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The effect of friendship groups on children's physical activity: An experimental study

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ABSTRACT

Background: Children often play with more than one friend and there is no experimental evidence that has measured the effect of friendship groups on physical activity behavior. Therefore, the purpose of this study was to assess children's physical activity in a controlled setting during three, separate social conditions; alone, with a single friend and with a group (four) of friends. **Materials and Methods:** A total of 24 children between the ages of 6 to 10 years old ($n = 12$ boys, $n = 12$ girls) participated in three separate free-choice social conditions for 30-min. For each condition, children could select from a variety of physical and/or sedentary activities. Children's physical activity was the measured via accelerometry during each condition. Upon completion of each 30-min condition children were given the option to participate in an additional 10-min bonus period. **Results:** Accelerometer counts were not significantly ($P < 0.05$) different throughout each 30-min condition. However, during the optional, additional 10-min bonus period, children's physical activity significantly ($P < 0.05$) increased from the alone (713 ± 283 counts/min) to the friend (2,713 ± 339 counts/min) condition and then increased again from friend to the group (3,253 ± 147 counts/min) condition. Furthermore, a significantly greater ($P < 0.001$) proportion of children chose to participate in the 10-min bonus period during the friend (92%) and group (100%) conditions than the alone condition (33%). **Conclusion:** Playing with a single friend and a group of friends, relative to playing alone, is more motivating, and can increase physical activity when given the option for additional time. Additional research is warranted to experimentally assess how friendship groups can impact physical activity behavior during 60-min of free-choice activities.

KEY WORDS: Accelerometer, peer groups, physically active, sedentary behavior

INTRODUCTION

The center for disease control recommends that children engage in physical activity for a minimum of 60-min/day [1]. Increasing physical activity participation in children has been connected to positive physical benefits such as improved aerobic and cardiovascular fitness [1,2] and increased muscular strength [1-3]. In addition, recent studies have concluded that the presence of a single peer or friend can have a positive impact on physical activity behavior in children [4-7]. While the presence of a single peer or friend appears to be beneficial for children's physical activity, less is known about how friendship groups (i.e., more than two children) affect physical activity behavior. Therefore, it is imperative to better understand how children's physical activity behavior is altered, while playing in a group environment in order to increase the likelihood that children meet the physical activity recommendations.

Currently, there are three studies that have experimentally investigated the effect of a single peer or friend on physical activity behavior in children. These studies agree that the presence, versus the absence, of peer contributes to increased physical activity participation in children [4,5,7]. More specifically, a study by Salvy *et al*. [5] found that overweight/obese and non-overweight children's motivation to be physically active as well as their actual activity levels (i.e., distance biked) increased with the presence of a friend. While these results were intriguing, the simulated environment and exercise equipment utilized (i.e., cycle ergometers) did not replicate a free-choice environment in which children could choose from a variety of physical and/or sedentary activity options. Therefore, two subsequent experimental studies were conducted utilizing a gymnasium environment designed to better simulate the types of physical activities children typically participate in (e.g., running, climbing, ball games, etc.)[4,7]. In these studies, children had the freedom to choose, in any order, any physical and/or

sedentary activity in the gymnasium they desired for a total of 30 min. The first of t hese studies found that the presence of an unfamiliar peer decreased the amount of time overweight/obese boys (8-12 years old) allocated to sedentary activities and increased their physical activity behavior to a level that was similar to non-overweight boys [4]. The second study used a similar free-choice design and assessed the physical activity behavior in young (i.e., 3-6 years old) children when playing alone and with a single self-selected friend [7]. Young children increased their physical activity levels by 54% when playing with a friend and every child (i.e., 100%) chose to play for an optional, additional 10-min session after their initial 30-min session while in the presence of a friend compared to only 43% during the alone condition [7].

These previous experimental studies only examined the effect of the presence of a single peer or friend on physical activity, and there is no experimental evidence we are aware of to assess how a friendship group (e.g., four children) can affect physical activity participation in children. However, a few studies have attempted to measure the impact of friendship groups utilizing self-reported data and quasi-experimental designs to assess the associations between friendship networks and physical activity behavior [8,9]. Jago *et al*. [8] used focus groups to engage children in a discussion about their physical activity behavior and with whom they were physically active. The authors concluded that children indicated several different friendship groups and that these groups may serve as an important factor to increasing and potentially maintaining physical activity behavior [8]. Another study used accelerometers to measure physical activity and a spatial analytic approach to assess the proximity of children's friends and found that children's physical activity is associated with their school-friends activity levels [9]. While these studies reveal pertinent information about friendship groups and its potential impact on children's physical activity, it is difficult to conclude if the presence of a group of friends directly impacts physical activity behavior in children.

The lack of evidence is problematic since children often participate in physical activities in a group setting (e.g., school recess, physical education class, sport teams). It is possible that the presence of a group of friends can increase the number of play options available to children, relative to the presence of a single friend, by allowing for team based activities (e.g., two vs. two kickball, basketball, tag, etc.). Therefore, playing with multiple friends may increase physical activity participation in children beyond what has been noted in previous studies examining peer influence and physical activity behavior.

Therefore, the purpose of this study was to assess the amount, liking (i.e., enjoyment), and preference of children's physical activity behavior in a controlled environment during three separate conditions; alone, with a single friend and with a group (four) of friends. To the best of our knowledge, this was the first study to experimentally assess the effects of friend/peer influence on physical activity while playing in a friendship group setting. We hypothesized that there would be a step-wise increase in physical activity behavior and liking of that activity with the alone condition yielding the least activity and lowest liking and the group condition yielding the greatest activity and liking.

MATERIALS AND METHODS

Participants

Participants included 24 children (n = 12 boys, n = 12 girls) between the ages of 6-10 years old, with no contraindications to physical activity (e.g., orthopedic injury). Participants came the laboratory for three separate visits; playing alone (control condition), with a single-friend and with a group of (four) friends. Upon completion of the study, children were compensated with a $45.00 gift card to a local store. This study was approved by the University Institutional Review Board and occurred in 2012.

Initially, 6 children (n = 3 females, n = 3 males) were recruited from the local community through flyers and from a database of potential participants and their parents or guardians who contacted the laboratory for separate, unrelated studies. Once a child and their parent agreed to participate, each child indicated three same-sex friends that were within 1-year of age to participate with them for the group condition. Research personnel then contacted one parent or guardian for each of the three friends, described the study, and then asked if their child wished to participate. Each group of children (e.g., four total), when asked by research personnel, indicated one another as friends. Each group of four children was then randomly divided into two separate groups of two children for the single-friend condition. Prior to a child's first visit, parents were advised to have their child wear appropriate clothes for physical activity, to maintain their normal diet, and refrain from eating and drinking 1 h prior to their condition. Finally, each child also participated in the alone condition. The order of the three social conditions (alone, with a single-friend, and group of friends) was counterbalanced. For each group, data collection was separated by 7 days and was scheduled for similar times across conditions.

Procedures

Upon arrival for the first visit, parental consent and child assent were obtained. Participants were then measured for height through stadiometer and weight was measured using a balance beam scale (Health O Meter, Chicago) by a trained anthropometrist.

During each of the three laboratory visits, participants were taken to a 4360 Square Foot gymnasium where research personnel demonstrated and allowed children to sample a variety of age appropriate physical and sedentary activity options (described in gymnasium configuration) that did not change across the conditions. The sedentary table was capable of accommodating four children and did not change across conditions. After the demonstration, prior to each condition research personnel fitted each child with an accelerometer (Actigraph GT1M, Pensacola, Florida, USA) that was worn

around their waist. Each accelerometer was numbered to ensure that children wore the same accelerometer for each of their conditions. At that time, children were given permission to begin and were able to participate in any of the physical and/or sedentary activities they wished, in any pattern for 30-min.

Gymnasium Configuration

Physical activity equipment

Physical activities/equipment included; four jump ropes, four Wilson® indoor/outdoor basketballs, 5, 6 inch (0.153 m) tall hurdles (SKLZ® Speed Hurdles), four Nerf™ Pro Grip™ footballs with targets and goals (Hasbro®, Pawtucket, Rhode Island), two Franklin® soccer balls for participants to kick around series of seven cones separated three feet apart, and navigating two obstacle courses made up of gymnastic/soft-play equipment (UCS Inc. Lincolnton, North Carolina). The two obstacle courses were consistent with a previous study by Barkley *et al*. [7].

Sedentary activity equipment

The sedentary activity area was equipped with two tables and four chairs to provide enough available space to accommodate four total children playing. The age-appropriate sedentary alternatives available included: Four different action figures (Hasbro®, Pawtucket, Rhode Island), four different toy dolls (MGA Entertainment Inc., Van Nuys, California), four reading books, Crayola® crayons, markers, and colored pencils with blank paper for drawing, coloring sheets, the block stacking game Jenga® (Hasbro®, Pawtucket, Rhode Island), the board game Sorry® (Hasbro®, Pawtucket, Rhode Island), and the matching game Perfection™ (Milton Bradley Company, East Longmeadow, Massachusetts).

The amount of each child's physical activity for each condition was monitored through accelerometry and was recorded during each session as counts per minute. Epoch length was set at 60 s and has been used in multiple experimental physical activity studies [7,10]. The accelerometer counts per minute were converted to metabolic equivalents using the validated Freedson equation [11]. The amount of time allocated to sedentary and physical activities was recorded using a stopwatch and recorded as minutes and seconds [7,10,12]. At the completion of each 30-min session, each child was independently asked to indicate their liking of the activity by making a mark on 10 cm line anchored "do not like at all" on the left and "like it very much" on the right. The liking score was the distance from the left most end of the line to the point where children made their mark. This visual analog scale for liking is a valid predictor of children's actual physical activity behavior [13]. Research personnel then asked each child if they would like to play for an optional, additional 10-min or they could be finished for the day and go home. If a child chose to participate in the optional, additional time, he/she was equipped with the same accelerometer and had the same options available as the 30-min session. If a child did not choose to participate in the optional, additional time, he or she was finished for the day and sent home. For the conditions that involved either a single friend or a group of friends, children were asked together and informed that they must collectively agree to play for the additional 10-min bonus period. If one child did not wish to participate in the optional, additional 10-min bonus period, the condition was over for the day and the children did not participate in any additional time. The use of the optional, additional 10-min bonus period was used as an estimate of a child's motivation to engage in more physical activity and has been previously used by Barkley *et al*. [7]. After all three conditions were completed, each child was asked to indicate which condition (alone, single-friend, or group of friends) was their favorite (preference of condition). Children reported their preference privately (i.e., not in the presence of their friends) to research personnel.

Note: During each activity session only the child or children participating in the activity session and members of the research staff that quietly observed the children (one staff member per child) were present in the gymnasium.

Analytic Plan

A two-sex (male, female) by three condition (alone, with a single-friend, and group of friends) mixed design was utilized. Sex was the between subjects variable and social condition was the within subjects variable. Independent samples *t*-tests were used to examine differences between sex (male, female) for physical characteristics (age, height, weight, and body mass index [BMI]).

Multiple mixed-effects models were used to analyze the relationship between the dependent variables (30-min accelerometer counts, sedentary time, liking, and 10-min bonus period counts) and the time variant (social condition) and time invariant (sex) factors and interactions between these terms. Mixed-effects models were necessary due to the multiple observations and interdependence of the observations within the participants [14,15]. For such analyses, the individual outcomes are modeled taking into consideration the dependence of observations within individuals.

$$\text{Accelerometer counts} = \alpha + \beta_1 (\text{social condition}) + \beta_2 (\text{sex}) + \beta_3 (\text{social condition} * \text{sex})$$

Note: The same model was utilized to examine the remaining dependent variables as well (sedentary minutes, liking, 10-min bonus period counts).

Upon completion of each 30-min condition children were given the option to participate in an additional 10-min bonus period. The 30-min session and 10-min bonus period were analyzed separately with the mixed-effects models.

Wilcoxon signed rank tests were used to examine the differences in children's decision to or not to participate in the optional 10-min bonus period of activity across the three conditions. In addition, a Chi-square analysis was performed to assess any differences in the number of children indicating their preference of the three conditions. All statistics were analyzed using IBM SPSS Statistics 21.0 (International Business Machines Corp., 2012).

RESULTS

Physical Characteristics

There were no significant differences ($P = 0.18$, [Table 1]) between boys and girls for age, height, weight, or BMI.

Thirty-Minute Accelerometer Counts

The mixed-effects model testing the effects of social condition and sex on 30-min accelerometer counts revealed a significant main effect of sex ($P = 0.002$, [Table 2]) as boys (3,717 ± 223 counts/min) accumulated more counts than girls (2,951 ± 184 counts/min). There were no other significant main ($P = 0.191$) or interaction ($P = 0.226$) effects.

Thirty-Minute Sedentary Time

The mixed-effects model for testing the effects of social condition and sex on time allocated to sedentary activities during the 30-min activity session revealed a significant sex by condition interaction ($P = 0.004$, [Table 3]). Girls, relative to boys, allocated significantly more time to sedentary activities during the alone condition ($P \leq 0.006$). There were no differences ($P \geq 0.083$) in the time allocated to sedentary activities between boys and girls during the friend and group conditions as girl's decreased sedentary time during the friend and group condition to a level that was similar to that of boys. The model also revealed a significant main effect of sex ($P = 0.001$) as girls (5.4 ± 1.1 min) allocated more time to sedentary activities than boys (0.8 ± 0.3 min), and a significant main effect of condition as children allocated more time to sedentary activities during the alone condition compared to friend and group conditions ($P = 0.012$).

Liking for Each Condition

The mixed-effects model for testing the effects of social condition and sex on liking of social condition revealed a significant main effect of condition for liking ($P < 0.001$, [Figure 1]). Children reported significantly ($P < 0.001$) greater liking in the friend and group conditions than the alone condition. There were no other significant main ($P = 0.874$) or interaction ($P = 0.639$) effects.

Table 1: Children's physical characteristics

	Boys (N=12)	Girls (N=12)
Age	8.59±1.6	9.33±1.0
Height (cm)	133.0±10.8	135.9±8.8
Weight (kg)	29.3±5.8	36.0±15.9
BMI	16.5±2.0	19.0±6.9

Data are means±SD. BMI: Body mass index, SD: Standard deviation

Choice of Bonus Period

A significantly greater ($Z = -3.742$, $P < 0.001$) proportion of children chose to participate in the additional 10-min bonus period during the friend (92%) and group (100%) social conditions than the alone condition (33%). There were no significant differences ($P = 0.157$) between friend and group conditions in the proportion of children choosing to participate in the bonus period.

Bonus Accelerometer Counts

The mixed-effects model testing the effects of social condition and sex on 10-min bonus accelerometer counts revealed a significant main effect of condition ($P < 0.001$, [Figure 2]).

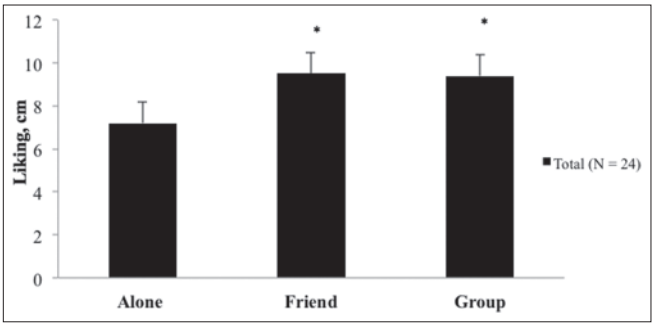

Figure 1: Liking fo r each condition. *Significantly different from the alone condition ($P < 0.001$)

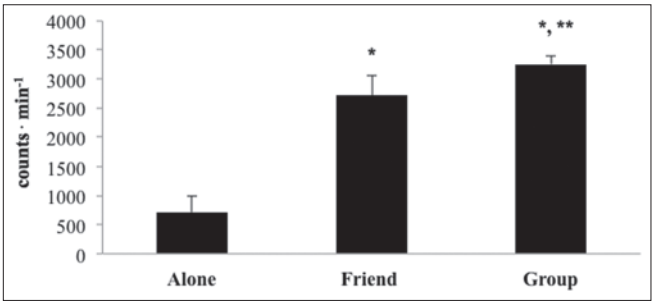

Figure 2: 10-min bonus period accelerometer counts. *Significantly greater than the alone condition. **Significantly greater than the friend condition. $P < 0.05$ for all

Table 2: Accelerometer counts per minute (CPM), Metabolic Equivalents level (MET's), and physical activity intensity category (Cat) for each 30-min condition

	Alone		Friend		Group	
	CPM	MET (Cat)	CPM	MET (Cat)	CPM	MET (Cat)
Boys (n=12)	3,720±217*	6.4 (Vig)	3,743±255	6.4 (Vig)	3,687±242*	6.3 (Vig)
Girls (n=12)	2,460±443	4.7 (Mod)	3,492±298	5.9 (Mod)	2,900±215	5.3 (Mod)
Total (N=24)	3,090±274	5.5 (Mod)	3,618±194	6.2 (Vig)	3,293±178	5.8 (Mod)

Data are Mean±SEM. Physical activity intensity categories (Cat) are labeled as light (lit), moderate (mod), or vigorous (vig). CPM: Counts per minute, MET: Metabolic equivalents level, SEM: Standard error mean. *Significantly greater than girls ($P<0.05$ for all)

Table 3: Time allocated to sedentary activities for each 30-min condition

Participants	Alone (minutes)	Friend (minutes)	Group (minutes)
Boys (n=12)	0.4±0.4	0.7±0.4	1.3±0.7
Girls (n=12)	11.1±3.5*	1.8±0.7	3.3±0.9
Total (n=24)	5.8±2.1**	1.2±0.4	2.3±0.6

Data are means±SEM. **Significantly greater than boys.
**Significantly greater than the friend condition. (P<0.05 for all).
SEM: Standard error mean

Children exhibited a step increase in accelerometer counts from the alone to the single friend condition and then another increase in accelerometer counts from the single friend to the group of friend's condition. There were no other significant main or interaction effects ($P \geq 0.06$).

Preference of Condition

Chi-square analysis revealed a significantly greater ($P = 0.004$) number of children indicated they preferred the group ($n = 19$) social condition versus the alone ($n = 0$) and friend ($n = 5$) social conditions.

DISCUSSION

This was the first experimental study designed to assess the effect a friendship group (i.e., four totals) can have on 6-10 years old children's physical activity behavior. The results indicate that children's physical activity did not significantly increase during a 30-min condition regardless of the number of friends present. However, there was a significant step increase in children's accelerometer counts during the optional additional 10-min bonus period as more friends were present (i.e., friendship groups lead to the greatest physical activity). In addition, more children chose to participate in the optional, additional 10-min bonus period after the single friend (92%) and group (100%) conditions than during the alone condition (33%). Moreover, 79% of the children indicated that they preferred to play with a group of friends while 21% preferred to play with a single friend. Interestingly, boys were more active and allocated significantly less time to sedentary activities than girls throughout the 30-min conditions. However, there were no differences between boy's and girl's physical and sedentary activities during the optional, additional time. Lastly, children equally liked the single friend and group conditions and both of these conditions were better liked than the alone condition. Therefore, it is reasonable to suggest that playing in friendship groups may be a favorable environment for children to engage in physical activity for a longer period of time.

The fact that children increased their physical activity, as additional friends were present when given the option for an additional 10-min bonus period suggests that friendship groups may positively influence physical activity participation. Applying a method previously utilized by Barkley *et al*. [7], children's motivation was assessed in the present study by providing them with the option to play for an additional 10-min bonus period after completing their initial 30-min activity session. Children's accelerometer counts during the 10-min bonus periods increased 280% from the alone condition to the friend condition and then increased another 20% from the friend condition to the group condition. Thus, playing with friendship may have the potential to increase physical activity to a greater extent if children are given longer periods of time (i.e., >30-min) to be active with friends of their choosing. These results coincide with findings from Jago *et al*. [8] who suggested that being physically active with friends can improve one's enjoyment of that activity and enjoyment of an activity is an essential component needed for children to maintain their physical activity. Maintaining physical activity participation may increase the likelihood that children engage in the recommended 60-min/day. It is also reasonable to suggest that the presence of additional friends allows for a greater variety of physical activity options. Increasing the variety of physical activity options has been shown to lead to greater amounts of physical activity in children and adults [12,16,17] and the autonomy that children may have experienced during the group 10-min bonus period may be culpable, in part, for the increase in physical activity [18,19].

Previous experimental studies that examined the impact of the presence or absence of peers on physical activity behavior in children failed to reveal any differences between boys and girls [5,7]. Interestingly, in the current study, there were significant differences in physical and sedentary activity participation between boys and girls. A plausible explanation as to why the sex difference in physical and sedentary activity occurred could be that children in the present study were older (6-10 years old vs. <6 years old) than the children that were examined in a previous study by Barkley *et al*. [7]. While some non-experimental studies [20,21] suggest that the difference between boys and girls physical activity levels may begin as children enter adolescence, others report the difference in physical activity levels may begin at an earlier age (e.g., <10 years old) [22]. Our experimental results concur with the non-experimental findings from Goran *et al*. [22] that the changes in physical activity behavior between boys and girls may occur at or before adolescence.

While this was the first experimental study to examine children's physical activity in a group setting, it is not without limitations. Currently, children played with same-sex friends of their choosing, and it is plausible to suggest that children still encounter social environments that involve members of the opposite sex and non-friend acquaintances. The presence of non-friends, members of the opposite sex, or other friendship groups may differentially alter physical activity behavior when playing in a group setting. Other limitations were the inability to limit children's activity prior to their participation in each condition and the 30-min and 10-min bonus time limit placed on their free-choice activity session. While the 2008 Physical Activity Guidelines for Americans [1] recommend that children engage in a minimum 60-min of physical activity per day, future studies should provide children with the option for an additional 30-min opposed to 10-min. Increasing the optional, additional time from 10-min to 30-min for the bonus period, would allow researchers to better assess if the presence of peers could actually increase the chance of children accumulating 60-min of physical activity per day. The current study also assessed physical activity behavior for a group of four total children. It is reasonable to speculate

that an odd number of children (i.e., a group of three children) may exhibit different physical activity behavior than a group of four children. An even number of children, opposed to an odd number, allows for activities that require two evenly distributed teams and participation in team activities may increase physical activity to a greater extent than non-team activities. Lastly, children often engage in bouts of physical activity lasting 15 s or less [23]. The number of minutes that children engaged in light, moderate, or vigorous physical activity was not isolated and examining the number of minutes engaged in a certain physical activity intensity would be beneficial in future studies. Additional research is warranted to examine how the amount of time given to children as well as the number of children present in a peer group may alter physical activity behavior.

CONCLUSION

The results demonstrated that the presence of single friend and a group of friends can increase physical activity behavior and liking to a greater extent than playing alone when given >30-min of time for play. Contrary to our hypothesis, playing with a group of friends, relative to a single friend, did not have an additive effect on increasing children's physical activity during the 30-min condition; although, it did increase physical activity during the optional, additional 10-min bonus period. Significantly more children preferred to play with their friendship group and 100% of the children choose additional time after playing for 30-min with their friendship group. These findings suggest that friendship groups can positively impact physical activity behavior in children; however, additional experimental research is warra nted to better understand if friendship groups can improve the likelihood of children achieving 60-min of physical activity per day.

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