

Peer Victimization and Reactive and Proactive Aggression in Childhood:

The Protective Roles of Physical Activity and Sleep

BY

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Abstract

A growing body of literature indicates that the link between peer victimization and aggressive behavior may vary according to specific aggression subtypes; however, research has yet to identify factors that moderate these associations. The purposes of the present study were to further examine the links between peer victimization and reactive and proactive aggression and evaluate whether physical activity and sleep moderated these relations. Participants included 294 predominantly Caucasian children (50.7% male) between 7 and 11 years of age ($M = 8.71$, $SD = 1.17$), and their homeroom teacher. Peer victimization was assessed using self- and teacher-reports, and teachers provided ratings of children's aggressive behavior. Children also completed self-report measures assessing physical activity and sleep duration. Consistent with previous research, peer victimization was uniquely associated with reactive, but not proactive, aggression. Findings failed to provide support for the hypothesis that physical activity and sleep would serve as protective factors against the reactive aggression associated with experiences of victimization. Directions for future research are discussed.

Table of Contents

	Page
Introduction.....	1
Peer Victimization	1
Reactive and Proactive Aggression	2
Protective Factors.....	5
Current Study	8
Method.....	9
Participants.....	9
Measures	10
Peer victimization	10
Reactive and Proactive Aggression	12
Physical Activity.....	13
Sleep.....	13
Procedure	14
Data Analytic Plan.....	15
Results.....	16
Preliminary Analyses	16
Path Models	16
Reactive Aggression	16
Proactive Aggression	17
Discussion.....	17
References.....	23
Tables.....	35

Peer Victimization and Reactive and Proactive Aggression in Children:
The Protective Roles of Physical Activity and Sleep

Peer victimization, or the experience of being the recipient of peers' aggressive behavior, occurs frequently in elementary, middle, and high schools and has damaging effects on children's psychological and social adjustment. Although experiences of victimization have been consistently linked to externalizing behaviors and growing evidence suggests differential relations with specific subtypes of aggression, research has yet to identify factors that mitigate these associations. The primary goal of the current study was therefore to examine physical activity and sleep as moderators of the relations between peer victimization and reactive and proactive subtypes of aggression in a sample of elementary school-age children.

Peer Victimization

Peer victimization is a pervasive problem among school-age youth. Approximately 10-20% of students are severely and repeatedly victimized by their peers (Graham & Juvonen, 1998; Kochenderfer-Ladd & Wardrop, 2001; Stadler, Feifel, Rohrman, Vermeiren, & Poustka, 2010), and many more experience periodic patterns of victimization. In fact, one longitudinal study found that over the course of four years, 60% of elementary school children were exposed to some form of victimization (Kochenderfer-Ladd & Wardrop, 2001). Furthermore, peer victimization is highly stable across the school years; some evidence suggests that victimization may become a stable experience for children as early as five or six years old (Kochenderfer & Ladd, 1996) and remain consistent throughout middle childhood and adolescence (Paul & Cillessen, 2003; Scholte, Engels, Overbeek, de Kemp, & Haselager, 2007).

It is well documented that peer victimization is associated with increased risk for a wide range of adjustment problems, including internalizing symptoms of depression, anxiety,

loneliness, and low self-esteem (Hawker & Boulton, 2000; Reijntjes, Kamphuis, Prinzie, & Telch, 2010), peer rejection (Crick & Bigbee, 1998), school avoidance (Rueger, Malecki, & Demaray, 2011), and poor academic performance (Nakamoto & Schwartz, 2010). A substantial body of research has also demonstrated that experiences of victimization are a reliable predictor of increased externalizing behaviors, including aggression and delinquency (e.g., Hodges, Boivin, Vitaro, & Bukowski, 1999; Khatri, Kupersmidt, & Patterson, 2000) in addition to cigarette, alcohol, and drug use (Sullivan, Farrell, & Kliewer, 2006). For example, peer victimization was found to be concurrently and prospectively associated with increased teacher-reported aggression and delinquency over a two-year period in a sample of elementary-age children (Hanish & Guerra, 2002). Correspondingly, sociometric nominations (Schwartz, McFadyen-Ketchum, Dodge, Pettit, & Bates, 1998) and observational measures (Snyder et al., 2003) of peer victimization have been shown to predict increased parent- and teacher-reports of aggressive and delinquent behaviors two years later among elementary school students. Consistent findings have emerged among early adolescents, as middle school students who were identified by their peers as victims reported higher levels of aggression and delinquency than non-victims one year later (Paul & Cillessen, 2003). However, a growing body of literature indicates that the nature of this relation may vary according to specific aggression subtypes, namely reactive and proactive aggression (e.g., Camodeca & Goossens, 2005; Lamarche et al., 2007; Poulin & Boivin, 2000; Salmivalli & Nieminen, 2002).

Reactive and Proactive Aggression

Subtypes of aggression are commonly distinguished by the underlying function or motivation behind the behavior (e.g., Dodge, 1991; Dodge & Coie, 1987). Reactive aggression, consistent with the frustration-aggression model (Berkowitz, 1993), is characterized by angry

retaliatory behavior that occurs in response to perceived provocations or threats. Proactive aggression, on the other hand, appears to be best explained by the social learning theory (Bandura, 1986) and refers to deliberate, goal-oriented, and offensive actions that do not require provocation and are motivated by anticipated rewards. Proactive aggression includes instrumental behaviors that are directed toward obtaining an object or resource as well as behaviors that are aimed at influencing others through intimidation or domination (Dodge, 1991).

Despite considerable statistical overlap, exploratory and confirmatory factor analyses have consistently supported the distinction between reactive and proactive aggression (e.g., Crick & Dodge, 1996; Dodge & Coie, 1987; Fite, Colder, & Pelham, 2006; Poulin & Boivin, 2000; Salmivalli & Nieminen, 2002; Xu & Zhang, 2008). Several investigations have also revealed that these subtypes of aggressive behavior are characterized by different patterns of social-information processing. Specifically, reactive aggression has been associated with the tendency to attribute hostile intent to peers' behavior in ambiguous social situations (Crick & Dodge, 1996; Dodge & Coie, 1987; Schwartz et al., 1998; Xu & Zhang, 2008). In contrast, proactive aggression has been associated with a positive evaluation of aggression and its likely consequences, especially in the context of peer conflict (Crick & Dodge, 1996; Hubbard, Dodge, Cillessen, Coie, & Schwartz, 2001; Schwartz et al., 1998; Xu & Zhang, 2008). Moreover, reactive and proactive aggression have been found to be differentially related to psychosocial functioning in childhood and adolescence, with reactive aggression more strongly linked to internalizing symptoms and peer rejection and proactive aggression more strongly linked to antisocial outcomes (for reviews, see Fite, Rathert, Colder, Lochman, & Wells, 2012; Vitaro & Brendgen, 2011).

It is posited that victimized children may use reactive aggression as a defensive response and as a way to retaliate against hostile peer attacks (Lamarche et al., 2007; Pelligrini et al., 1999). Consistent with research examining the social-information processing deficits that characterize reactive aggression (e.g., Dodge & Coie, 1987), victimized children tend to exhibit a hostile attribution bias (Camodeca & Goossens, 2005; Schwartz et al., 1998). Thus, it is conceivable that youth who experience victimization may come to view their peers' behavior as provocative and hostilely motivated, which may lead them to react with angry retaliatory behavior. Indeed, Mahady Wilton, Craig, and Pepler (2000) observed that 43% of children in their sample of elementary school students were most likely to use the least effective methods, including physical and verbal aggression, when responding to peers' aggressive behavior.

Importantly, research findings have demonstrated that peer victimization is associated with reactive, but not proactive, aggression (Camodeca & Goossens, 2005; Camodeca, Goossens, Terwogt, & Schuengel, 2002; Card & Little, 2006; Pellegrini, Bartini, & Brooks, 1999; Poulin & Boivin, 2000; Salmivalli, & Helteenvuori, 2007; Salmivalli & Nieminen, 2002; Schwartz et al., 1998; Xu & Zhang, 2008). Of particular note, Lamarche and colleagues (2007) investigated the prospective links between experiences of victimization, assessed by sociometric nominations, and teacher-reported reactive and proactive aggression among twin children in elementary school. Results indicated that after taking into account previous levels of aggressive behavior, peer victimization uniquely predicted increases in reactive aggression, but not proactive aggression one year later. Given that reactive aggression is strongly associated with a host of adjustment difficulties (see Fite et al., 2012), including more stable and severe patterns of victimization (e.g., Camodeca et al., 2002), further research examining its relation to peer victimization, as well as what factors may moderate this association, is warranted.

Protective Factors

Despite the extensively documented link between peer victimization and psychosocial maladjustment, few studies have explored what individual, interpersonal, or environmental factors may mitigate this association and render some youth more resilient to such interpersonal experiences. Most extant research has focused on the protective role of social support among victimized youth. Studies have revealed that aspects of peer relationships, including having a best friend and friendship quality, may reduce risk for internalizing symptoms when children experience peer victimization (e.g., Hodges et al., 1999; Schmidt & Bagwell, 2007); however, findings have been equivocal (see Bollmer, Milich, Harris, & Maras, 2005). Likewise, investigations regarding the roles of parent and school support on the effects of peer victimization have yielded mixed results (e.g., Stadler et al. 2010). To date, only one known cross-sectional study has examined individual-level factors that protect victimized youth and found that the strength of children's religious and ethnic identity mitigated the effects of peer victimization on depressive symptoms (Hunter, Durkin, Heim, Howe, & Bergin, 2010). Thus, additional work is clearly needed to identify factors that moderate the association between peer victimization and maladjustment. Although few studies have examined health-promoting activities in the context of peer victimization, several lines of evidence support the hypotheses that physical activity and sleep may serve as protective factors against the reactive aggression associated with experiences of victimization.

Physical activity, which refers to bodily movement that results in energy expenditure (Caspersen, Powell, & Christenson, 1985), may involve a variety of activities ranging from active play and aerobic exercise to competitive sports. Previous research indicates that youth who engage in regular physical activity experience numerous health, psychological, social, and

behavioral benefits. For example, higher levels physical activity have been associated with lower levels of anxiety and depressive symptoms, higher self-concept, and improved academic performance and classroom behavior (for a review, see Strong et al., 2005). One study of high school students found that adolescents who reported engaging in physical activity were less likely to participate in an array of risk behaviors related to illegal drug use, alcohol, cigarette smoking, sexual intercourse, truancy, property damage, and violence (Nelson & Gordon-Larsen, 2006).

Several findings have also revealed that physical activity is linked to lower levels of aggressive behavior. One study of 8-year-old children demonstrated that physical activity was inversely related to emotional, social, and behavioral problems, including aggressive behavior (Martikainen et al., 2012). Correspondingly, another study of male undergraduate students found that individuals who did not report exercising exhibited higher levels of aggression and hostility than those who engaged in running (Nouri & Beer, 1989). Very little research to date has examined the impact of physical activity on aggression subtypes, with only one study showing a stronger inverse relation between physical activity and proactive aggression than with reactive aggression (Fite & Vitulano, 2011). Thus, the role of physical activity in the links between peer victimization and reactive and proactive aggression is in need of evaluation.

It has been suggested that engaging in physical activities may reduce risk for maladjustment “through a variety of mechanisms such as providing role models, peer networks, opportunities for teamwork, social development, problem solving, and effective outlets for energy” (Nelson & Gordon-Larsen, 2006, p. 1288). By providing opportunities for social development and problem solving, participation in physical activities may intervene on the process through which hostile attribution biases lead to reactive aggression among youth with

social-information processing deficits. Physical activity has been positively related with effective emotion management and coping strategies among adolescents (Isasi, Ostrovsky, & Willis, 2013). Further, previous research indicates that physical activity is associated with lower reactivity of the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis to psychological stress (e.g., Jackson & Dishman, 2006; Rimmelme et al., 2007). Thus, youth who engage in more frequent physical activity may be better able to cope with the negative emotions and stress associated with experiences of victimization and less likely to exhibit angry retaliatory behavior. The increase in positive affect (Pasco et al., 2011) and corresponding reduction in negative affect, anger, and tension associated with physical activity (McGowan, Pierce, & Jordan, 1991) may also help buffer the impact of peer victimization on the development of reactive aggression.

Sleep also represents an important indicator of physical and mental health in childhood and adolescence (for a review, see Dahl & Lewin, 2002). Whereas overall length of sleep has been linked to psychological well-being (e.g., Hamilton, Nelson, Stevens, & Kitzman, 2007), insufficient sleep and other indices of sleep problems have been associated with depressive and anxiety symptoms (Alfano, Zakem, Costa, Taylor, & Weems, 2009), poor academic performance (Wolfson & Carskadon, 1998), and substance use (Johnson & Breslau, 2001). Research findings have also revealed that lower quantity of sleep in childhood is significantly associated with increased externalizing problems, including aggression and delinquency (Aronen, Paavonen, Fjallberg, Soininen, & Torronen, 2000; Clinkinbeard, Simi, Evans, & Anderson, 2011; Pesonen et al., 2010). For example, aggressive behavior was shown to be more frequent among children and adolescents with reported sleep disturbances in a clinical study (Chervin, Dillon, Archbold, & Ruzicka, 2003). Haynes and colleagues (2006) examined behavioral and emotional changes in substance-abusing adolescents undergoing a behavioral sleep intervention, and found that

increases in sleep duration were associated with decreases in self-reported aggressive thoughts and actions. Furthermore, one long-term longitudinal study demonstrated that sleep problems at four years of age predicted increases in aggression 11 years later (Gregory & O'Connor, 2002). Similarly, parent-reported sleep problems in childhood have been found to be associated with higher levels of aggression in adulthood (Gregory, Van der Ende, Willis, & Verhulst, 2008).

Although no known studies have examined the associations between sleep and aggression subtypes, sleep variables appear to share similar correlates with reactive aggression. More specifically, insufficient sleep has been linked to higher levels of impulsivity (Paavonen et al., 2009), inattention (Gregory & O'Connor, 2002), and lower levels of self-regulation (Kahn-Greene, Lipizzi, Conrad, Kamimori, & Kilgore, 2006). Likewise, reactive aggression is characterized by impulsive behavior and attention problems (Dodge, Lochman, Harnish, Bates, & Pettit, 1997) as well as emotion dysregulation (Shields & Cicchetti, 1998). Considering the effects of insufficient sleep on mood lability and impulsivity and the fact that it impedes stress management skills (Killgore et al., 2008), sleep duration may impact children's ability to cope with experiences of victimization. As such, it follows that children who receive sufficient sleep may be less likely to react with angry retaliatory behavior when faced with interpersonal stressors such as victimization.

Current Study

Although a considerable body of research has identified the numerous consequences associated with peer victimization, only a few studies have examined its associations with subtypes of aggression. Moreover, relatively little is known about the factors that protect victimized youth from the emergence of these aggressive behaviors. The purposes of the current investigation were to address these gaps in the literature by further examining the links between

peer victimization and reactive and proactive aggression and evaluating whether physical activity and sleep may serve as moderators of these relations. The goals of this study were addressed using an elementary school-age sample. Recent evidence suggests that many forms of peer victimization are more prevalent among elementary school students as compared to older school-age populations (Turner, Finkelhor, Hamby, Shattuck, & Ormrod, 2011). Given that the onset and duration of peer victimization has significant implications for the development of adjustment problems (Kochenderfer & Ladd, 1996), this age range represents a critical time period for studying children's experiences of victimization.

Consistent with previous research (e.g., Dahl & Harvey, 2007; Martikainen et al., 2012; Lamarche et al., 2007), it was hypothesized that (1) peer victimization would be positively associated with reactive, but not proactive, aggression, and (2) peer victimization would be less strongly related to reactive aggression at high, as compared to low, levels of physical activity and sleep.

Method

Participants

Participants included 294 children (50.7% male) in Grades 2 (24.8%), 3 (25.9%), 4 (28.6%) and 5 (20.7%) from an elementary school located in a small, rural Midwestern community, and their homeroom teacher. Data collection occurred as part of a larger project examining the impact of bullying and victimization on children's psychological and social adjustment. All children in the second through fifth grades ($N = 490$) were recruited for participation. The study was approved by the university's Institutional Review Board as well as by school administrators. Caregiver consent and youth assent were obtained before student-reported data were collected. Recruitment was conducted during a community-wide information

session for caregivers regarding the upcoming school year, where study personnel set up a table and provided information to families interested in enrolling their child in the study. Consent forms were also sent home to the caregivers of the remaining eligible students at the beginning of the fall semester. Overall, consent forms were returned by 73% of the families ($n = 358$); of these, 89% of caregivers gave permission for their child to participate in the study ($n = 318$; approximately 65% of the eligible children). Data were missing for 16 students who were absent on the days of testing, four children who declined to participate, two children who did not complete the study because they required special testing accommodations, and two children who had transferred to another school between the time of obtaining consent and data collection.

The final sample consisted of 149 males and 145 females who ranged from 7 to 11 years of age ($M = 8.71$, $SD = 1.17$). School records indicated that the racial composition of students attending the elementary school was predominantly Caucasian, with less than 21% identifying as a racial minority (9% African-American, 6% Hawaiian/Pacific Islander, 4% American Indian, 2% Asian). Socioeconomic data were not available from the participants; however, per capita income for the city was approximately \$25,369, with 5.1% of individuals living below the federal poverty line (U.S. Census Bureau, 2010). According to school records, approximately 35% of all students were eligible for free or reduced-price lunch.

Measures

Peer victimization. Children's exposure to peer victimization was assessed using both self- and teacher-reports. Children completed a modified version of the Victimization of Self (VS) scale of the Peer Experiences Questionnaire (PEQ; Vernberg, Jacobs, & Hershberger, 1999). A downward extension of the PEQ was created by modifying the original questionnaire items to be appropriate for children reading at or below a 3rd grade level (Dill, Vernberg, Fonagy,

Twemlow, & Gamm, 2004). The final VS scale consisted of 9 items assessing a broad range of victimization experiences, including overt (e.g., “A kid hit, kicked, or pushed me in a mean way”) and relational (e.g., “A kid told lies about me so other kids wouldn’t like me”) victimization. In the present study, children were asked to rate the frequency of such occurrences since the beginning of the current school year (i.e., over a 10-week period) on a 5-point scale ranging from 1 (*Never*) to 5 (*Several Times a Week*). The VS scale has demonstrated good internal consistency among samples of both children (Dill et al., 2004) and adolescents (Vernberg et al., 1999).

Teacher-reports of peer victimization were evaluated using an 18-item measure adapted from a peer nomination scale (Crick & Bigbee, 1998). This measure includes six items pertaining to youth’s experiences of overt (e.g., “Gets hit, kicked, punched by others”) and relational (e.g., “Other kids tell rumors about them behind their back”) victimization. The remaining 12 items assess aggressive and bystander behaviors and were not included in the current analyses. Teachers responded to items on a 5-point Likert scale ranging from 1 (*Never*) to 5 (*Almost Always*). The adapted scale has demonstrated good internal consistency among samples of both children (Williford, Fite, & Cooley, 2013) and adolescents (Fite, Evans, Cooley, & Rubens, 2013).

The use of self-reports of peer victimization is supported in the literature given that such measures correspond to reports by peers (Graham & Juvonen, 1998) and parents (Bollmer, Harris, & Milich, 2006) and can capture subtle experiences of which others are unaware (McLaughlin, Hatzenbuehler, & Hilt, 2009). Teacher-reports have also demonstrated reliability and validity and been shown to correlate significantly with self-reports of victimization (Ladd & Kochenderfer-Ladd, 2002). In the current sample, self- and teacher-reports were significantly

correlated ($r = .15, p = .008$); thus, consistent with previous research (Rudolph, Troop-Gordon, Hessel, & Schmidt, 2011), a composite victimization score was created by averaging self- and teacher-reports, with higher scores indicating more severe experiences of victimization. Composite scores have been shown to reduce the influence of measurement error and provide a more reliable and comprehensive index of peer victimization (Ladd & Kochenderfer-Ladd, 2002). In fact, previous findings indicate that self- and teacher-reports are uniquely associated with children's adjustment, and a multi-informant composite of peer victimization yields more accurate estimations of adjustment than measures obtained from a single informant (Ladd & Kochenderfer-Ladd, 2002). The composite child- and teacher-report of peer victimization demonstrated good internal consistency in this sample ($\alpha = .86$).

Reactive and Proactive Aggression. Aggressive behavior was assessed using teacher-reports of the reactive-proactive aggression measure developed by Dodge and Coie (1987). This measure consists of six items, including a three-item reactive aggression subscale (e.g., "When the child has been teased or threatened, he/she gets angry easily and strikes back") and a three-item proactive aggression subscale (e.g., "The child uses physical force (or threatens to use physical force) in order to dominate other kids"). Responses were rated on a 5-point scale ranging from 1 (*Never*) to 5 (*Almost Always*). For each subtype of aggression, mean scores were computed and used for analyses, with higher scores indicating greater levels of reactive and proactive aggression. This instrument is a widely used measure of aggressive tendencies that has been shown to have strong construct validity and good reliability in previous research (e.g., Dodge & Coie, 1987; Poulin & Boivin, 2000; Waschbush, Willoughby, & Pelham, 1998). In the current sample, internal consistencies for the reactive and proactive aggression subscales were .92 and .88, respectively.

Physical Activity. Frequency of physical activity was assessed using a modified version of the Self-Administered Physical Activity Checklist (SAPAC; Sallis et al., 1996; Jensen & Steele, 2009). The SAPAC is a self-report measure that comprises a list of 21 different physical activities (e.g., bicycling, basketball, soccer, running); children are instructed to report their engagement in each activity before, during, and after school. The SAPAC was developed for use with pre-adolescent children, and it has demonstrated good reliability and validity based on objective measures of physical activity, including heart rate monitors and accelerometers (Sallis et al., 1996). The SAPAC was further adapted for use in the present study by combining before and after school activity engagement into one category and eliminating spaces for reporting additional activities as well as items assessing sedentary activities (e.g., playing video games). Children were asked to rate how often they participated in each activity for more than five minutes over a three-day period (i.e., *1 day, 2 days, 3 days, No days*). Consistent with previous research (e.g., Jensen & Steele, 2009), an overall score was generated by summing the number of physical activities children engaged in over a three-day period.

Sleep. Children's sleep duration was assessed using a modified version of the Sleep Habits Survey (SHS; Wolfson & Carskadon, 1998). The SHS is a self-report measure of sleeping and waking behaviors that was originally developed for use among adolescents. Only items evaluating bedtimes and wake times were included in the present study, and these questions were adapted to be developmentally appropriate for children by avoiding issues related to their ability to recall behaviors over the past two weeks. Specifically, children were asked to report their bedtime the previous night ("What time did you go to bed last night?") and their wake time that day ("What time did you wake up this morning?"). Response scales based on 30-minute intervals were created and ranged from *Before 8:00* to *After 10:00* for bedtimes and *Before 6:00* to *After*

8:00 for wake times. Differences between bedtimes and wake times were calculated and used to create a variable representing whether children met sleep duration recommendations (National Sleep Foundation, 2011); students' responses were dichotomized as ≥ 10 hours of sleep (1) and < 10 hours of sleep (0).

Procedure

Student data collection occurred approximately 10 weeks after the start of the fall semester. In order to accommodate all students without making any alterations to the standard school schedule, self-report measures were collected through group administration over the course of one week, with an adult-to-child ratio between 1:4 and 1:8. Children were assured of the confidentiality of their responses and provided verbal assent prior to their participation (98.7% agreed to participate; $n = 4$ refusals). During the 30-minute testing session, a trained research assistant read standardized instructions to the students, provided a description of the response scales, and then read each questionnaire item aloud. Trained research assistants circulated through the classroom to answer individual questions and help children who had difficulty reading or understanding particular items. Due to the time constraints of data collection, several groups of children in the second and third grade were unable to complete the self-report measures in the allotted time. As a result, data were missing for up to 25% for the SAPAC, which was the final measure administered during the testing session.

Homeroom teachers provided written informed consent ($n = 24$; 100% participation) prior to completing study measures. Teacher-reported data was collected through online surveys in the same month in which child self-reported measures were collected. All school classrooms, regardless of rates of participation, received a \$75 gift card upon completion of the study, and teachers were paid \$7 as compensation for each survey completed.

Data Analytic Plan

Correlational analyses were first estimated to evaluate bivariate associations between peer victimization, reactive and proactive aggression, physical activity, and sleep and to determine whether demographic variables, including gender and grade, should be included as covariates in subsequent analyses. Unique associations and the proposed moderating effects of physical activity and sleep were then evaluated within a structural equation model framework by estimating four path models using Mplus statistical software (Muthen & Muthen, 2010). More specifically, a hierarchical approach was employed in which reactive and proactive aggression were separately regressed on peer victimization, physical activity, sleep, and demographic variables to examine unique effects. Further, proactive aggression was controlled for in the model examining reactive aggression and vice versa in order to account for the statistical overlap in the aggression subtypes. Next, peer victimization by physical activity and peer victimization by sleep interaction terms were added to the models to evaluate whether the relations between peer victimization and aggression subtypes differed as a function of these health-promoting behaviors. All variables were standardized prior to analyses to reduce multicollinearity and aid in the interpretation of significant interactions. Based on the sample size of 294 participants, the present study had sufficient power to detect interactions with moderate to large effect sizes (Aiken & West, 1991).

In order to accommodate the previously noted missing data, full information maximum likelihood estimation (FIMLE) was used. FIMLE has been found to provide less biased parameter estimates and to be more efficient compared to other methods of handling missing data (Arbuckle, 1996). In addition to FIMLE, robust maximum likelihood estimation was used due to proactive aggression being positively skewed (value = 3.4) and leptokurtic (value = 11.97).

This estimation method uses a chi-square test statistic and maximum likelihood parameter estimates with standard errors that are robust to non-normally distributed data. Each evaluated model was fully saturated (0 degrees of freedom), which resulted in perfect fits to the data; accordingly, model fit statistics are not reported.

Results

Preliminary Analyses

Means, standard deviations, and correlations among all study variables are presented in Table 1. As shown, more frequent experiences of victimization were associated with higher levels of physical activity, reactive aggression, and proactive aggression. Whereas physical activity was negatively related to sleep, it was found to be positively associated with proactive aggression. Consistent with expectations, reactive aggression and proactive aggression were highly correlated. Effects for gender and grade level were also observed. Specifically, boys experienced more frequent peer victimization and were rated as exhibiting higher levels of reactive and proactive aggression than girls. Further, grade level was positively associated with physical activity and negatively associated with sleep. Thus, both demographic variables were included as covariates in subsequent analyses. Overall, 38% of the sample reported meeting the sleep duration recommendations (i.e., ≥ 10 hours) the previous night. Of note, only 2.4% of study participants had experienced more frequent incidents of peer victimization as defined by an average composite score greater than or equal to 2.5.

Path Models

Reactive Aggression. A first-order effects model was first estimated in which reactive aggression was regressed on proactive aggression, gender, grade, peer victimization, physical activity, and sleep (see Table 2). Results indicated that gender (being male; $B = -.16, p < .001$),

high levels of proactive aggression ($B = .68, p < .001$), and high levels of peer victimization ($B = .12, p = .04$) were uniquely associated with high levels of reactive aggression. The potential moderating effects of physical activity and sleep were then evaluated by adding the cross product terms of peer victimization and these health-promoting activities to a second model. However, neither physical activity ($B = -.10, p = .11$) nor sleep ($B = .02, p = .74$) interacted with peer victimization to influence reactive aggression.

Proactive Aggression. When proactive aggression was regressed on reactive aggression, gender, grade, peer victimization, physical activity, and sleep, high levels of reactive aggression were uniquely associated with high levels of proactive aggression ($B = .73, p < .001$; see Table 2). In contrast, gender, peer victimization, and physical activity were no longer significantly associated with proactive aggression. Peer victimization by physical activity and peer victimization by sleep cross product terms were then added to a second model to evaluate potential moderating effects. However, neither physical activity ($B = .11, p = .11$) nor sleep ($B = -.04, p = .43$) interacted with peer victimization to influence proactive aggression.

Discussion

The pernicious effects of peer victimization on youth's behavioral and emotional functioning are well documented in the extant literature. In particular, experiences of victimization have consistently been shown to predict increased aggressive behavior up to two years later among children and adolescents (e.g., Hanish & Guerra, 2002; Paul & Cillessen, 2003; Schwartz et al., 1998; Snyder et al., 2003). Although growing evidence suggests that the nature of this relation may vary according to specific aggression subtypes (e.g., Lamarche et al., 2007), research has yet to identify factors that buffer the impact of victimization on the development of these aggressive behaviors. Thus, the primary goal of the present study was to

examine physical activity and sleep as moderators of the relations between peer victimization and reactive and proactive aggression in a sample of elementary school-age children.

Consistent with previous research (Camodeca & Goosens, 2005; Camodeca et al., 2002; Card & Little, 2006; Lamarche et al., 2007; Pellegrini et al., 1999; Poulin & Boivin, 2000; Salmivalli & Nieminen, 2002; Schwartz et al., 1998; Xu & Zhang, 2008), peer victimization was found to be uniquely associated with higher levels of reactive, but not proactive, aggression. Lamarche and colleagues (2007) suggest that victimized youth may come to use reactive aggression as a means to protect themselves or retaliate against hostile peers; however, it is important to note that this relation is likely reciprocal in nature. Thus, youth who experience victimization may respond with reactive aggression, thereby inadvertently reinforcing their peers with dramatic emotional responses (Perry, Williard, & Perry, 1990) and exaggerated retaliatory behavior (Schwartz et al., 1998) and increasing their risk for future victimization (Camodeca et al., 2002). Although significantly correlated at the bivariate level, peer victimization was no longer uniquely associated with proactive aggression after taking into account other variables in the path model; this finding was consistent with expectations based on past studies, which have shown that bullying is positively related to both reactive and proactive aggression, whereas victimization is linked only to reactive aggression (e.g., Camodeca et al., 2002; Pellegrini et al., 1999).

Findings from the current study did not support the hypothesis that physical activity and sleep would serve as buffers against the reactive aggression associated with experiences of victimization. Although prior research has shown that these health-promoting behaviors are linked to lower levels of aggressive behavior (e.g., Clinkinbeard et al., 2011; Martikainen et al., 2012), physical activity and sleep were not uniquely related to aggression subtypes, nor did they

interact with peer victimization in the prediction of reactive or proactive aggression. The lack of support for the protective role of these health-promoting behaviors may be due to several measurement issues as described below. However, considering the numerous psychosocial benefits associated with physical activity and sleep (e.g., Hamilton et al., 2007; Strong et al., 2005), continued research investigating whether engaging in regular physical exercise and obtaining sufficient sleep renders youth less vulnerable to the effects of peer victimization, including depressive and anxiety symptoms, substance use, and delinquency, is warranted. Future work should incorporate other indices of sleep, as both sleep duration and sleep quality have been linked to mental health problems in childhood and adolescence (e.g., Dahl & Lewin, 2002). Moreover, future investigations may benefit from examining participation in individual (e.g., running, bicycling) and group-based activities (e.g., football, soccer) separately, as the mechanisms by which physical activity confers protection may differ according to extent to which one is involved with peers. For example, group-based activities may provide opportunities for social development and problem solving (Nelson & Gordon-Larsen, 2006), whereas the benefit of individual activities may be attributed to their tendency to increase positive affect (Pasco et al., 2011) while reducing negative affect, anger, and tension (McGowan, Pierce, & Jordan, 1991).

Of note, experiences of victimization were related to greater engagement in physical activity at the bivariate level. In fact, the results of several studies have revealed that children who are victimized at school are also victimized while taking part in sports both within (Peguero, 2008) and outside of the school context (for a review, see Collot D'Escury & Dudink, 2010). It is posited that this may occur because aggressors have more opportunities to victimize their peers or because coaches interfere less or are less aware of such incidents (Collot D'Escury & Dudink,

2008; Peguero, 2008). These findings are concerning in light of the fact that peer support and acceptance are associated with motivation for physical activity (Smith, 1999), sport continuation, perceived self-confidence, and enjoyment of physical activity in adolescence (Fitzgerald, Fitzgerald, & Aherne, 2012). Further, Fitzgerald and colleagues (2012) assert that “peer victimization, in particular, may create an environment where adolescents feel more insecure about being active, worry about not being selected to participate on sports teams, and have limited opportunities and support for physical activity; all of which may cause them to avoid situations that involve physical activity” (p. 954). Given the importance of regular physical activity in maintaining physical and mental health (e.g., Strong et al., 2005), additional research is needed to address the potential barrier peer victimization may create for children and adolescents’ engagement in a physically active lifestyle.

The findings of the present study should be considered within the context of several limitations. First, the research design was cross-sectional in nature. Future work examining these associations from childhood to adolescence would be useful for determining the long-term impact of peer victimization on aggression subtypes. Although this study employed a multi-informant method, which reduces the risk of response bias and shared method variance, a second limitation involves the reliance on retrospective self-reports of physical activity and sleep. As previously noted, the time constraints of data collection prevented approximately 25% of our sample from completing the measure of physical activity, which may have impacted the accuracy of the activity estimates. However, post-hoc independent *t*-tests and chi-square analyses revealed that children who completed the physical activity measure did not differ on any study variable other than grade level, as non-completers were disproportionately represented in the second and third grades, as compared to the fourth and fifth grades. Future research would benefit from

using more precise, objective measures of physical activity, such as actigraphs. Moreover, in order to avoid issues related to children's ability to recall their behaviors over longer periods of time, the items used to assess sleep duration were modified to inquire only about the previous night. The use of actigraphs in future work would also provide the opportunity to more accurately examine sleep duration and sleep quality, both of which have been found to impact psychological well-being (e.g., Dahl & Lewin, 2002).

The percentage of children who were exposed to more frequent patterns of peer victimization in this sample was relatively lower than previously reported estimates, which range between 10-20% (Graham & Juvonen, 1998; Kochenderfer-Ladd & Wardrop, 2001; Stadler et al., 2010). Although this may have been due to the time frame in which such experiences were assessed (i.e., over a 10-week period), future research may benefit from examining these associations among a more chronically victimized group of children. Finally, it is important to note that the present study only had sufficient power to identify interactions with moderate to large effect sizes. Thus, it is possible that physical activity and sleep may in fact moderate the associations between peer victimization and reactive and proactive aggression, albeit with small effect sizes that this project was underpowered to detect.

Nonetheless, taken together with previous work examining the link between experiences of victimization and maladjustment, the current findings highlight the need for interventions to address the mental health needs of children who are victimized by their peers. To date, most interventions have been designed as school-based programs that are aimed at changing normative beliefs about the acceptability of aggressive behavior and reducing the prevalence of aggression among peers (for a review, see Leff, Power, Manz, Costigan, & Nabors, 2001). A recent meta-analysis of school bullying interventions found that such programs were more likely to influence

attitudes, knowledge, and self-perceptions rather than the incidence of bullying and victimization behaviors (Merrell, Gueldner, Ross, & Isava, 2008). Although these prevention-based programs are important for reducing the overall rates of victimization within schools, they are unlikely to completely eliminate peer aggression. Consequently, it is essential for interventions to target youth who are victimized by their peers in order to mitigate the negative psychosocial sequelae of victimization experiences, including reactive aggression. One school-based program, the “Social Skills Group Intervention (S.S.GRIN),” has demonstrated efficacy in improving peer acceptance, social self-efficacy, and self-esteem and in reducing depressive symptoms, social anxiety, and aggression among victimized third-graders over a one-year period (DeRosier & Marcus, 2005). Although further research is needed to evaluate the effectiveness of this intervention in other school-based settings, the S.S.GRIN shows particular promise in ameliorating adjustment problems among youth who are frequently victimized by their peers. Given that children who fight back against their aggressors are more likely to develop stable and severe patterns of victimization (Kochenderfer & Ladd, 1997), timely interventions such as this may prove to be an important aspect of preventing an escalating cycle of peer victimization and reactive aggression.

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Table 1

Descriptive Information and Correlations Among All Study Variables

	1	2	3	4	5	6	7
1. Gender	–						
2. Grade	-.09	–					
3. Peer Victimization	-.15*	-.02	–				
4. Physical Activity	.03	.31***	.23***	–			
5. Sleep	.08	-.13*	-.10	-.21***	–		
6. Reactive Aggression	-.27***	.08	.38***	.12	-.07	–	
7. Proactive Aggression	-.13*	.10	.34***	.14*	-.08	.74***	–
<i>M</i>	–	3.45	1.29	24.33	–	1.51	1.20
<i>SD</i>	–	1.08	0.42	17.30	–	0.93	0.56

Note. * $p < .05$; *** $p < .001$; Gender (1 = Female, 2 = Male).

Table 2

Path Coefficients for Reactive and Proactive Aggression Models

	<u>Reactive Aggression</u>		<u>Proactive Aggression</u>	
	<i>B</i>	SE <i>B</i>	<i>B</i>	SE <i>B</i>
Proactive Aggression	.68***	.05	--	--
Reactive Aggression	--	--	.73***	.09
Gender	-.16***	.04	.08	.04
Grade	.00	.04	.04	.05
Peer Victimization	.12*	.06	.08	.06
Physical Activity	.00	.04	.01	.05
Sleep	.02	.04	-.02	.04

Note. * $p < .05$; *** $p < .001$; Gender (1 = Male, 2 = Female).