at an MNM level, and one out of four could perform the kick. One explanation for these findings is that boys may receive greater encouragement, positive reinforcement, and prompting to participate in activities involving object control skills, particularly throughout adolescence.

Gender Differences in Locomotor Skills

We found no differences between boys and girls in locomotor skill performance in either childhood or adolescence. Similar to our findings, studies using process-oriented instruments reported no childhood gender differences in the run (Hume et al., 2008), hop (van Beurden et al., 2002), or vertical jump (Hume et al., 2008). Also, using product-oriented assessment, run performance has not been reported to differ by gender (Raudsepp & Paasuke, 1995). In contrast to our findings, studies using product-oriented assessments reported adolescent boys as more proficient in the standing long jump (Keogh & Sugden, 1985), vertical jump (Keogh & Sugden, 1985), and run (Haubenstricker et al., 1997). In a meta-analysis examining gender differences in motor performance, boys and girls had similar performance curves in the vertical jump (jump and reach task) until around 11 years of age, or until puberty (Thomas & French, 1985), when female performance plateaues (Keogh & Sugden, 1985). Our study assessed the jump qualitatively, rather than in terms of outcome, which may explain why we found no gender differences in the vertical jump in adolescence.

Percentage Improvement in MNM Performance

It is important to note there may be a ceiling effect within the motor skill instrument that might potentially mask gender improvement differences. However, if this were the case it might be expected that girls would improve more than boys because they had greater potential to change, particularly in object control skills. Instead, similar proportions of boys and girls developed proficiency from childhood to adolescence in the catch, overhand throw, vertical jump, and hop.

Although similar proportions of girls improved in the overhand throw, they could not "catch up" to the boys, because they had been less proficient in childhood. Only 13% of girls reached MNM in the overhand throw at 10 years of age, and this was after the MIGI intervention (van Beurden et al., 2003). This seems to indicate that throwing skill developed prior to 10 years of age is important to subsequent motor skill competency and low-skilled girls may need particular intervention while in early elementary school. Instruction and adequate opportunity for practice are significant factors in the development of throwing techniques in children (Halverson & Roberton, 1978). Therefore, one plausible explanation for our findings is that girls may not receive enough practice time in these skills (Ehl et al., 2005; Halverson, Roberton, & Langendorfer, 1982; Runion et al., 2003). This appears to be the case in Australia. Of the top 12 organized out-of-school activities reported by girls, none involved the overhand throw (Australian Bureau of Statistics, 2008), whereas 10.1% of 5–14-year-old boys participated in cricket in 2006 (Australian Bureau of Statistics). Perhaps because throwing is a phylogenetic skill and does not have cultural dominance for girls in Australia, this may partially account for why girls performed so poorly.

At the start, girls, as a group, were much less competent in the kick than the boys, but, in contrast to the throw, fewer girls improved over the time period. This may also indicate that there were fewer opportunities in kicking activities over this period for girls than for boys. Of all reported out-of-school organized activities in Australia, boys had the highest participation rate in soccer, at 19.6% in both 2000 and 2006. For girls, the participation rate was considerably lower (2.9% in 2000 and 6.4% in 2006; Australian Bureau of Statistics, 2008).

Influence of Gender on Object Control Skill

This study showed that childhood object control proficiency influenced proficiency in adolescence, signifying that programs for developing object control are important in elementary schools. While boys outperformed girls, gender did not affect the relationship between childhood and adolescent proficiency, meaning that developing childhood skill in catching, kicking, and throwing may be equally important for adolescent boys and girls.

Few studies compare the findings in this area. Existing data reported the relationship between movement outcomes (i.e., product assessment) and motor fitness

(Malina, 1996). Interage correlations for jumping range from moderately low to moderately high, varying according to the study and the age interval (Malina, 1996). One study showed similar interage (8–14 years) correlations for boys and girls in the vertical jump; .45 for girls and .48 for boys (Branta et al., 1984). Another study found that age to age (10–17 years) correlation for the velocity throw was .23 in girls compared to .46 in boys (Rarick & Smoll, 1967). Even the highest correlation in these studies (.48) is low (after squaring) compared to our explained variance (39%) in the general linear model for adolescent object control proficiency. Perhaps a proficiency assessment is more accurate than a product outcome assessment, in predicting students who will reach proficiency in subsequent years.

Influence of Gender on Locomotor Skill

Childhood locomotor skill proficiency had virtually no relationship with adolescent proficiency, and gender was not a predictor. It may be that locomotor skills depend more on other factors, such as weight, which may affect performance (Okely, Booth, & Chey, 2004). Instrument measurement issues could also have contributed to the negligible relationship found between childhood and adolescent locomotor proficiency. The hop had the lowest interrater reliability of the six skills assessed in the PASS adolescent sample (Barnett, van Beurden, Morgan, Lincoln et al., 2009) and was one of the most poorly performed skills by both genders, indicating it may be a problematic skill to assess or assessment may need further development

While the hop assessment in Get Skilled Get Active is fairly comparable to others, there are some differences. The final stage of the arm action in one assessment (Level 5 Opposing assist) involves the arms moving in synchrony with each leg rather than with each other (Roberton, 1984). The arm action in Get Skilled Get Active (Feature 5) is not specified in terms of whether it should be a bilateral or opposing assist action. This lack of clarity may have reduced the ability to describe proficiency adequately. However, the Test of Gross Motor Development–Second Edition (TGMD-2) in Component 3, similar to Get Skilled Get Active, also required arms to be flexed and swinging forward to produce force in the hop (Ulrich, 2000).

Implications

Our findings that girls perform object control skills poorly relative to boys and that childhood object control proficiency helps predict adolescent proficiency have important implications for physical education (PE) in schools and subsequent physical activity behavior. In NSW, as in many parts of the United States and Great Britain, classroom teachers, not specialists, primarily conduct PE in elementary schools. These teachers perceive considerable barriers to implementing quality PE including time constraints and lack of expertise, knowledge, resources, and professional development (Morgan & Hansen, 2008). The quality of school PE has been seriously questioned, with current Australian school PE programs critiqued for not catering to the skill-specific needs and abilities of girls or less skilled students (Morgan & Hansen, 2007). Gender differences in object control development may be minimized if there are efforts to ensure girls receive developmentally appropriate instruction using pedagogically meaningful and relevant PE learning experiences in elementary school.

The PASS finding that object control proficiency in childhood helps to explain this proficiency in adolescence highlights the fact that all low-skilled children in the elementary years need intervention with object control so they will not be low-skilled in adolescence. Also, because object control proficiency tracks to some degree for both boys and girls, it gives further weight to the notion that childhood motor proficiency may contribute to subsequent physical activity and fitness later in the lifespan (Stodden et al., 2008). Thus, developing object control proficiency in low-skilled students may also be important for subsequent physical activity participation (Stodden et al., 2008).

Study Limitations

While there was little evidence of bias, our findings should be considered in the light of a one third follow-up rate. This was unavoidable due to the length of the follow-up period and difficulties locating students who had moved between regions or schools. However, the consent rate in PASS was higher than for similar studies (Booth et al., 2006). While there were some differences in consent by grade, the reason for lower consent in grade 11 was due to the inability to locate more students of this age (students of this age in Australia can legally leave school). There was also no differential loss to follow-up by gender; however, there was a difference in mean composite childhood skill scores, suggesting that students in the follow-up study may have been potentially more skilled. However, as this difference was only 1 point on a 30-point scale, loss to follow-up is unlikely to have biased our findings in any substantial way.

The development of Get Skilled Get Active appears to have been thorough and meticulous; however, a limitation is that validity was not assessed in terms of whether the specific skill features reflected proficient performance compared to that specified in the current literature. Also, the motor skill instrument, while process oriented, was not developmental (Stodden et al., 2008). Last, because the PASS study did not assess weight status, we were unable to control for this aspect, which would have enabled us to assess whether it was a factor in different locomotor skill performance (Okely, Booth, & Chey, 2004). In conclusion, because childhood object control proficiency can partially explain adolescent object control performance, elementary school programs for low-skilled students are crucial. Because many girls perform object control skills (such as the kick and overhand throw) so poorly relative to boys, they may have to be especially targeted.

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