Development of Gender Differences in Physical Activity

Jerry R. Thomas and Katherine T. Thomas

The development of gender differences in physical activity was reviewed using the categories of motor performance, motor activity, physical activity, and health related physical fitness. Gender differences in motor performance were related to age in 12 of 20 tasks, resulting in three types of developmental curves. Most differences are suggested as being environmentally induced prior to puberty but influenced by a biology–environment interaction after puberty. The level of motor activity is higher in boys even in infancy, and gender differences increase across childhood and adolescence. This suggests that heredity influences initial differences but interacts with environmental circumstances as children grow and develop. Boys from several countries are observed to be more physically active than girls, probably accounting in part for their better performance on physical fitness tests. Boys perform better than girls on three of the four measures of health related physical fitness: mile run, chin-ups, and sit-ups, but not the sit-and-reach. However, these differences are small prior to puberty and are adjusted to zero by degree of fatness and intensity of exercise. After puberty, hormonal differences in combination with environmental opportunities produce better performance by males.

Gender differences in performance have been reported for many types of tasks. For example, the classic work by Maccoby and Jacklin (1974) reviews gender differences in cognitive, affective, and motor performance. In addition, Maccoby and Jacklin suggest that many types of gender differences may be age related. However, just identifying gender differences is of little value unless it leads to understanding why gender differences exist. Are these differences based on heredity, environment, or their interaction? Can inferences be made about the sources of the gender differences based on their developmental patterns?

Reliable gender differences have been reported in large-scale meta-analyses for aggression (Hyde, 1984), mathematical reasoning (Rossi, 1983), motor activity level (Eaton & Enns, 1986), motor performance (Thomas & French, 1985), proportional reasoning (Meehan, 1984), and spatial ability (Hyde, 1981). In the two meta-analyses of motor performance/activity, the gender differences were related to age at least through adolescence: Gender differences increased with

About the Authors: Jerry R. Thomas and Katherine T. Thomas are with the Department of Health and Physical Education, Arizona State University, Tempe, AZ 85287.
increasing age. Patterns of small differences in early childhood that increase during the elementary school years are often thought to begin with differential parental treatment of boys and girls of preschool age, followed by teachers, coaches, and peers acting as if these differences were biological and continuing to treat boys and girls differently (Greendorfer, 1980; Housner, 1981; Sherif & Rattray, 1976; Thomas & French, 1985). For example, it is common to see primary grade teachers handing out jump ropes to girls and balls and bats to boys at recess time.

Thomas and French (1985) reported that gender differences were small or nonexistent in 19 of 20 motor tasks for children at 3 years of age. However, they found relatively large gender differences in throwing as early as age 3. In addition, boys are observed to be more active than girls even in infancy (Eaton & Enns, 1986). These types of findings suggest, at least for certain types of activities, that heredity may be involved in the development of gender differences.

In this paper we review the findings relative to the development of gender differences in physical activity. Although part of the paper will focus on the development of gender differences in health related physical fitness, using the broader concept of physical activity is appropriate because (a) measuring health related physical fitness in infants and preschool children is not typically done, yet measures of the level of motor activity are regularly reported (see Eaton & Enns, 1986, for a review); (b) moderate to vigorous physical activity’s connection to health may be the important issue rather than health related physical fitness (Paffenbarger, Hyde, Wing, & Hsieh, 1986; Simons-Morton, O’Hara, Simons-Morton, & Parcel, 1987); and (c) looking at the pattern of gender differences across motor performance, motor activity, physical activity, and health related physical fitness may allow stronger inferences about possible explanations for these differences. In the remaining parts of this paper we review age changes in gender differences from infancy through adolescence for motor performance, motor activity, physical activity, and health related physical fitness.

Motor Performance

In a comprehensive review and meta-analysis of the development of gender differences in motor performance, Thomas and French (1985) reported that 12 of 20 motor performance tasks were found to be related to age: balance, catching, dash, grip strength, long jump, pursuit rotor tracking, shuttle run, sit-ups, tapping speed, distance throw, throwing velocity, and vertical jump. Five of the tasks (dash, sit-ups, long jump, grip strength, and shuttle run) followed what has been regarded as a typical motor development curve (see Figure 1 for dash; data in this figure are expressed as effect sizes [ES] at each age: mean for boys minus the mean for girls divided by a pooled standard deviation) (see Thomas & French, 1986, for more details about meta-analysis). The differences (expressed in standard deviation units) slightly favor boys in early childhood (ES = .25 to .50), increase somewhat but remain below 1.00 until puberty, and then increase steadily until late adolescence (ES = 1.5 to 2.5).

Patterns such as this suggest that small initial differences are likely caused by differential treatment of boys and girls by parents, especially fathers. For example, fathers react more negatively when boys play with dolls than when girls participate in rough and tumble games (Fling & Manosevitz, 1972; Lansky, 1967).
Parents also tend to send subtle messages that some types of toys and gross motor activities are more acceptable for boys (Fagot, 1978). Differences increase across childhood because teachers, coaches, and peers accept these initial differences as if they are biological and thus continue to treat boys and girls in very different ways as well as having different expectations and providing different practice opportunities. Around puberty, biology plays an important role in the development of gender differences since hormonal changes result in increased muscle mass in boys and increased essential fat in girls. Thus boys have an advantage in activities involving strength, size, and power. However, differences are still influenced by environmental experiences since girls are less likely to participate in activities that promote the development of motor skills associated with sport.

Five of the other motor performance tasks reported by Thomas and French (1985) show a pattern of no differences, or very small ones, across childhood but substantial increases around puberty: balance, catching, pursuit rotor tracking, tapping, and vertical jump (Figure 2 shows this curve for balance). Patterns like these are difficult to interpret because of task characteristics. For example,
we would guess that the vertical jump is influenced by increased muscle mass in boys and increased essential fat in girls, but that seems an unlikely explanation for catching, pursuit rotor tracking, and tapping. Environmental influences such as practice opportunities and concepts about appropriate gender role behavior seem more viable hypotheses.

Two tasks in which gender differences were related to age varied substantially from other patterns: throwing distance and velocity (see Figure 3). Differences were 1.5 $SD$ units at 3 years of age and increased dramatically over childhood and adolescence to over 3.5 $SD$ units. Said another way, at 17 years of age the average male throws farther than 99% of the 17-year-old females. Thomas and French (1985) suggested that when differences are this large so early in life, biological factors are likely to be involved. Following up on this suggestion, Nelson, Thomas, Nelson, and Abraham (1986) reported that accounting for joint diameters, shoulder/hip ratio, and sum of skinfolds resulted in adjusting girls’ performance from 57 to 69% of that of boys. However, environmental factors are still important, as boys participate in more organized baseball/softball activities and practice throwing more than girls do (Halverson, Roberton, & Langendorfer, 1982).
Figure 3 — Gender differences in throwing distance and velocity. (From "Gender differences across age in motor performance: A meta-analysis" by J.R. Thomas and K.E. French, 1985, Psychological Bulletin, 98, 260-282. Reprinted with permission.)
Thomas and French (1985) reported eight tasks in which gender differences were not related to age. Six of these tasks had effect sizes below .40: agility, anticipation timing, arm hang, fine eye–motor coordination, flexibility, and reaction time. It is likely that differences this small are environmentally induced by differing expectations, practice, and gender identification. The other two tasks, throwing accuracy and the wall volley, had effect sizes above .80, but since they were not age related they seem more likely a result of environmental factors.

Motor Activity

The data available on very young children is generally reported as the degree of motor activity. In a review and meta-analysis of gender differences in motor activity, Eaton and Enns (1986) reported a mean effect size of .49 ($SD = .44$) across 127 studies of motor activity in children, or “the average male subject (at the 50th percentile) is more active than 69% of the female subjects” (p. 22).

Baby boys were significantly ($p < .001$) more active than baby girls (ES = .29), and the effect size increased to .44 for preschoolers and .64 for older children. As expressed by Eaton and Enns (1986, p. 25), “we would note that a gambler would do well to always bet that the most active child in a group will be a boy. For example, in a group of 20 children the odds would be 2 to 1 in the gambler’s favor, assuming $d = .40$” ($d$ is the same as ES). The differences in motor activity as early as infancy suggest some hereditary influence. This is supported by Eaton and Enns’ finding of an ES of .33 for six prenatal studies. However, given the small number of studies, this effect size was not large enough to be reliable. Social influences that serve to magnify initial hereditary differences are suggested by the gradual increase in effect sizes across age.

Physical Activity

The President’s Council on Physical Fitness and Sports (Reiff, 1985) reported that 50% of the girls and 30% of the boys (ages 6 to 17 years) failed to run a mile in less than 10 minutes. In addition, Krahenbuhl, Skinner, and Kohrt (1985) reported that while boys’ $VO_2$ max remains stable across childhood and adolescence, girls show a steady decline after 11 to 12 years of age. Thus, on both field and laboratory tests girls appear to fall below boys in cardiovascular endurance.

Evidence appears to be increasing that the relationship of exercise to health is strongest between moderate to vigorous physical activity and health (Paffenbarger et al., 1986; Simons-Morton et al., 1987). Thus it seems appropriate to review whether studies report boys as being more physically active than girls.

The gender difference in measures of cardiovascular endurance is supported by observations of the amount of moderate to vigorous physical activity boys and girls engage in. Gilliam, Freedson, Geenen, and Shahrraray (1981) found that during a given 12-hour period in the summer, boys had a heart rate above 140 bpm for an average of 56 minutes while girls averaged above 140 bpm for 29 minutes. In data from a retrospective questionnaire (Andersen et al., 1984), West German boys reported more habitual physical activity than girls did, although both groups declined over adolescence. Kemper et al. (1985) reported similar
findings for Dutch adolescents. Ross and Gilbert (1985), in a report from the National Children and Youth Fitness Study, found that boys from 9 to 18 years of age had more high intensity activities outside of school than girls did. In a secondary analysis of these data, Thomas, Nelson, and Church (1988) reported that although the absolute difference between males and females stays the same over this age range, there is a steady decrease in the number of activities after puberty, a finding consistent with results from West German (Andersen et al., 1984) and Dutch (Kemper et al., 1985) children.

**Health Related Physical Fitness**

Ross and Gilbert (1985) and Ross and Pate (1987) have reported results of the National Children and Youth Fitness Study (NCYFS), which was designed to assess the health related physical fitness of boys and girls in the United States. These two studies included results from a national probability sample of over 13,000 children from 6 to 18 years of age. Data were collected on the performance variables of the mile run (half-mile run for younger children), sit-ups, chin-ups (modified pull-ups for younger children), and sit-and-reach. Physical characteristics measured were height, weight, waist size, and skinfolds. Environmental variables such as activity patterns and school, community, and home influences were determined by survey.

Thomas et al. (1988) have completed a secondary analysis of these data to identify where gender differences occurred in health related physical fitness and what physical and environmental characteristics were related to the observed differences. Their findings are summarized next according to the health related physical fitness test items.

**Mile Run**

The gender differences in effect sizes for the mile run (half-mile run for younger children) are less than .5 SD units until age 8, then effect sizes are between .5 and 1.0 through age 12. Beginning at age 13 to 18 years, effect sizes are from 1.0 to 1.5. This increase is rather steady although it appears to accelerate after puberty.

Thomas et al. (1988) also evaluated the relation between the mile run performance and the physical and environmental variables. Sum of skinfolds was the only physical characteristic related to mile run (or half-mile) performance at every age level. Children with a larger sum of skinfolds ran more slowly. For younger children (under age 10), the number of organized community activities and having physical education taught by a specialist were positively related to better mile run performance. For older children (over age 10), the intensity of exercise both in and out of school was positively related to better mile run performance.

Since sum of skinfolds is influenced by both exercise and diet, it seems likely that gender differences in performance in the mile run prior to puberty are environmentally induced. In fact Thomas et al. (1988) found that the effect sizes could be reduced to nearly zero when mile run performance was adjusted for sum of skinfolds. They also showed that differences could be reduced after puberty when corrected for skinfolds and a composite of environmental charac-
teristics involving the intensity of exercise. However, the differences were still about 1.0 $SD$ unit after the adjustment, probably reflecting boys' longer leg length, greater muscle mass, and higher $VO_2$ max. In addition, it is unlikely that all environmental variables were accounted for in the covariance adjustments.

**Chin-ups**

Gender differences in chin-ups (modified pull-ups for younger children) follow a very similar pattern prior to puberty: Differences are less than $.5$ $SD$ units in favor of boys until after age 9. From 10 to 12 years of age, effect sizes are between $.5$ and 1.0. After age 12, effect sizes accelerate rapidly and are above 1.5 $SD$ units by 14 years and above 2.0 by 15 years of age.

Sum of skinfolds was the best predictor of chin-ups at every age and became increasingly important as children got older (smaller skinfolds were related to more chin-ups). Height and weight were also related to chin-ups: Better performance in younger children was reflected by a shorter but more muscular body type; after puberty taller and more muscular adolescents could do more chin-ups. Starting at about age 8, environmental variables reflecting high intensity activities were positively related to chin-ups.

Chin-up performance was only minimally adjusted by a linear composite of these physical and environmental characteristics. In particular the rapid acceleration of gender differences after puberty reflects the influence of hormonal changes in boys and girls—more muscle in boys and essential fat in girls. However, until many girls begin their prepubertal growth spurt (about 9 or 10 years), the differences are minimal and seem most likely to be influenced by differential treatment and expectations of girls.

**Sit-ups**

Effect sizes for sit-ups are less than .25 (favoring boys) through age 8, less than .5 through age 12, and less than 1.0 through age 18. Sum of skinfolds was a significant predictor of sit-up performance at every age (smaller skinfolds related to children doing more sit-ups). Weight is important in the years before and after puberty, reflecting that children who are more muscular can do more sit-ups. However, during the 10-to-12-year age range, weight is not important. Amount and intensity of exercise is also positively related to sit-up performance for 7- to 18-year-old subjects. Using these characteristics to adjust sit-up performance reduces the effect sizes to less than $.5$ $SD$ units at all age levels. Differences this small probably reflect environmental considerations rather than any biological effects.

**Sit-and-Reach**

Thomas et al. (1988) found that sit-and-reach performance was considerably different from other health related physical fitness tests. Girls’ performance was better than that of boys at all ages. Effect sizes were $-.25$ to $-.63$ from 6 to 11 years of age. From 12 to 16 years of age, effect sizes increased to about $-1.0$; then after 16 years of age the effect sizes dropped back to about $-.5$ standard deviation units. None of the physical or environmental characteristics were reliably related to sit-and-reach performance.
The rather small differences before age 12 probably reflect environmental influences. However, the dramatic increase about puberty is likely to be growth related. It may reflect the differences observed in standing/sitting height ratio (Malina, 1984) whereby boys' legs make up more of their standing height than do girls' legs.

**Implications**

Taking all these data together, it seems likely that nearly all the gender differences prior to puberty in health related physical fitness are due to the different treatment and expectations our society has for girls and women. The differences are generally small, increase gradually, and are adjusted downwards to even smaller levels by variables that are influenced by environmental circumstances (e.g., degree of fatness, intensity of exercise). For example, having different norms/standards for health related physical fitness tests results in different expectations for boys and girls. Norms/standards are based on performances, not actual capabilities. Thus children, teachers, and parents all accept differential norms/standards for girls as reflecting acceptable performance, and girls meet these expectations. We suspect the same is true for nearly all the motor performance tasks (throwing distance/velocity is a likely exception) and for the amount of physical activity. Level of motor activity may have some basis in heredity, given the findings for infants (and even prenatally in a very small sample of studies) reported in the meta-analysis by Eaton and Enns (1986).

After puberty, a biological–environmental interaction appears to be the best hypothesis for the increasingly large effects noted in tasks wherein differential hormonal effects may influence performance (e.g., tasks involving strength, power, muscular endurance, and cardiovascular endurance). Boys are larger because of more muscle mass and a longer period of growth. Girls add essential fat at puberty. Thus, for tasks in which strength, power, and size are important, boys will typically perform better. However, the differences reported across the many motor performance and health related physical fitness tasks are considerably larger than would be expected from only biological factors. In fact it seems likely that our treatment and expectations of girls interacts with the biological factors to produce these large differences. Many parents, teachers, coaches, and peers continue to behave as if girls should not exercise and participate in sport to the same degree and level that boys should. This attitude and expectation results in the self-fulfilling prophecy: Girls participate, perform, practice, compete, and behave exactly as society expects. The result is reduced levels of physical activity and practice, in turn resulting in lower levels of health related physical fitness and sport skills.

As much as anything else, the solution to this issue is a matter of attitude. The passage of Title IX in the early 1970s has provided many additional opportunities for girls and women in high level sport, some of which have not been very desirable. For example, recruiting scandals and steroid use are now frequently reported for girls and women. However, in our opinion little has changed for the typical girl or woman. She does not exercise as much or as often as boys and men, nor as much as she should. Society must expect that girls and women will participate regularly in exercise and sport at all levels of performance.
References


LANSKY, L.M. (1967). The family structure also affects the model: Sex-role attitudes in parents of preschool children. Merrill-Palmer Quarterly, 13, 139-150.


