Effect of Peers and Friends on Youth Physical Activity and Motivation to be Physically Active

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Objective To test whether the presence of a peer or a friend increases the motivation to be physically active in overweight and non-overweight youth in a laboratory setting. Methods Youth motivation to be physically active as a function of the social context was measured using a computerized relative reinforcing value task to earn points exchangeable for physical and/or sedentary activities. Results The presence of a friend (p<.001) increased youth’s motivation to be physically active. The presence of a peer increased overweight youth’s motivation to be physically active, whereas this was not the case for lean youth (p=.47). Participants biked a greater distance in the presence of a friend than when alone (p<.001). Overweight youth biked a greater distance in the presence of a peer than when alone, while this was not the case for lean youth (p=.23). Conclusions Friendships may increase youth’s motivation to engage in physical activity and promote greater physical activity in non-overweight and overweight youth.

Key words childhood obesity; peer influence; physical activity.

Regular physical activity and active play during childhood and adolescence is associated with several physical and psychological benefits (Byers & Walker, 1995; Callas & Taylor, 1994; Janz et al., 2006). Many children, however, make the choice to be sedentary rather than physically active (Crespo et al., 2001; Dietz & Gortmaker, 1985; Gortmaker et al., 1996) because these activities are highly reinforcing and easily accessible (Epstein et al., 2001; Epstein & Roemmich, 2001; Epstein & Saelens, 2000). Research is needed to develop a better understanding of factors associated with children’s choice of physical activity.

One factor that may influence youth activity levels is the social context. Youth are more likely to be active when they are in the company of peers and friends than when they are alone because youth physical activity typically involves some form of play that requires peers or play partners. The nature of this play ranges from organized sports to spontaneous physically active play (Pellegrini, Blatchford, Kato, & Baines, 2004; Pelligrini & Smith, 1998). Peer relationships offer important opportunities for companionship and recreation (Bukowski, Hoza, & Boivin, 1994) and may set the occasion for physically active alternatives to eating and sedentary behavior. For instance, youth who report greater presence of peers in their lives also report engaging in greater physical activity (Beets, Vogel, Forlaw, Pitetti, & Cardinal, 2006; Duncan, Duncan, & Strycker, 2005; Salvy et al., 2008) and there is evidence that participating on a sports team with a friend is associated with increased physical activity during adolescence (Voorhees et al., 2005). Companionship provided by friends is associated with positive affect during physical activity and with the choice to participate in physical activity among adolescents (De Bourdeaudhuij et al., 2005; Duncan, 1993; Duncan et al., 2005).

Children’s weight status (WS) may play a role in the effects of the presence of others on youths’ activity level. Overweight children are less physically active (Sallis, Alcaraz, McKenzie, & Hovell, 1999), perceive physical activity more negatively (Salmon, Timperio, Tellford, Carver, & Crawford, 2005; Worsley, Coonan, Leitch, & Crawford, 1984; Zabinski, Saelens, Stein, Hayden-Wade, & Willfley, 2003), and find sedentary activities more reinforcing than...
physical activities when compared to normal weight children (Epstein, Beecher, Graf, & Roemmich, 2007; Epstein, Smith, Vara, & Rodefer, 1991). Weight criticism during physical activity has been hypothesized to decrease overweight children’s motivation to be active as children who are teased are less likely to be active when given the choice to do so (Faith, Leone, Ayers, Moonseong, & Pietrobelli, 2002). Consequently, the relationship between social contexts and youths’ activities may not be the same for overweight and lean youth as overweight youth may avoid taking part in social activities to avoid peer victimization (Faith et al., 2002; Storch et al., 2007) and choose leisure activities that are solitary in nature. A greater understanding of the social context in relation to overweight youth’s physical activity behavior and motivation could be particularly informative for the design of more effective physical activity interventions.

One way to operationalize the motivation to be physically active is to assess the number of instrumental responses youths are willing to perform to gain access to physical activity (Epstein & Saelens, 2000). The relative reinforcing value (RRV) of activities is assessed in the laboratory using an operant computer task, which requires participants to press a computer mouse button to earn points exchangeable for one or more activities. RRV assessed in a laboratory setting has been found to reliably predict 6- to 11-year-old children’s activity level in the natural environment (Epstein, Kilanowski, Consalvi, & Paluch, 1999). More recently, Roemmich and his colleagues found that liking and the RRV of physical activity were independently associated with moderate-to-vigorous physical activity (MVPA) in 8- to 12-year-old youth. Furthermore, the combination of a high reinforcing value and liking of physical activity was associated with 33% greater participation in MVPA. In the present article, motivation to be physically active and the RRV of physical activity are used interchangeably.

Summary and Research Questions

The present study assesses youth’s motivation to be physically active (i.e., how much youth want to be physically active) and their actual physical activity behavior (i.e., distance biked), as a function of three social contexts: (a) in an alone condition; (b) a peer condition (in the company of an unfamiliar peer); and (c) a friend condition (in the presence of a friend).

Based on previous studies (Beets et al., 2006; Duncan et al., 2005), we hypothesized that the presence of a friend would increase overweight and lean youth’s motivation to exercise. Empirically, this would translate in all youth showing a greater response rate to earn time in physical activity when they have the opportunity to be physically active with a friend then to earn time in physical activity alone. We also predicted that the presence of a peer would increase motivation to exercise in lean participants. However, consistent with the literature on weight criticism and physical activity (Faith et al., 2002; Storch et al., 2007), we expected that the presence of a peer would not increase overweight youth’s motivation to exercise compared to alone.

Similarly, we hypothesized that the presence of a friend would increase both overweight and lean youth’s actual physical activity (i.e., distance biked) through social facilitation (Triplett, 1898). However, we predicted that the presence of a peer would increase lean youth’s physical activity compared to alone; whereas this would not be the case for overweight youth. Presumably, an unfamiliar peer may be viewed as more likely to judge one’s performance than a friend and the fear of being evaluated was hypothesized to have a detrimental effect on overweight youth’s physical activity (Baron, 1986).

Methods

Overview and Design

The design was a $2 \times 2 \times 2$ mixed design with weight and gender as between-factor and the social context of physical activity (alone vs. friend or peer) as a within-factor. The amount of instrumental responding (clicking a computer mouse) youth performed to gain access to sedentary (video game) and physical activity (interactive bicycle game) was compared on two occasions. One session tested the RRV of biking alone relative to playing video games alone. The other session tested the RRV of biking either (a) with a friend or (b) with a peer (depending on the social condition). The order of presentation of the alone and social (peer or friend) sessions was counterbalanced.

Participants

Participants included 44 boys and 44 girls between 12 and 14 years of age ($M = 13$, $SD = 1$). Forty-four participants were between the 15th and the 85th body mass index (BMI) percentile (26 girls, 18 boys) and 44 youth were at or above the 85th BMI percentile (26 boys, 18 girls). The sample was 81% Caucasian, 12% African American, 4% Hispanic, 1% Asian, and 1% American Indian. Participants were excluded if they were: below the 15th BMI percentile; had a cold or upper respiratory distress; had current psychopathology or developmental disability; and/or if they were on medications or had conditions
that could influence their mobility or their activity level (e.g., methylphenidate).

The Children & Youth Institutional Review Board of the University at Buffalo approved all procedures used in this study and all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research.

**Recruitment and Randomization**

Participants were recruited using newspaper, radio and television advertisements, posters, articles in parent–teacher association journal, and church and community newsletters. The recruitment material targeted “youth between the ages of 12 and 14” with no reference to WS. All participants contacted were enrolled in the study and scheduled for their first experimental session.

All participants completed the alone session and they were randomly assigned to one of the two social conditions (peer or friend). Parents of the participants assigned to the friend condition were informed that the experiment required their child to bring a friend for one experimental session. If the family agreed to participate, a parent was asked to give the investigator’s contact information to the parents of their child’s friend to preserve the confidentiality of the friend’s family. Participants were reminded of their appointments by phone. In the event that appointments needed to be cancelled by the participants, new appointments were rescheduled at the participants’ convenience. Five participants were removed from the sample because they only completed one session and we were unable to reschedule them. Twenty-six overweight and 16 nonoverweight participants completed the social session with a friend, whereas 18 overweight and 28 lean participants completed the social session with an unfamiliar peer.

**Procedure**

Upon arrival to the laboratory for their first session (alone or social session depending on the counterbalancing), youth participants heard an assent script and they were asked if they were willing to participate. Peers and friends heard an assent describing their role as confederates in the study and they were asked if they were willing to take part in the procedure. Parents were asked to read and provide written consent. Participants, but not confederates, were then shown a computer room and an activity room. The computer room was equipped with two computers stations with chairs. The activity room was divided in a “sedentary activity” side and a “physical activity” side. The sedentary side was equipped with a television monitor, a bean bag chair, a X-box video game console and a controller, and a variety of X-box video games (Fable®: The Lost Chapters™, Microsoft Game Studios; Forza Motorsport™, Microsoft Game Studios; Sonic Heroes, SEGA®). The physical activity side was equipped with a television monitor and two interactive game bikes (Cateye Fitness, Dallas, TX, USA), connected to a Playstatton video game console. The interactive game (Crash Team Racing, Sony USA) requires pedaling and steering to move and turn the video game character through a circuit in an outlandish environment. The multiplayer mode displays both players on a split-screen television monitor. This physically active game system makes it possible for the youths to be physically active in the laboratory setting, while simulating playing alone or together outdoors. These activities are similar to sports in youths’ natural environment as opposed to more typical indoor exercise equipment.

Participants were asked to sample both games. Then, they were taken to the computer room and instructed on how to perform the RRV task. These instructions were not repeated at the second session.

**Alone Session**

For the alone session, participants were told they were working for points that they could exchange for time playing an interactive bike game alone and/or for time playing video games alone. On one computer, subjects worked to earn sedentary points and on the other computer they worked to earn physical activity points. Participants were told that they could earn a total of 45 points equal to 18 min to play the different activities. The response requirements increased progressively over the nine trials (described below). Participants were told that they could alternate between the two computers and that they would accumulate their points and play the active and sedentary games after the computer task was completed. The total number of points was used as an index of the RRV of these activities.

**Social Session**

For the social session, the participants were told that they were working for points exchangeable for time playing video games alone or for time playing the interactive bike game with a peer or with a friend depending on the condition. As in the alone session, subjects worked to earn video game points on one computer and they worked to earn physical activity points on another computer. Friends and peers were required to wait in the waiting room, while the participants were working on the operant task. Once the participants had completed the computer task and their time doing the sedentary activity alone, peers/friends were
escorted to the experimental room to join the participants and play the interactive bike game. Each session took about 60 min to complete. Participants worked on the computer task for 20 min; played the sedentary and/or physical activity for 18 min. An additional 20 min was allowed for reading and signing of the assent and consent forms on the first session and completion of the questionnaires, and weight and height measurements at the end of the second session of testing. When the child had completed both sessions (alone and social), they were debriefed in the presence of their parents and compensated for their time with a $60 gift card for a local shopping mall. Friends and peers were debriefed separately and compensated for their time with a $15 gift card for a local shopping mall.

**Measurement**

**Reinforcing Value of Activities**
The operant computer task used in the study requires participants to click a computer mouse button to earn points exchangeable for activities. Since the number of points was fixed, it was possible to examine points earned on either schedule (video game or biking) to understand the RRV of these activities. The uneven number of points (i.e., 45 points) also forced the participants to choose which activity they wanted to play the most. For instance, if they were earning 30 points of video games, they only had 15 points for biking. The number of physical activity points the participants earned was used as an index of the RRV of physical activity. On one computer subjects worked to earn sedentary activity points (i.e., video game) and on the other computer they worked to earn physical activity points (i.e., interactive bicycle game). Each computer screen displayed three boxes that varied in shape and color. The boxes rotated and changed color each time the mouse button was pressed. A point was awarded each time the shapes matched. Participants earned 2 min of access to one of the activities for each 5 points awarded. The sedentary and physically active points were delivered on a fixed-ratio (FR) schedule of reinforcement. The response requirements to gain activity points doubled from trial to trial within the course of the session (i.e., FR4, FR8, FR16, ..., FR1024, mouse-presses).

**Physical Activity**
To quantify the amount of physical activity youth performed, the number of pedal revolutions was recorded using magnet sensors attached to the pedal cranks. The sensors were interfaced with an event counter (Cole Parmer, Vernon Hills, IL, USA). The number of pedal revolutions was converted to kilometers using the formula: \([\text{revolutions} \times 6 \text{ meters/revolution}]/1000 \text{ m/km}\].

**Weight and Height**
Weight and height measurements were taken by a trained staff member using a digital scale and a SECA stadiometer. On the basis of the height and weight data, the BMI was calculated \((\text{BMI} = \text{kg/m}^2)\). The BMI-for-age percentile was used to interpret BMI data and classify youth. Youth were considered overweight if they were at or above the 85th BMI percentile and were considered nonoverweight if below the 85th BMI percentile for their age and gender (Krebs et al., 2007).

**Analytic Plan**
Analysis of the data involved in this study requires accounting for multiple observations within individuals as well as dyadic analysis. In both cases, the mutual influence violates the assumption of independence between observations required for analysis of variance (ANOVA).

The analysis of these data was completed using mixed regression models (MRM; also called random-effects models). MRM provide a useful approach to account for interdependence in multiple observations within individuals and in two-person relationships (Gibbons & Hedeker, 1994; Hedeker & Gibbons, 1994, 1996; Hedeker, Gibbons, & Flay, 1994). MRM assume that the data within clusters are dependent among the observations. This is determined by the covariances among the regression coefficients and can be characterized by a covariance function (Hedeker & Gibbons, 1996). The outcomes at the individual level are modeled taking into consideration the dependence of observations within individuals or within dyads (Hedeker, 2003). These models allow simultaneously estimating the parameters of the regression model and the variance components that account for the data clustering (Gibbons & Hedeker, 1994). MRM, using SAS Software (SAS, 2002) were used to analyze the data.

The social condition (alone, peer, and friend) was dummy-coded as either 0 or 1. For each model, two of the social condition variables were entered into the regression model and compared to the reference group, which was left out of the model.

**Reinforcing Value of Activities**
Two MRM were conducted to assess the relation between the reinforcing value of physical activity and WS, gender, and the social condition. In the first model, the alone condition was used as the reference condition (peer vs. alone and friend vs. alone). In order to assess differences between the peer and the friend conditions, a second
model was run with the peer condition as the reference (peer vs. friend).

Number of points for physical activity = \( \alpha + \beta_1 \) (gender) + \( \beta_2 \) (WS) + \( \beta_3 \) (peer) + \( \beta_4 \) (friend) + \( \beta_5 \) (peer × WS) + \( \beta_6 \) (friend × WS).

Number of points for physical activity = \( \alpha + \beta_1 \) (gender) + \( \beta_2 \) (WS) + \( \beta_3 \) (alone) + \( \beta_4 \) (friend) + \( \beta_5 \) (alone × WS) + \( \beta_6 \) (friend × WS).

Physical Activity
Two MRM assessed the relationship between the youth’s kilometers (km) biked and the following predictors. Again, the alone condition was the reference condition in the first model and the peer condition was the reference condition in the second model.

Physical activity (km) = \( \alpha + \beta_1 \) (gender) + \( \beta_2 \) (WS) + \( \beta_3 \) (peer) + \( \beta_4 \) (friend) + \( \beta_5 \) (peer × WS) + \( \beta_6 \) (friend × WS).

Physical activity (km) = \( \alpha + \beta_1 \) (gender) + \( \beta_2 \) (WS) + \( \beta_3 \) (alone) + \( \beta_4 \) (friend) + \( \beta_5 \) (alone × WS) + \( \beta_6 \) (friend × WS).

Results
Reinforcing value of physical activity
The results from MRM predicting the total number of points earned for physical activity are presented in Table I. Youth earned more points for physical activity when they had the choice to be physically active with a friend (friend condition, \( M = 24.05, SD = 9.73 \), \( F(1,1536) = 104.84, p < .0001 \), than when they were alone (\( M = 18.07, SD = 10.19 \)). Results also indicated a significant interaction of WS by peer condition, \( F(1,1536) = 22.23, p < .0001 \). Overweight youth earned significantly more points for physical activity when they had the opportunity to be physically active with a peer than when they were alone, whereas this was not the case for lean youth (\( p = .47 \)). Furthermore, the presence of a friend had a greater impact on overweight than on lean youth’s motivation to be physically active \( F(1,1536) = 12.15, p < .001 \) (Fig. 1).

Physical Activity
Results from the MRM predicting the kilometers biked are presented in Table II. Youth pedaled a greater distance when they were in the presence of a friend (\( M = 3.80, SD = 2.44 \)) than when they were alone (\( M = 2.72, SD = 1.67 \), \( F(1,1395) = 133.21, p < .0001 \). Furthermore, there was a significant interaction of WS by peer condition, \( F(1,1395) = 12.14, p < .001 \). Overweight youth biked a greater distance in the presence of a peer than when alone (Fig. 2), while this was not the case for lean youth (\( p = .23 \)).

Discussion
This research investigated how the presence of peers and friends impact youth’s motivation to be physically active and their actual activity levels. Consistent with previous studies (Faith et al., 2002; Salvy et al., 2008; Storch et al., 2007; Voorhees et al., 2005), we found that the presence of a friend increased overweight and nonoverweight youth’s motivation to be physically active as well as their actual physical activity (i.e., distance biked). It is possible that
participants biked more in the presence of friends because of social facilitation (Triplett, 1898). However, social facilitation refers to an increased performance in presence of other individuals and it cannot account for the increase in reinforcing value of physical activity or the motivation to be physically active, not does it account for the differential effect of friends (vs. peers) observed in this study.

In fact, contrary to our expectation findings indicated that the presence of a peer increased the motivation to exercise and was associated with greater physical activity in overweight but not in lean participants. These results are somewhat surprising given the research indicating that weight criticism from the larger peer group may decrease overweight youth’s motivation to be physically active (Faith et al., 2002; Storch et al., 2007). However, these findings may also reflect overweight youth’s concerns with conveying a favorable impression in presence of an unfamiliar peer. Presumably, the importance of conveying a positive image is greater during the initial interactions with a stranger than with someone you know well (Leary et al., 1994). Friends are generally more assured of their mutual affection and have less need to use strategies to obtain each other’s approval (Jellison & Gentry, 1978; Leary et al., 1994). Overweight youth may be more concerned with making a good impression through physical activity in the presence of unfamiliar peers because of their history of weight criticism during physical activity and in an attempt to avoid such criticism. Albeit this strategic self-presentation hypothesis may help understand why overweight youth biked more in the peer condition than in the alone condition, it cannot fully explain their increased motivation to be physically active with someone they have not met.

Despite the difference between the friend and peer conditions in overweight versus lean youth’s actual activity, both of these social contexts (friend and peer) increased overweight youth’s motivation to be active and their actual physical activity relative to the alone condition. These findings are noteworthy because it is well-known that sedentary behaviors in children are concurrently and prospectively related to obesity and other health difficulties (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998; Dietz & Gortmaker, 1985, 2001; Dietz & Robinson, 2005). Many overweight youth experience problematic peer relations with school-based peers, which may in turn, lead to solitary and sedentary inactivity (Neumark-Sztainer, Croll et al., 2002; Neumark-Sztainer, Falkner et al., 2002; Strauss, Smith, Frame, & Forehand, 1985). The present findings strongly suggest that opportunities to be with friends and unfamiliar peers, with whom overweight children do not have any negative relationship history, may promote physical activity. Similar to other at-risk populations (Burgess, Wosjlawowicz, Rubin, Rose-Krasnor, & Booth-LaForce, 2006; Rubin, Wosjlawowicz, Rose-Krasnor, Booth-LaForce, & Burgess, 2006), peer involvement may be especially beneficial for overweight youth because they are often rejected and excluded from the larger peer group.

This study is not without limitations. First, the design used was not a true factorial design, as the option of playing video game with a friend or a peer was not available. In the social condition, participants had to chose between

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**Table II. Mixed Regression Models Predicting the Kilometers Biked**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilometers biked</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>3.86</td>
<td>0.44</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Peer vs. Alone</td>
<td>0.12</td>
<td>0.10</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Friend vs. Alone</td>
<td>-1.06</td>
<td>0.14</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>[Peer × WS] vs. [Alone × WS]</td>
<td>-0.58</td>
<td>0.17</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>[Friend × WS] vs. [Alone × WS]</td>
<td>0.10</td>
<td>0.17</td>
<td>.55</td>
</tr>
</tbody>
</table>

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**Figure 2.** Mean ± SEM distance biked (km) as a function of WS and social conditions.
(a) being alone and sedentary or (b) being active with a peer or a friend. However, the objective of the study was not to test the general effect of the presence of other individuals on sedentary and physical activities, but rather to test whether peers and friends can increase youth motivation to be physically active. We were especially interested in youth’s choices when confronted with solitary/sedentary and social/physically active alternatives. Second, although we had a heterogeneous sample in terms of ethnicity, the sample was relatively small and only involved youths aged 12–14. Teens of these ages may not be representative of “youth” of other ages. Furthermore, it is important to note that our sample did not include an even distribution of male and female overweight and normal weight participants, which may also qualify the results. The limited scope of this investigation prevents generalizing beyond this group of youth who participated in the study, and replication with independent samples is necessary. Finally, although the laboratory environment was useful to quantify the RRV of physical activity, future studies would benefit from examining the impact of peers and friends on the reinforcing value of physical activity in youth’s natural environment.

While investigators have examined peers as a moderator of social and emotional development (Rubin, Bukowski, & Parker, 2006), the present study is one of the first to demonstrate that peers and friends can promote physical activity and increase youths’ motivation to be physically active. The companionship provided by peers and friends during physical activity may increase youth’s positive emotion towards physical activity (Duncan, 1993) and increase the reinforcing value of exercise (Faith et al., 2002). Despite the importance of peers in the lives of adolescents, few studies have included peers as part of the physical activity support network for youth (Sallis, Alcaraz et al., 1999; Sallis, Prochaska, Taylor, Hill, & Geraci, 1999). These findings provide evidence that peer relationships are also relevant for understanding adherence to a healthy lifestyle. Decreasing sedentary behavior and increasing active leisure activities may require the structure of meaningful relationships with peers and friends. Any attempt to substitute physical activity for sedentary behavior and overeating may not be effective if problematic peer relationships persist, in part because sedentary activities and snack foods are easily accessible. Applications include improving interventions designed to address whether peers and friends can increase adherence to weight control recommendations. An important future step is to test whether peers and friends may be used to modify youths’ time allocation to alternative activities to sedentary behavior and to incorporate these interventions into a comprehensive pediatric weight-control program.

Conflicts of interest: None declared.

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