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Proximal Associations among Bullying, Mood, and Substance Use: A Daily Report Study

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Abstract

Adolescent involvement in bullying as a victim or perpetrator has been associated with negative health outcomes, including emotional distress and substance use. Whether negative affect and substance use are acute responses to bullying involvement or whether they develop over time is unknown. Such knowledge is needed to understand the conditions under which bullying contributes to adverse outcomes, as well as to inform the development of appropriate interventions. This study examined the daily-level associations among bullying, negative affect, and substance use (i.e., alcohol, cigarettes, electronic-cigarettes, marijuana) among a community sample of adolescents (N = 204) ages 13 – 16 years (55% female, 81% European American, 13% African-American) who had reported bully victimization or perpetration in the past six months. Participants completed a brief on-line survey every day for 56 consecutive days, reporting on their experiences with bully victimization, bully perpetration, mood, and substance use for that day. Consistent with hypotheses, being bullied on a given day was associated with reporting greater than average levels of sadness (b = 0.279, *95% CI* = [0.172, 0.387]), anger (b = 0.354, *95% CI* = [0.242, 0.466]), and cigarette use (OR = 1.453, *95% CI* = [1.006, 2.099]) on that day; however, it was not associated with alcohol, electronic-cigarette, or marijuana use. Perpetration was not associated with same day negative affect or substance use. Results of the current study suggest that negative affect and cigarette use may be acute responses to bully victimization. Bully perpetration does not appear to be proximally linked to mood or substance use after accounting for victimization.

Author Contributions

JAL designed and executed the study and wrote the manuscript. JLD conducted the primary data analysis and wrote part of the results. WW assisted with the data analysis and wrote part of the results section. MT contributed to the design of the study and collaborated on the writing and editing of the final manuscript. ABN and DLE provided consultation on the design and execution of the study and contributed to writing and editing the final manuscript. KEM contributed to the design and execution of the study and collaborated on the writing and editing of the final manuscript.

Compliance with Ethical Standards

All procedures performed in this study involving human participants were in accordance with the ethical standards of the University at Buffalo, State University of New York Institutional Review Board and national research committees and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent (from parents) and assent (from adolescents) was obtained from all individual participants included in the study.

Introduction

Bullying is a form of peer aggression that is commonly experienced by adolescents in middle and high school; approximately 20% of US public school students reported being bullied in 2015 (Kann et al., 2016). Bully perpetration is a multifaceted phenomenon that is characterized as the intentional, unsolicited, and repeated use of physical (e.g., hitting, kicking, pushing, shoving), verbal (e.g., name-calling, teasing), and/or social (e.g., spreading rumors, social exclusion) aggression toward one's peers to inflict physical, psychological, social, or educational harm (Gladden, Vivolo-Kantor, Hamburger, & Lumpkin, 2014). It peaks in early to mid-adolescence, a developmental period characterized by a propensity towards risk behavior and heightened sensitivity to social and emotional rewards. This heightened sensitivity amplifies the significance of peer acceptance and rejection as well as the allure of risky activities (Steinberg, 2008; 2014). As such, negative social interactions can have a devastating impact on psychological adjustment, spur involvement in high risk activities, and disrupt various developmental trajectories. Indeed, involvement in bullying as a perpetrator, victim, or bully-victim has been associated with a host of long-term negative health outcomes including depression, anxiety, trauma symptoms, and substance use (Espelage, Hong, & Mebane, 2016; Farrington, Loeber, Stallings, & Ttofi, 2011; Ttofi, Farrington, Lösel, Crago, & Theodorakis, 2016).

The potential for bullying to contribute to adolescent substance use is particularly concerning, given that adolescent use has been associated with substance use disorders, risky sexual behavior, and dating and sexual violence (King & Chassin, 2007; Temple & Freeman, 2011; Young, Grey, Abbey, Boyd, & McCabe, 2008). While experimentation with tobacco, alcohol, and marijuana are normative during adolescence, bullies, victims, and bully-victims may be prone to using these substances in riskier ways (i.e., earlier or heavier use) that contribute to the development of substance use problems and other negative health outcomes (e.g., accidents or violence; Sullivan, Farrell, & Kliewer, 2006). Although the bivariate relationship between bullying and substance use is well-documented (e.g., Tharp-Taylor, Haviland, & D'Amico, 2009), the nature and timing of this association is not well understood. One important question that remains to be answered is whether substance use occurs as an acute response to a bullying event or whether it develops over time, possibly in response to chronic emotional distress, repeated exposure to traumatic events, or association with delinquent peers. Examination of the timing of substance use in relation to involvement in peer aggression as a victim or a perpetrator will increase understanding of the underlying mechanisms and help guide prevention and intervention efforts.

Both bully victimization and perpetration have been associated with substance use among adolescents; however, the manner in which they are related appears to differ in meaningful ways. Studies examining the relation between bully victimization and substance use have yielded mixed findings. For example, in a cross-sectional study of 8th graders, experiencing physical and relational victimization by peers was associated with cigarette and alcohol use; relational aggression was also associated with marijuana use (Sullivan et al., 2006). There have been longitudinal studies that have found evidence for a prospective relationship between bully victimization and substance use among middle school students, with experiences of being bullied predicting future use of alcohol, marijuana and cigarettes

(Earnshaw et al., 2017; Tharp-Taylor et al., 2009). Yet other studies have failed to find a direct relationship between victimization and substance use (e.g., Hong, Voisin, Cho, Smith, & Resko, 2017) or found it only for those victims who also engage in bullying (i.e., bully-victims; Kelly et al., 2015; Radliff, Wheaton, Robinson & Morris, 2012).

In contrast, the relationship between bully perpetration and substance use is much more robust. Both cross-sectional and longitudinal research consistently reveal an association between bully perpetration and use of alcohol, tobacco, and marijuana among adolescents (e.g., Espelage, Low, Rao, Hong, & Little, 2014; Hemphill et al., 2011; Lamb & Craig, 2017). Cross-sectional studies of middle and high school students comparing substance use for victims and perpetrators have found that bully perpetration, but not victimization, was associated with cigarette, alcohol and marijuana use (Morris, Zhang, & Bondy, 2006; Radliff, Wheaton, Robinson, & Morris, 2012). Prospectively, over the course of a school year (fall to spring), bully perpetration and pro-bullying attitudes predicted alcohol and cigarette use among high school students, while victimization did not (Quinn, Fitzpatrick, Bussey, Hides, & Chan, 2016). The relation between bully perpetration and substance use extends into young adulthood, with youth who perpetrated bullying in middle school reporting higher rates of violence involvement, heavy drinking and marijuana use at age 21, compared with non-bullies (Kim, Catalano, Haggerty, & Abbott, 2011).

Research and theory suggest that emotional dysregulation may play an important role in the relation between peer aggression and substance use. Adolescents tend to be emotionally labile and have underdeveloped emotion regulation skills, which can lead to the development of maladaptive coping responses (Brooks-Gunn, Graber, & Paikoff, 1994; Mischel et al., 2014). Involvement in negative peer interactions such as bullying is likely to increase emotional arousal; indeed, both bully perpetration and victimization have been associated with negative affective states (Kowalski & Limber, 2013). Specifically, bullies have been found to report high levels of anger and hostility (Espelage, Bosworth, & Simon, 2001; Golmaryami et al., 2016) and victims often report high levels of internalizing symptoms, such as sadness and depression (Espelage, Low, & De La Rue, 2012; see Moore et al., 2017). Bullying and substance use may occur as a maladaptive means of coping with feelings of anger and hostility (Espelage et al., 2001; Low & Espelage, 2013; Wills, Simons, Sussman, & Knight, 2016). Consistent with this premise, Herts, McLaughlin, & Hatzenbuehler (2012) found that emotional dysregulation mediated the relation between exposure to stressful life events and aggressive behavior among adolescents. In the substance use literature, emotion regulation (i.e., tension reduction) has long been identified as an important motive for alcohol use among adults and adolescents (Cooper, 1994; Sher & Grekin, 2007), and smoking has been identified as a means of coping with negative affect, particularly anger, among adolescents (Mischel et al., 2014; Piko, Varga, & Wills, 2015).

The role of emotion regulation in the association between peer aggression and substance use has been studied more extensively for bully victimization than for bully perpetration. Peer victimization tends to be associated with internalizing forms of negative affect including sadness, depression, anxiety and suicidal ideation (Turner, Exum, Brame, & Holt, 2013). According to the self-medication hypothesis, victims of peer aggression may use substances to cope with the negative affect associated with victimization (Khantzian, 1997; Luk, Wang,

& Simons-Morton, 2010; Marschall-Lévesque et al., 2017). Consistent with the self-medication hypothesis, negative affect (i.e., depression, sadness, loneliness) has been found to mediate the relation between bully victimization and substance use (i.e., cigarettes, alcohol, drunkenness, marijuana) in large cross-sectional studies of 9–10th grade students (Lambe & Craig, 2017; Luk et al., 2010). Negative affect has also been implicated in the substance use behavior of bullied adolescents prospectively, with various studies showing that coping motives, depression, and suicidal ideation mediate the association between peer victimization and substance use over time (Earnshaw et al., 2017; Marschall-Levesque et al., 2017; Topper, Castellanos-Ryan, Mackie, & Conrod, 2011). Although these findings are supportive of the self-medication hypothesis, to date, it is unknown whether negative affect and substance use occur as acute responses to victimization (i.e., same day), or whether the use of substances as a strategy for coping with emotional distress develops over time, after multiple victimizations. With regard to bully perpetration it is less clear whether adolescents use substances to relieve negative affect after perpetrating aggression, or whether bully perpetration and substance use are both means of dealing with negative affect.

If emotion regulation is indeed a mechanism through which bullying is related to substance use, there should be close, temporal relations between negative affect and substance use on days when bullying occurs. Daily report methods are ideal for capturing proximal associations between events. Compared with traditional survey reports which require participants to recall details about events that occurred several weeks, months, or years in the past, daily reports reduce retrospective bias and improve ecological validity by collecting information about an event close to the time it occurred. Daily reports also allow for the assessment of transient states (i.e., moods), which cannot be recalled reliably over long periods of time (Bolger, Davis, & Rafaeli, 2003; Iida, Shrout, Laurenceau, & Bolger, 2012). Daily reports are also optimal for examining within-person effects, independent of between-person effects that may be masked by between-person differences (Hamaker, 2012). Although people who experience more bullying may drink more than the sample as a whole (between subjects effect), only by looking within individuals can we determine whether experiencing bullying on a given day increases that person's drinking relative to a day when that person is not involved in bullying. This is particularly relevant for adolescents who vary in terms of their access to and use of substances.

A few studies have used daily report methods to examine the proximal effects of bullying on adolescent well-being. Those studies that have used daily report methods have focused on the proximal effects of victimization on adolescents' mood and well-being. Their findings revealed that experiencing peer aggression (i.e., physical, verbal, relational) on a given day was associated with increased odds of reporting higher levels of sadness, embarrassment, anger, nervousness, and physical complaints (e.g., stomachache) on that day (Morrow, Hubbard, Barhight, & Thomson, 2014; Nishina, 2012; Reavis, Donahue, & Upchurch, 2015). It is plausible that adolescents are more likely to use substances on days that they experience bullying; however, this has not been examined. Moreover, the proximal associations among bully perpetration, negative affect, and substance use are unknown.

Although the acute effects of bullying on substance use have not been well studied, findings from several studies using daily report methods with adult samples indicate that perpetrators

and victims of other forms of interpersonal violence are more likely to report substance use later that day. For example, in a sample of married and cohabitating adults, Derrick and Testa (2017) found that partners who reported involvement in verbal aggression as a victim or a perpetrator were more than two times as likely to consume alcohol within three hours of the event. In a daily report study examining the temporal relations among alcohol, marijuana, angry affect, and dating violence perpetration among college women, the odds of perpetrating psychological aggression increased on days when marijuana use, alcohol use, and angry affect were reported. Relevant to the current study, angry affect moderated the relation between substance use and dating violence perpetration, such that alcohol and marijuana use increased odds of perpetration on days when angry affect was high, but not when angry affect was low (Shorey, Stuart, Moore, & McNulty, 2014). This finding suggests that an inability to regulate angry affect plays an important role in the perpetration of dating aggression and may be relevant to the perpetration of other kinds of aggression as well. Research findings from adult samples have also indicated that the effects of involvement in interpersonal violence on substance use, particularly alcohol use, can surface both within the next few hours following the aggressive incident (Derrick & Testa, 2017) and also the next day (Parks, Hsieh, Bradizza, & Romosz, 2008), making it important to consider effects from the following day as well as same day effects. For example, in a college sample of women, Parks et al. (2008) found that the odds of alcohol use were three times higher in the 24 hours following verbal victimization and 1.3 times higher one week after experiencing sexual victimization.

The Current Study

The current study examined the proximal, daily associations among bully victimization, bully perpetration, negative affect and substance use. Using daily report data collected over an eight week period (56 days), we examined whether adolescents were more likely to report negative affect and substance use (i.e., alcohol, cigarettes, electronic-cigarettes and marijuana) on days when they experienced bullying and on days when they bullied a peer. Based on within-person analyses, we hypothesized that: a) an individual's negative affect will be greater than that person's typical negative affect on days when they are involved in bullying as either a victim or a perpetrator; b) the type of negative affect will differ according to whether victimization or perpetration was reported, such that victimization will be associated with greater than average sadness and bully perpetration will be associated with greater than average anger on the day of the aggression; c) substance use will be more likely to be reported on days when either bully victimization or perpetration occurs compared to days without bullying. We examined use of alcohol, cigarettes, electronic cigarettes (e-cigarettes) and marijuana as outcomes because these substances are used commonly by adolescents in this age range and are easily accessible because they are often used by parents or older siblings (see Johnston, O'Malley, Miech, Bachman, & Schuelenberg, 2017). We included electronic cigarette use as well as conventional cigarette use because, although little is known about e-cigarette use, it is rapidly becoming more common than conventional cigarette use among adolescents in general (Hines, Fiala, & Hedberg, 2017). Consistent with this trend, e-cigarette use was more prevalent in the current sample (Lessard, Livingston, Molnar, Eiden & Schuetze, 2016).

Method

Participants

Participants were a sample of adolescents (N = 204, 55.4% female) between 13 and 16 years of age (M = 14.04, SD = 0.81) recruited from the community. Consistent with the demographics of the county, approximately 81% of participants self-identified as European American, 13% as African American, 2.5% as multiracial, and 1% as Native American. Hispanics/Latinos comprised 8.4% of the sample. Median household income was $40,000 - $79, 999 (mother – reported). The majority of participants were in 8th (28.4%), 9th (37.7%), or 10th (25.0%) grades. Adolescents participating in the daily report study were selected from a larger sample (N = 801) of youth who were participating in a longitudinal survey study of the impact of social relationships on adolescent development and health outcomes.

Procedure

Recruitment for longitudinal survey study.—The sample for the main longitudinal survey study was recruited using address-based sampling between October 2014 and June 2016. A minimum of two mailings describing the study and providing study contact information were mailed to households in a county in western New York State. Mailing lists were purchased through Click2 Mail, a company that prepares marketing lists based on publicly available data. Neighborhoods that had a high concentration of families with children in the desired age range (13 – 15 years) were targeted for recruitment. In order to increase sample diversity, we purchased supplemental marketing lists that targeted neighborhoods with higher concentrations of racial and ethnic minorities and low income households; one to two additional mailings were sent to households in this sample. Individuals interested in participating contacted the study via phone, e-mail, or US mail and were screened by phone to determine eligibility. To be eligible for the survey study, adolescents had to be 13 – 15 years of age, be enrolled in a public or private school (i.e., not homeschooled), speak and read English at a 6th grade proficiency level and be living with a mother or female guardian who was also willing to participate in the study. Once an eligible mother-adolescent dyad had been identified, a secure link to an on-line consent form and survey was sent to the mother. After the mother indicated consent electronically, a separate, secure link was sent to the adolescent with an on-line assent form and baseline survey to complete.

As part of the baseline survey, adolescent participants provided demographic information and reported on their experiences with bullying and other forms of peer aggression using the California Bully Victimization Scale (CBVS: Felix, Sharkey, Green, Furlong, & Tanigawa, 2011), described below. Participants rated how often in the past six months they experienced or perpetrated acts of physical, verbal, relational, and property-based aggression. Responses were on a scale from 0 through 6: 0 = *Never happened*, 1 = *Less than once a month*, 2 = *About once a month*, 3 = *2 or 3 times per month*, 4 = *About once a week*, 5 = *Several times per week*, 6 = *Every day or almost every day*.

Recruitment for daily report study.—Recruitment for the daily report study took place on a rolling basis between January 2015 and June 2016. To be eligible, participants had to

indicate that they had experienced bully victimization once a month or more on the baseline survey. Participants had to be recruited to the daily report study within 90 days of completing their baseline survey to increase the likelihood of capturing current and on-going victimization. Eligible participants were contacted by phone and offered the opportunity to participate in the daily report study, which was presented as separate but related to the main study. Verbal parental consent and electronic adolescent assent were obtained for those who agreed to participate and a secure link to access the daily reports was sent to each of the adolescent participants. Out of 801 participants who completed the baseline survey, 345 (43.1%) qualified for the daily report study. Of these, 110 were not recruited within the 90-day window, 20 refused participation and 10 agreed to participate but withdrew prior to completing any daily reports. This left a final sample of 204 participants who provided at least two consecutive days of daily report data and were included in the analyses (Range = 8 to 56 completed reports, $M = 49.8$, $SD = 8.52$, $Mdn = 53$).

Compared to adolescents who were ineligible, those who were eligible for the daily report study were more likely to be girls (63.9% vs. 52.6%) than boys (36.1% vs. 47.4%), $\chi^2(1) = 10.266$, $p = .001$, experience more bully victimization ($M = 1.04$, SD = 0.89 vs. $M = 0.15$, SD = 0.26), $t(798) = -20.548$, $p < .001$, report more bully perpetration ($M = 0.30$, SD = 0.51 vs. $M = 0.10$, SD = 0.26), $t(798) = -6.912$, $p < .001$, more childhood experience of violence ($M = 0.40$, SD = 0.39 vs. $M = 0.22$, SD = 0.28), $t(799) = -7.770$, $p < .001$, to be drunk in lifetime ($M = 0.48$, SD = 1.13 vs. $M = 0.28$, SD = 0.81), $t(532) = -2.336$, $p = .020$, to smoke in lifetime ($M = 0.25$, SD = 1.00 vs. $M = 0.09$, SD = 0.55), $t(798) = -2.878$, $p = .004$, use an e-cigarette in lifetime ($M = 0.60$, SD = 1.40 vs. $M = 0.35$, SD = 1.05), $t(797) = -2.852$, $p = .004$, and use marijuana (e.g., pot, grass, hashish) in lifetime ($M = 0.16$, SD = 0.36 vs. $M = 0.08$, SD = 0.27), $t(799) = -3.342$, $p = .001$. There were no differences in age and ever using alcohol.

Among those who were eligible for the daily report study, boys were more likely to participate than girls (72.4% of boys vs. 51.4% of girls), $\chi^2(1) = 14.304$, $p < .001$. Eligible participants did not differ from eligible non-participants on bully victimization, bully perpetration, childhood experience of violence, age, or use of alcohol, cigarettes, e-cigarettes, or marijuana. Procedures for both the longitudinal and the daily report studies were approved by the University at Buffalo Institutional Review Board.

Participants were instructed to complete a five-minute on-line daily survey for 56 consecutive days between the hours of 3:00 PM and 11:59 PM using a computer, tablet, or smartphone device. Participants were paid $0.50 each day for each completed report plus a $10 bonus for each week when they completed all seven reports and a partial bonus ($7) for each week when they completed five or six reports. At the end of the 8-week period, participants received an additional $20 bonus for having completed a total of 51, 52, or 53 reports ($n = 35$), or a $25 bonus for having completed 54, 55, or 56 reports ($n = 82$). If participants missed a reporting day, they were able to complete an abbreviated make-up report the following day (e.g., affect was not assessed retrospectively). The maximum possible payment amount, including bonuses for complete data, was $133. Participants were paid for their participation by checks, which were mailed to them every two weeks.

Measures

Mood/affect.—Daily mood was measured using the two higher order scales of the Positive and Negative Affect Schedule - Expanded Form (PANAS - X; Watson & Clark, 1994; Watson, Clark, & Tellegen, 1988). The Positive Affect scale consisted of five items (e.g., happy, energetic) to assess mood valence, as did the Negative Affect Scale (e.g., gloomy, irritable). Participants rated their daily mood on a 5-point scale from 0 = *Not at all* through 4 = *Extremely*. Preliminary analyses showed that positive and negative affect were inversely related. Based on this and our primary interest in adverse outcomes associated with peer victimization, only negative affect subscales were used in these analyses. Based on exploratory factor analysis, negative affect was divided into two subscales reflecting internalizing (sad, gloomy) and externalizing (angry, irritable) mood. Items were averaged to create a sadness variable and an anger variable for each participant. Internal consistency for these subscales was $\alpha = 0.81$ and $\alpha = 0.75$.

Peer victimization and perpetration.—Experiences with bullying as either a victim or a perpetrator were assessed each day for 56 consecutive days. Bullying was measured using an adapted version of the California Bully Victimization Scale (CBVS; Felix et al., 2011; see above). This measure includes six items assessing intentionally mean or hurtful acts of teasing, spreading rumors, ignoring/excluding others, physical harm (i.e., hit, push), making threats, and stealing or damaging property. All six of these items were included in the daily report. In addition, based on feedback received from adolescent participants during pilot testing of the instrument, we added a seventh item that assessed passive aggressive teasing, "Did any of your peers say something to you in a joking way that offended you?" Each day participants indicated whether they experienced each of the behaviors since the previous day's report (0 = *No*, 1 = *Yes*). All seven items were summed to create a peer victimization score for each day for each participant. Parallel questions were used to assess adolescents' behavior towards their peers each day (perpetration). These items were also summed to create a perpetration score for each day for each participant.

Substance use.—Each day, participants reported on whether or not they used the following substances that day: alcohol, cigarettes, e-cigarettes and marijuana (0 = *No*, 1 = *Yes*). If a substance was used, participants were also asked to report on the amount or frequency of usage for that day (i.e., number of drinks, number of cigarettes smoked, number of times smoked marijuana).

Timing of peer aggression and substance use events.—Adolescent participants reported the timeframe when bullying, alcohol use, and marijuana use occurred, on a 7-point scale: 1 = *Very late evening (midnight-6am*); 2 = *Early morning (6am – 9am)*; 3 = *Late morning (9am – 12 noon)*; 4 = *Afternoon (12 noon – 3pm)*; 5 = *Late afternoon (3pm – 6pm)*; 6 = *Early Evening (6pm – 9pm)*; 7 = *Late Evening (9pm – midnight)*. Because cigarette and e-cigarette use could occur at multiple time points during the day, the timing was not assessed.

Childhood experiences of violence.—At baseline, adolescent's exposure to childhood victimization was measured using the Childhood Experiences of Violence Questionnaire

(CEVQ; Walsh, MacMillan, Trocme, Jamieson, & Boyle, 2008). Two items assessed adult aggression toward other adults (i.e., parent-to-parent aggression), eight items assessed adult aggression toward the child (e.g., slapped; grabbed or shoved; kicked, bit, or punched), and six items assessed sexual abuse (e.g., showed private parts; threatened to have sex). All these items were rated on a 5-point scale from 0 = *Never* through 4 = *More than 10 times*. An average score was computed over these sixteen items to create a CEVQ variable for each adolescent participant. Internal consistency for the CEVQ scale was $\alpha = 0.77$. Given that childhood victimization (e.g., interparental violence, childhood maltreatment) can have an impact on all of the key variables of interest (e.g., Espelage et al., 2012; Hébert, Cénat, Blais, Lavoie, & Guerrier, 2016; Kristman-Valente, Brown, & Herrenkohl, 2013; Lucas, Jernbro, Tindberg, & Janson, 2016; Shin, Edwards, & Heeren, 2009), we included it as a Level 2 covariate.

Demographics.—Demographic information was assessed as part of the baseline survey and included age, year in school, sex, race, and ethnicity.

Data Analyses

An a priori power analysis was conducted using a Monte Carlo simulation approach (described in Muthén & Muthén, 2002). We set α at .05 and generated and analyzed 1000 datasets for each effect of interest. To be conservative, we estimated an effect size corresponding to Cohen's $d = .10$ for associations between the predictors (bullying victimization and perpetration) and both the continuous and categorical outcomes (negative mood and substance use). According to simulations using 200 participants, 56 reports, and data missing at random at Level 1, this test would have greater than .99 power to detect significant associations between bullying and both negative mood and substance use.

We used multilevel modeling in Mplus Version 7.4 (Muthén & Muthén, 1998–2015) using maximum likelihood estimation with robust standard errors to examine daily outcomes resulting from bully victimization and perpetration each day. Unlike other methods for analyzing repeated measures data (e.g., ANOVA), our strategy does not require listwise deletion for missing data at Level 1. Instead, all available entries are analyzed, and participants with more complete data are weighted more heavily than those with less complete data. Thus, we included any participants with at least two consecutive days of reports in our analyses (two days are necessary, rather than one, given our lagged predictors). Although two consecutive days was the cut off, all of our participants had at least 8-days of data. Several other studies using daily report data have conducted their analyses with fewer than eight days of data (e.g., Nishina & Juvonen, 2005; Reavis et al., 2015; Testa et al., 2015). We used a two-level nested structure: day (Level 1) was nested within person (Level 2). The negative affect outcomes (sadness, anger) were analyzed as continuous and substance use outcomes (cigarettes, e-cigarettes, alcohol, marijuana) as dichotomous outcomes.

The primary predictors in each model included today's bully victimization and today's bully perpetration (both Level 1 variables, person mean centered [PMC]), to examine same-day effects, and yesterday's bully victimization and yesterday's bully perpetration (both Level 1

variables [PMC]), to control for stability in the predictors and to examine cross-day effects (Enders & Tofighi, 2007). We included victimization and perpetration in the same model because research has indicated that bully victimization and perpetration are associated both concurrently and over time (e.g., Barker, Arseneault et al., 2008; Bowes et al., 2013; Haltigan & Vaillancourt, 2014), and we wanted to ensure we were attributing any apparent associations to the appropriate type of event. We included three additional Level 1 variables: the lagged dependent variable (PMC for negative affect or coded 0 = no use, 1 = use for substance use), to control for stability in the outcome, day of the study (coded 1–56 but grand mean centered [GMC] for analyses), to control for unmeasured temporal confounds, and weekend (0 = weekday, Sunday - Thursday; 1 = weekend, Friday-Saturday; uncentered), considering that there might be a weekend effect on negative affect and substance use outcomes in adolescence. We also included Level 2 control variables that were related to bully victimization, bully perpetration, negative affect, or substance use in our descriptive statistics: 1) baseline reports of childhood experiences of violence (GMC), to control for previous exposure to violence; 2) age level (GMC), to control for cohort differences in bullying experience; and 3) gender (coded 0 = boys, 1 = girls; uncentered), to control for mean differences between boys and girls. The intercept was allowed to vary randomly, but given issues with convergence, all slopes were treated as fixed effects. The intercept represents the average mood (or the likelihood of substance use) for boys with average childhood experiences of violence and age reported at baseline, on a “typical” day of the study, on days following “typical” negative affect (or no substance use), with typical levels of victimization and perpetration.

Results

Compliance with daily reports was excellent. Of a possible 11,424 daily reports (56 days × 204 participants), adolescents reported on 9,600/11,424 days (84.0%, range = 8 – 56, M = 49.82, SD = 8.52), with identical rates for boys (n = 91), who reported on 4,283/5,096 days (84.0%, range = 8–56, M = 49.85, SD = 8.56), and girls (n = 113), who reported on 5,317/6,328 days (84.0%, range = 9–56, M = 49.79, SD = 8.50). Of these reports, 7,825/9,600 (81.5%) were made on time and 1,775 (18.5%) were make-ups. Make-up reports were included in the analyses. On average, adolescent participants completed reporting at 7:00 pm (M = hour 7:13, SD = 2.79). The most common reporting times occurred between 4:00 – 5:59 PM (33.8%) and 9:00 – 10:59 PM (23.8%). The majority of bully victimization and perpetration occurred during the period of time that corresponds to the school day (i.e., between 9:00am and 3:00pm, 54.9% and 56.9% respectively), followed by late afternoon (3:00pm – 6:00pm, 17.4% and 16.3% respectively). The times when cigarette and e-cigarette use occurred were not recorded; the majority of alcohol use occurred between 6:00pm and midnight (60.4%).

Table 1 presents the range of responses, means and standard deviations for an average day, as well as the correlations between study variables within individuals. Notably, the maximum value for bully victimization reached on a given day was 7.0 (the maximum possible on the scale), and the maximum value for bully perpetration reached on a given day was 4.0 on the scale from 0 to 7. At the bivariate level, on an average day bully victimization and perpetration were positively associated with each other (r = .29, p < .01) and both were

positively associated with childhood experiences of violence, sadness, anger, and use of cigarettes and e-cigarettes. Age and childhood experiences with violence were both significantly correlated with several of the outcome variables.

Table 2 displays the frequency of bully victimization, bully perpetration, negative affect, and substance use days, the percentage of days out of 56 days overall, and the values for boys and girls separately. Victimization was reported on 562 days. Individual participants reported 2.8 days of victimization on average (range = 0 – 33 days, SD = 4.13). Perpetration was reported on 182 days, with participants reporting an average of 0.9 days of perpetration (range = 0 – 25 days, SD = 2.43) over the 56-day period. Participants reported feeling "a little bit," "moderately," "quite a lot," or "extremely" sad or gloomy on 4,195 days (M = 20.6 days, range = 0 −53, SD = 13.25) and feeling "a little bit," "moderately," "quite a bit," or "extremely" angry or irritable on 4,656 days (M = 22.8 days, range = 0 −55, SD = 13.74). There were 103 days of smoking reported, a mean of 0.5 days (range = 0–39, SD = 3.50). The average number of cigarettes smoked on a day when cigarette use was reported was 3.12 (SD = 2.41). A total of 211 days of e-cigarette use were reported, with a mean of 1.0 days (range = 0 – 39, SD = 4.18). On days when e-cigarette use was reported, the daily average frequency of use was 4.70 (SD = 3.62). Adolescents also reported 125 drinking days (M = 0.6 days, range = 0–12, SD = 1.78). On a day when alcohol use was reported, adolescents consumed alcohol on a mean of 1.24 occasions (SD = 0.65) and had an average of 2.52 drinks (SD = 2.23). There also were 112 days of marijuana reported, a mean of 0.5 days (range = 0–14, SD = 2.13).

Boys were more likely than girls to bully others, $t(9{,}538) = 2.15$, $p = .031$. Girls were more likely than boys to be sad, $t(7{,}806) = -10.47$, be angry, $t(7{,}807) = -8.92$, be victimized, $t(9{,}560) = -4.63$, have more childhood experiences of violence, $t(11{,}422) = -14.61$, and be older, $t(11{,}422) = -3.57$ (all p's < .001). Girls also reported more e-cigarette use (2.6% vs. 1.7%), χ^2 (1) = 9.79, $p = .002$, and more alcohol use (1.7% vs. 0.8%) than boys, χ^2 (1) = 14.26, $p < .001$. Boys reported more cigarette use than girls (1.7% vs. 0.6%), χ^2 (1) = 26.78, $p < .001$. There were no gender difference in marijuana use (boys 1.4% vs. girls 1.0%), $\chi^2(1) = 3.607$, $p = .058$. Given these gender differences, we included gender as a covariate in the daily report analyses.

We also ran a series of t-tests and cross-tabulations exploring the scores on sadness, anger, cigarette use, e-cigarette use, alcohol use, and marijuana use for adolescents who experienced bullying versus those who did not (i.e., between-person). Results showed that adolescents who experienced bully victimization reported greater sadness (M = 1.26, SD = 1.13 vs. M = 0.69, SD = 0.89), $t(7{,}801) = -13.210$, $p < .001$, and anger (M = 1.40, SD = 1.34 vs. M = 0.77, SD = 0.93), $t(7{,}802) = -14.129$, $p < .001$, more cigarette use (4.8% vs. 0.8%), $\chi^2(1) = 78.204$, $p < .001$, and more e-cigarette use (4.1% vs. 2.1%), $\chi^2(1) = 9.992$, $p = .002$, compared to adolescents who did not experience bully victimization. There were no differences in alcohol use (0.9% vs. 1.3%), $\chi^2(1) = 0.796$, p = .372, and marijuana use (1.1% vs. 1.2%), $\chi^2(1) = 0.052$, p = .819. With respect to bully perpetration, adolescents who engaged in bully perpetration reported greater sadness (M = 1.00, SD = 1.10 vs. M = 0.72, SD = 0.92), $t(7{,}787) = -3.654$, $p < .001$, and anger (M = 1.34, SD = 1.14 vs. M = 0.80, SD = 0.94), $t(7{,}788) = -14.129$, $p < .001$, more cigarette use (11.1% vs. 0.9%), $\chi^2(1)$ =

172.496, $p < .001$, and e-cigarette use (5.6% vs. 2.2%), $\chi^2(1) = 9.441$, $p = .002$, compared to adolescents who did not engage in bully perpetration. There were no differences in alcohol use (1.7% vs. 1.3%), $\chi^2(1) = 0.177$, $p = .674$, and marijuana use (1.1% vs. 1.2%), $\chi^2(1) = 0.007$, $p = .935$.

Looking within participants, we hypothesized that adolescents would report greater than average sadness and substance use on days when they experienced bully victimization. We did not expect to observe elevated anger. As can be seen in the upper part of Table 3, within individuals, experiencing bully victimization was associated with greater sadness, greater anger, and greater likelihood of using cigarettes that same day compared with non-bully days. Importantly, these associations emerged after controlling for bully perpetration. These associations were not significant for e-cigarette use, alcohol use, or for marijuana use. The associations with victimization were limited to same-day consequences; we did not observe cross-day associations.

We similarly hypothesized that adolescents would be more likely to report anger and substance use on days when they reported perpetrating aggression against a peer. Contrary to our hypothesis, when controlling for victimization, perpetration was not a significant predictor of any of the outcome variables on the same day or the next day with two exceptions: adolescents were *less* likely to report marijuana use on the same day perpetration was reported and less likely to report e-cigarette use on the day *after* perpetration was reported.

In the current data, participants were also asked, if a substance was used, to reported on the amount of usage. We repeated our analysis using number of drinks, number of cigarettes smoked, and times of using an e-cigarette and smoking marijuana as the outcomes. We did not observe a significant association between bully victimization or perpetration and the amount of usage.

Discussion

The purpose of the current study was to examine adolescents' acute responses to bullying as a victim or a perpetrator, with the goal of identifying the onset of two adverse health outcomes that have been linked to bullying: emotional distress and substance use. Understanding the timing of these outcomes is critical to developing effective intervention approaches for those involved in bullying. Theories of emotional regulation posit that involvement in bullying as a victim or a perpetrator is associated with acute, negative emotional responses which may spur use of substances as a means of regulating negative affect (Luk et al., 2010; Marschall-Levesque et al., 2017). Based on this theory, we hypothesized that participants would report greater negative affect and have higher odds of using substances on days when greater than usual bullying occurred. Consistent with expectations, adolescents who reported being bullied more than usual by a peer on a given day reported greater sadness and were more likely to use cigarettes on that day than on days when they experienced less victimization than usual. They also reported higher levels of anger on higher victimization days. However, contrary to our hypotheses, perpetration of

peer aggression was not significantly associated with same day changes in negative affect or substance use.

Our findings provide additional support for the self-medication hypothesis for victimization by establishing that there are close, proximal associations among victimization, negative affect and cigarette use. These findings are consistent with prior research showing that adolescents may use cigarettes to cope with negative emotions, particularly anger (Mischel et al., 2014; Piko et al., 2015). The results of this study extend the literature by showing that the associations between negative affect and substance use occur in temporal proximity to a bully victimization event, suggesting that victimization can be a significant stressor. It is important to note that while our findings document proximal associations among bully victimization, negative affect and cigarette use that are consistent with theories of emotion regulation, we do not know the exact temporal ordering of these events within the day.

Despite prior research indicating that bully victims may use alcohol to cope with the distress associated with victimization (e.g., Luk et al., 2010; Topper et al., 2011), in this study, there was no relation between victimization and alcohol use at the daily level. Thus, the relation between victimization and alcohol use does not appear to be contemporaneous, at least not among early adolescents. It may be that use of alcohol to cope with negative affect occurs later in adolescence when alcohol is more accessible and use is more normative. Younger adolescents (i.e., 8^{th} and 9^{th} graders) are somewhat more likely to smoke cigarettes than to drink alcohol; however, alcohol use increases with age and exceeds cigarette use among older adolescents (Johnston et al., 2017). Conducting a similar study with older adolescents may yield different results. It is also possible that use of alcohol as a coping strategy only occurs for more chronic or severe mood disturbances (i.e., depression vs. transient sadness). Future research should examine whether experiencing victimization and sadness over multiple days is prospectively associated with depression and substance use over time. An important caveat to these findings is that a substantial portion of participants completed their daily reports in the late afternoon, possibly before drinking occurred on that day. Because of this, alcohol use may have been underreported.

The finding that bully perpetration was not associated with negative affect or use of any substances on the day of perpetration suggests that perpetrators do not feel more distressed than usual on these days and substance use does not serve an emotion regulation function for them, at least not in the short term and after controlling for victimization effects. For perpetrators of peer aggression, substance use may not be proximally linked to perpetration, but rather may be associated more globally through affiliating with delinquent, substance using peers, and engaging in other externalizing behaviors (Lambe & Craig, 2017). It is also important to note that the current study examines within-person variation in mood and substance use based on bullying involvement for a given day. It could be that the high rates of anger and hostility associated with bully perpetration in other samples (e.g., Espelage et al., 2001; Golmaryami et al., 2016) are reflective of between-person differences. Indeed, when examining differences between perpetrators and non-perpetrators in the current sample, perpetrators did report greater sadness, anger, cigarette use and e-cigarette use than non-perpetrators.

It is unclear why a pattern of decreased marijuana use was observed on the days when greater than average bullying perpetration occurred and a pattern of decreased e-cigarette use was observed on the day following bully perpetration. Marijuana use is globally associated with bully perpetration (e.g., Merrin, Espelage, & Hone, 2018); however, the proximal association between marijuana use and perpetration is unknown. Also, little is known about the proximal relation between e-cigarette use and bullying. More research is needed to shed light on why marijuana and e-cigarette use might decrease following bully perpetration or whether this is a spurious finding, which is plausible given the small number of people who used these substances.

Limitations

This study had several strengths, including the daily report methodology that assessed bully perpetration, victimization, and multiple forms of substance use with excellent compliance over a two-month period. Use of within-person analysis allowed for the examination of how involvement in bullying affected adolescents at an individual level. That is, we were able to observe whether involvement in bullying resulted in negative affect or substance use that was significantly different from what was typical for that individual. Previous research has primarily focused on between-person associations, and thus, cannot rule out the possibility that unmeasured between-person variables (e.g., general delinquency, accessibility of substances) account for the associations between bullying and negative affect and substance use. By examining within-person associations, and therefore using an individual as his or her own control, we were able to minimize this problem.

Nonetheless, as with any research, there are important limitations to consider when interpreting the results. Although the sample was representative of the surrounding county in terms of race and ethnicity, 81% of participants self-identified as European American, which limits generalizability to a more racially diverse population. In addition, the mean age of the sample was 14 years. The pattern of results may differ in an older adolescent sample as a function of having more experience with bullying, greater involvement with substances, or developmental changes in coping skills or perceptions of peer aggression. Although reports of daily affect were always made after the occurrence of bullying, another limitation of the current study is that the timing of substance use in relation to involvement in bullying on a given day is unknown. In general, across reports, bullying most commonly occurred in the late morning and afternoon hours and alcohol use most commonly occurred in the evening hours so it is likely that the aggression preceded alcohol use. The time of day when cigarettes or e-cigarettes were typically used is unknown.

Although over half of our participants reported being victimized and over a quarter of them reported perpetrating bullying against others at some point over the eight-week course of the study, the likelihood of being involved in bullying as a victim or a perpetrator on any given day was fairly small. We selected eight weeks as a time period long enough in duration to capture some aggressive events without overburdening participants. The effect sizes for the effects of victimization were somewhat small (a one-unit increase in victimization only leads to a .28 to .35-unit increase in negative mood and a 44% increase in the likelihood of using cigarettes; see Table 3). However, it is important to remember that these values represent

within-person changes in mood and substance use on a particular day, given less or more bully victimization or perpetration *than usual* for a particular individual. In this study, we focused on the daily mood and substance use of 13–15 year-olds. The cumulative effect of enduring bully victimization over a long period of time may be substantially greater (Murray et al., 2009).

Future Research Directions

This study is an important first step in examining the proximal associations among peer aggression, negative affect, and substance use. Results indicate that at the daily level, victimization is associated with increased emotional distress and cigarette use. These findings underscore the importance of intervening with victims of bullying as soon after the victimization occurs as possible, to help them find effective means of coping with distress. Programs that are designed to enhance social and emotional skills and mindfulness show promise in helping high school students manage their emotions and may be helpful for youth involved in bullying (Conley, 2015). Going forward, it is also important to consider the cumulative effects of victimization and negative affect over time. For example, are adolescents who experience victimization and distress over multiple days more likely to develop symptoms of depression or anxiety over time? What are the substance use trajectories of adolescents who are currently using cigarettes contemporaneous to being bullied? Are these individuals more prone to using other substances over time? Future research should also consider whether other factors (e.g., social support, bystander intervention) can mitigate or exacerbate negative affect associated with a bullying event.

Although the current study revealed no proximal associations among perpetration, negative affect and substance use, it does not rule out the possibility that there are cumulative effects that occur over time. More research is needed to understand the mechanisms and timing through which bully perpetration and substance use come to be associated. There may be factors other than negative affect (e.g., delinquency, desire for peer approval, poor self-regulatory skills) that play a role in perpetration of aggression and substance use. Future research on perpetration also needs to consider the contextual factors (e.g., presence of others, response of others) proximal to the aggressive incident to determine the role of social factors in substance use and bully perpetration.

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Table 1

Score Minimums, Maximums, Means, Standard Deviations, and Correlations for Bully Victimization, Bullying Perpetration, Sadness, Anger, and Substance Use over 56 Days within Individuals

Variable	Descriptive Statistics				Correlations									
	Min	Max	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1. Bully victimization	0.00	7.00	0.07	0.34	--									
2. Bullying perpetration	0.00	4.00	0.02	0.19	0.29**	--								
3. Age	13.01	16.02	14.51	0.85	−0.04**	0.01	--							
4. Childhood experiences of violence	0.00	2.44	0.42	0.40	0.13**	0.12**	0.12**	--						
5. Sadness	0.00	4.00	0.72	0.92	0.15**	0.05**	0.03*	0.18**	--					
6. Anger	0.00	4.00	0.81	0.95	0.15**	0.08**	0.07**	0.14**	0.68**	--				
7. Cigarette use	0.00	1.00	0.01	0.10	0.14**	0.19**	0.07**	0.18**	0.09**	0.08**	--			
8. E-cigarettes use	0.00	1.00	0.02	0.15	0.04**	0.03**	0.05**	0.04**	0.05**	0.08**	0.19**	--		
9. Alcohol use	0.00	1.00	0.01	0.11	0.00	0.01	0.07**	0.02	0.04**	0.06**	0.16**	0.16**	--	
10. Marijuana	0.00	1.00	0.01	0.11	0.02	0.00	0.10**	0.02	0.05**	0.07**	0.28**	0.24**	0.13**	--

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 2

Daily Reporting of Study Variables in the Aggregate (N = 204; Boys = 91, Girl = 113)

Variable					Boys				Girls			
	Number of teens	% of teens with at least one event	Days	% of Days[a]	Number of boys	% of teens with at least one event	Days	% of Days[b]	Number of girls	% of teens with at least one event	Days	% of Days[b]
Bully victimization	138	67.6	562	5.9	52	57.1	191	4.5	86	76.1	371	7.0
Bully perpetration	59	28.9	182	1.9	24	26.4	94	2.2	35	31.0	88	1.7
Sadness[c]	200	98.0	4,195	43.7	87	95.6	1,704	39.8	113	100	2,491	46.8
Anger[c]	203	99.5	4,656	48.5	90	98.9	1,937	45.2	113	100	2,719	51.1
Cigarette use	11	5.4	103	1.1	6	6.6	72	1.7	5	4.4	31	0.6
E-cigarette use	30	14.7	211	2.2	13	14.3	72	1.7	17	15.0	139	2.6
Alcohol use	37	18.1	125	1.3	11	12.1	35	0.8	26	23.0	90	1.7
Marijuana use	24	11.8	112	1.2	12	13.2	27	0.6	12	10.6	52	1.0

Note:

[a]Reports based on a total 9,600 days.

[b]Reports based on a total 4,283 days for boys and 5,317 days for girls.

[c]Days of Sadness included any days in which teens reported they felt “a little bit”, “moderately”, “quite a bit” or “extremely” sad or gloomy; Days of Anger referred to any days in which teens reported they felt “a little bit”, “moderately”, “quite a bit” or “extremely” angry or irritable.

Table 3.

Associations with Daily Bullying Victimization and Perpetration

	Sadness		Anger		Cigarette Use		E-cigarette Use		Alcohol Use		Marijuana Use	
	b	***95% CI***	***b***	***95% CI***	***OR***	***95% CI***	***OR***	***95% CI***	***OR***	***95% CI***	***OR***	***95% CI***
Intercept	0.625***	[0.510, 0.740]	0.738***	[0.608, 0.868]	0.000***	[0.000, 0.000]	0.000***	[0.000, 0.000]	0.000***	[0.000, 0.000]	0.000***	[0.000, 0.000]
Within (Level 1)												
Victimization (PMC)	0.279***	[0.172, 0.387]	0.354***	[0.242, 0.466]	1.453*	[1.006, 2.099]	1.099	[0.637, 1.896]	0.911	[0.361, 2.298]	1.042	[0.712, 1.526]
Victimization (PMC, *t* − 1)	−0.024	[−0.094, 0.045]	−0.053	[−0.126, 0.021]	1.073	[0.933, 1.234]	1.209	[0.813, 1.797]	1.064	[0.557, 2.034]	1.470	[0.851, 2.539]
Perpetration (PMC)	0.048	[−0.111, 0.206]	0.103	[−0.078, 0.285]	0.888	[0.455, 1.735]	1.114	[0.649, 1.913]	0.964	[0.469, 1.979]	0.187**	[0.064, 0.548]
Perpetration (PMC, *t* − 1)	−0.013	[−0.120, 0.094]	−0.078	[−0.197, 0.040]	1.021	[0.798, 1.306]	0.441*	[0.196, 0.993]	0.956	[0.290, 3.149]	0.228	[0.020, 2.637]
Day of Study (GMC)	0.001	[−0.001, 0.003]	0.002*	[0.000, 0.003]	0.997	[0.967, 1.027]	1.003	[0.988, 1.019]	1.005	[0.994, 1.016]	0.986	[0.962, 1.010]
DV (*t* −1)	0.240***	[0.190, 0.289]	0.166***	[0.126, 0.206]	3.842*	[1.310, 11.272]	5.152***	[2.101, 12.636]	3.860**	[1.541, 9.671]	3.395**	[1.697, 6.790]
Weekend (weekday=0, weekend=1)	−0.048*	[−0.087, −0.010]	−0.052**	[−0.088, −0.016]	1.360	[0.683, 2.707]	1.263	[0.855, 1.864]	0.854	[0.545, 1.336]	0.920	[0.509, 1.664]
Between (Level 2)												
Childhood Victimization (GMC)	0.428***	[0.200, 0.656]	0.391**	[0.158, 0.624]	18.011*	[1.822, 178.039]	4.904*	[1.146, 21.010]	1.319	[0.429, 4.059]	1.870	[0.376, 9.281]
Age (GMC)	−0.014	[−0.112, 0.085]	0.033	[−0.069, 0.134]	8.215*	[1.313, 51.470]	2.305	[0.807, 6.580]	2.280*	[1.176, 4.415]	6.773**	[1.811, 25.330]
Gender (0=boys, 1=girls)	0.157+	[−0.001, 0.315]	0.137	[−0.035, 0.310]	0.234	[0.011, 4.928]	1.028	[0.175, 6.062]	2.782+	[0.899, 8.611]	0.656	[0.107, 4.031]

*** $p < .001$,

** $p < .01$,

* $p < .05$,

+ $p < .10$

Note. DV (*t* − 1) refers to the lagged dependent variable, included to control for stability in the outcome. Day of the study was originally coded from 1–56, but was grand mean centered for analyses and included to control for unmeasured temporal confounds. Lagged and concurrent victimization and perpetration variables were person mean centered. *b*s less than zero represent decreases and greater than

zero represent increases; *OR*s less than one represent decreases and greater than one represent increases. *b* = unstandardized regression coefficient; *95% CI* = 95% confidence interval; *OR* = odds ratio; *t* – 1 = time-lagged predictor; GMC = grand mean centered predictor; PMC = person mean centered (concurrent) predictor