Mapping Developmental Precursors of Cyber-Aggression: Trajectories of Risk Predict Perpetration and Victimization

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Abstract

Technologically mediated contexts are social arenas in which adolescents can be both perpetrators and victims of aggression. Yet, there remains little understanding of the developmental etiology of cyber aggression, itself, as experienced by either perpetrators or victims. The current study examines three-year latent within-person trajectories of known correlates of cyber-aggression, problem behavior, (low) self-esteem, and depressed mood, in a large and diverse sample of youth (N = 1364; 54.6% female; 12-14 years old at T1). Findings demonstrate that developmental increases in problem behavior across grades 8-10 predict both cyber-perpetration and victimization in grade 11. Developmental decreases in self-esteem also predicted both grade 11 perpetration and victimization. Finally, early depressed mood predicted both perpetration and victimization later on, regardless of developmental change in depressed mood in the interim. Our results reveal a clear link between risky developmental trajectories across the early high school years and later cyber-aggression and imply that mitigating trajectories of risk early on may lead to decreases in cyber-aggression at a later date.

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Introduction

Online social contexts afford a wealth of opportunities to interact with peers, express identity, experience belonging, and seek distraction. Most adolescents have access to these aspects of the digital world, and roughly 95% of adolescents are connected to the internet, with most of those young people accessing social media or other online modes of communication (Australian Bureau Statistics, 2009; Lenhart, Maddeen, Smith, Purcell, Zickuhr, Rainie, 2011). Despite the prevalence of online social interaction, and its dramatic recent proliferation, little is known about how the nature of interactions in the online environment is related to adolescent maladjustment and wellbeing.

As with face-to-face contexts, technologically mediated contexts are social arenas in which adolescents can be both perpetrators and victims of aggression (Law, Shapka, Hymel, Olson, & Waterhouse, 2012; Lester, Cross, & Shaw, 2012). There is general consensus that, like face-to-face aggression, online aggression can result in negative consequences for victims and perpetrators, although variation in definitions and measures results in a wide range for prevalence estimates of online aggressive behavior (Levy, Cortesi, Crowley, Beaton, Casey, & Nolan, 2012; Ybarra, Boyd, Korchmaros, & Oppenheim, 2012). For instance, there is considerable discourse regarding the use and operationalziation of terms such as online aggression, internet harassment, online bullying, electronic bullying and cyberbullying (Langos, 2012; Menesini et al., 2012; Pyzalski, 2012; Ybarra, Boyd et al., 2012). In particular, the traditional bullying construct has not been readily translatable to the cyber realm (Dooley, Pyzalski, & Cross, 2009; Ybarra, Boyd et al., 2012), and criteria of repetition and power

imbalance may not apply to cyberbullying (Dooley et al., 2009; Runions, Shapka, Dooley, & Modecki , 2012; Ybarra, Mitchell et al., 2012) . Consequently, within the context of the current study, the term cyber-aggression is used to examine the aggression perpetrated and experienced by adolescents through information and communication technologies (ICTs).

A growing body of research has documented the potential harmful effects that result from ICT mediated aggression. For instance, youthful perpetrators and victims of cyber-aggression have concurrently high levels of alcohol use (Ybarra, Diener-West, & Leaf, 2007) and substance use, including marijuana (Hinduja & Patchin, 2008). Likewise, cyber-aggression perpetration is linked with a higher prevalence of problem behaviors such as physical aggression and damaging property (Ybarra & Mitchell, 2004a), and perpetration and victimization are related to frequent substance use and delinquency (Hinduja & Patchin, 2007; Ybarra & Mitchell, 2004b). Finally, there is an apparent link between cyber-aggression and poor mental health, including lowered self-esteem (Brighi, et al, 2012; Patchin & Hinduja, 2010) and elevated depressive symptoms (Wang, Nansel, & Iannotti, 2011;Ybarra & Mitchell, 2004b;Ybarra, Mitchell, Wolak, & Finkelhor, 2006). For victims, this extends to psychosomatic difficulties (Sourander, et al, 2010) including adjustment issues such as higher feelings of loneliness from parents and peers (Brighi, et al. 2012). While such data provide important insight, there remains little understanding of the developmental etiology of cyber-aggression, itself, as experienced by either perpetrators or victims.

Because the developmental precursors of cyber-aggression are not well understood, it remains unclear whether the negative outcomes described above result from cyber aggression perpetration and victimization, or whether cyber perpetration and victimization are markers of more broad-spectrum problematic development (Bender & Losel, 2011). For instance, it is

possible that cyber perpetration and victimization are part of a constellation of risky indicators linked to lower prosocial affect and values (e.g. Perren & Gutzwiller-Helfenfinger, 2012). Adolescence is a developmental period of increased involvement in antisocial behavior, including delinquency and substance use (e.g.; Modecki, 2008; 2009) and also is a time of increased risk for poor mental health, including depression (e.g. Lewinsohn, Rohde, & Seeley, 1998). Given that cyber-aggression is often co-morbid with these adverse developmental outcomes (Hinduja & Patchin , 2008; Luk, Wang, Simons-Morton, 2012; Vieno, Gianluca, & Santinello, 2012;Wang et al., 2011; Ybarra & Mitchell, 2004b), it is important to understand how their developmental progression relates to perpetration and victimization of cyber-aggression.

Although the developmental etiology of cyber-aggression is not yet well understood, longitudinal predictors of traditional victimization and bullying perpetration can provide a valuable starting point for investigation (Mitchell, Ybarra, & Finkelhor, 2007). When face-to-face victimization is examined, low levels of psychological adjustment have been shown to place adolescents at risk. High levels of internalizing symptomology during childhood and adolescence predict subsequent victimization eight years later (Cook, Williams, Guerra, Kim, & Sadek, 2010; Sourander, Helstela, Helenius, & Piha, 2000). Furthermore, children who are not victimized but display depressive symptoms at the start of a school year are at increased risk for victimization six months later (Fekkes, Pijpers, Fredriks, Vogels, & Verloove-Vanhorick, 2006). A recent meta-analysis of 18 longitudinal studies also confirms this prospective relationship between internalizing and victimization (Reijntjes, Kamphuis, Prinzie, & Telch , 2010). Victims of bullying also report more negative self-related cognitions (Cook et al, 2010) and this link holds over time, with negative self-perceptions prospectively predicting victimization one year later

(Salmivalli & Isaacs, 2005). Whether maladjustment similarly poses a risk for becoming an online victim is not yet known.

Both internalizing and externalizing problems predict face-to-face perpetration of aggression, but negative views of the self are only marginally related to bullying (see Cook, et al., 2010; and Card, Stucky, Sawalani, & Little, 2008 for recent meta-analyses of relationships between maladjustment and aggression and bullying). For example, high levels of externalizing during childhood independently predict traditional bullying perpetration in adolescence, above and beyond a range of individual and contextual predictors (e.g., Sourander et al., 2010). Even after accounting for prior perpetration and victimization, a prospective relationship emerges between problem behavior, poor mental health and subsequent bullying involvement. Furthermore, controlling for bullying at time one, both problem behavior and depression predict bullying perpetration four months later (Espelage, Bosworth, & Simon, 2001). However, this research demonstrating a link between prior risk and later bullying involvement has not yet extended to cyber-aggression. As a result, we know relatively little about how these indicators of risk link to later online perpetration of aggression.

Developmental Course of Risk Indicators

Researchers have become increasingly sophisticated in disentangling the developmental progression of the risks explicated above that are likely to be associated with cyber-aggression. Normative increases in problem behaviors such as substance use, delinquency and aggression during adolescence are well documented (e.g. Moffitt, 1993). Research has mapped within person, latent trajectories of substance use across time (e.g. Duncan, Duncan, & Hops, 1996). This research indicates systematic, age-related growth in substance use across adolescence, followed by overall declines in alcohol and marijuana use in the mid-twenties. Of particular

relevance to the current study, both alcohol and marijuana use escalate during the high school years (e.g . Connell, Deater-Deckard, & Dishion, 2006; Chassin et al., 2010), and there is significant heterogeneity in substance use during early adolescence (intercept) and in trajectories of substance use over time (slope) (Chassin, Flora, King, 2004). Likewise, latent trajectories of delinquent behavior also show a developmental progression during adolescence. There are age-related increases in delinquent and risky behaviors during the high school years, including status offenses and aggression. This involvement reaches its peak around age 17 to 18, followed by gradual decreases in emerging adulthood (Windle, 2000). Of course, individuals also vary in their mean levels of delinquency involvement in early adolescence, and in their rate of change over time (e.g. Weisner & Windle, 2004). However no study, to date, has examined whether the developmental course of problem behavior is related to later cyber-aggression.

Not surprisingly, studies also indicate that emotional well-being and views of the self deteriorate during adolescence. On average, self-esteem weakens during adolescence (Rhodes, Roffman, Reddy, & Fredriksen, 2004), and this decline may be most pronounced once individuals enter mid-adolescence (Baldwin & Hoffmann, 2002). Depressed mood also increases during adolescence, peaking in mid-adolescence and then diminishing thereafter (Natsuaki, Biehl, & Ge, 2009). Once youth enter early adulthood, however, well-being generally seems to increase (Galambos, Barker, & Krahn, 2006). As with problem behavior, there are inter-individual differences in the developmental course of emotional well-being and self- esteem, which arguably may predict later cyber-behavior.

As noted above, significant heterogeneity exists in the developmental progression of each of these risk factors over the high school years. Key characteristics, such as gender and pubertal timing, typically account for a portion of the heterogeneity in these trajectories. For example,

boys have steeper gains in problem behaviors and girls have stepper declines in emotional well-being (Bongers, Koot, van der Ende, & Verhulst, 2003). Likewise, earlier pubertal timing is linked to steeper decreases in depressed mood (Natsuaki et al., 2009) and sharper increases in substance use (Biehl, Natsuaki, & Ge, 2007).

Yet, research has yet to examine whether variability in the development of these risks leads to subsequent cyber-aggression. For instance, sharp increases in either substance use or delinquency could lead to the perpetration of cyber-aggression at a later date, as youth on an upward trajectory of problematic behavior act out on-line. Likewise, steep declines in emotional well-being arguably may lead to subsequent cyber-victimization. Youth take aim at those individuals who show signs of poor adjustment (Storch et al., 2007; Wang, Iannotti, & Nansel, 2009), and adolescents who are on a downward trajectory of lowered self-esteem or increased depressed mood may be the most vulnerable. Alternatively, early manifestation of any of these risks may be linked to later cyber-aggression, regardless of developmental change. If this is the case, then a high level of risk vis a vis problem behavior or low emotional well-being early in high school will be predictive of heightened involvement in cyber-aggression later on, notwithstanding the progression of risk across time.

The Current Study

The current study uses longitudinal data across grades 8-11 in a large sample of adolescents, and maps individual trajectories of known correlates of cyber-aggression, including problem behavior, (low) self-esteem, and depressed mood. Although these indicators are important correlates of cyber-aggression at a mean-level, this is the first study to test the latent, within person, developmental etiology of these risks in relation to later cyber-aggression. Specifically, we test whether increasingly heavy involvement in problem behavior or

increasingly poor emotional well-being across the early high school years predicts higher involvement in both perpetration and victimization of cyber-aggression three years later. Moreover, we account for the effects of gender and pubertal timing on both the development of risk and on later cyber-aggression perpetration and victimization, so that this study provides a relatively conservative test for the role of risk trajectories in cyber-aggression.

Methods

Longitudinal data were examined from a sample of 1,364 Western Australian students recruited from 39 schools throughout the state for the Youth Activity Participation Study (YAPS-WA; Blomfield & Barber, 2009; 2011). Participants were recruited from high schools (21 government, 18 non-government), selected to represent the metropolitan and regional school districts across Western Australia. The number and type of schools (government, non-government) selected within each district was determined by the high school student enrolment rate for each district, although the non-government school enrolment rate for Western Australia was slightly higher than the Australian average (41%; Australian Bureau of Statistics, 2007).

Participating schools were recruited to include a range of socio-economic statuses (SES) (see Blomfield & Barber, 2011). School level SES for YAPS-WA schools were obtained from the Department of Education and Training in Western Australia, which computes the Index of Community Socio-Educational Advantage (ICSEA) for each school in the state. The ICSEA is calculated using data from the Australian Bureau of Statistics, and draws on the education, occupation, income, ethnicity, and single parent status of each student's household (Australian Curriculum, Assessment and Reporting Authority, 2010). Schools were placed on a numerical scale that described their comparative socio-economic advantage, and schools in YAPS-WA ranged from two standard deviations above and below the state mean.

Ethics approval to conduct research was obtained from the university Human Research Committee, the Education Department, and the Catholic Education Office. Study participation required active informed parent and student consent. In return for their participation, participants were entered into an immediate small prize draw (e.g. posters, vouchers) at the school level and were also included in a final prize draw (e.g. iPod). The survey was administered using 20 wireless-laptop computers, connected to a Web server, over a 45-minute session. An alternative paper survey was provided if requested. Students were logged onto the computer survey using a unique identification (ID) number to maintain confidentiality. Participants were told that the survey was confidential, that participation was entirely voluntary, and that completed surveys would not be available to their teachers, school, or parents.

Participants

The sample for the present study consisted of 1,364 students who participated in the YAPS-WA survey during the four years of annual data collection, beginning in grade 8 (54.6% female). The mean age of participants in grade 8 was 13 years old (SD = .34 years) and ranged from 12 to 14 years. Of the sample, 83.9% of participants were Caucasian, 7.2% Asian, 2.1% Aboriginal or Torres Strait Islander and 6.8% other (e.g., Middle Eastern, African, Indian, and Maori).

Measures.

Problem behavior

The YAPS survey includes eight problem behavior items drawn from Fredericks and Eccles (2006) and which have been shown to have strong validity. Items tapped substance use, delinquency, and aggressive behaviors, and were measured on an eight point scale from (1) None

to (8) 31 or more times. Example items include: “In the past six months, how often have you had more than 5 alcoholic drinks on one occasion?”; “how often have you skipped school without parent permission?” and “have you gotten in a physical fight with another person?” Scale reliability was strong at each of the three waves of the survey. Cronbach’s $\alpha_{w1} = .83$; $\alpha_{w2} = .85$; $\alpha_{w3 = .}88$.

Depressed Mood and Self-Esteem

The YAPS study also includes eight items measured at each wave designed to tap emotional well-being that were drawn primarily from similar items in the longitudinal Michigan Study of Adolescent Life Transitions (MSALT) and have been used extensively in prior research (e.g. Barber, Eccles, & Stone, 2001; Durkin & Barber, 2002). Preliminary analyses included principal component analyses on these items at wave 1 of the survey. Using both varimax and promax rotation, the PCA resulted in the same two factor solution which fit the data well. The resulting scales tapped depressed mood and self-esteem, in line with the factors derived in MSALT. As explicated below, reliability for both scales was strong at each of the three waves of the survey.

Depressed mood was measured using five items adapted from Barber et al. (2001), and included items, such as: “How often do you feel that difficulties are piling up so high that you can't overcome them?”; “How often do you feel unhappy sad or depressed?”; “How often do you feel there is nothing nice you can look forward to?” Items were measured on six-point scale from 1 (never) to 6 (daily). A shortened (three-item) depressed mood scale has been used extensively in previous research (Barber et al., 2001; Durkin & Barber, 2002), and our five-item version has also been published (Abbott & Barber, 2010) where the validity of the scale items was

supported. The five item scale in this study had good reliability (Cronbach's α_{w1} = .75; α_{w2} = .82; α_{w3} = .81).

Self-esteem was measured using a three item scale taken from previous research (Barber et al., 2001) and also used in published studies from the YAPS-WA data (e.g. Abbott & Barber, 2010). Items were measured on a six-point scale from 1 (never) to 6 (daily). For example, "How often do you feel satisfied with who you are?"; "How often do you feel sure about yourself?"; "How often do you feel satisfied with who you are?". The self-esteem scale has been used extensively in previous research (Barber et al., 2001; Durkin & Barber, 2002), where the validity of the scale has been ascertained. Both previous research and the current study have found the scale to have good reliability Cronbach's α_{w1} = .88; α_{w2} = .86; α_{w3} = .84.

Pubertal Timing

Pubertal timing was measured in grade 8 using one item, taken from Dubas, Graber, and Petersen (1991), and used in previously published studies from the YAPS-WA data (e.g. Abbott & Barber, 2010). This item asks: "Teenagers' bodies change a lot as they grow up, this is referred to as your physical development. Compared to other people your age do you think your physical development has started?" with responses indicated from (1) much later to (5) much earlier. At wave one, this item was correlated positively with self-report weight (r (963) = .31, p < .001) and was correlated negatively with menarche status for girls (r (518) = -.09, p < .05).

Cyber-Aggression Perpetration

Cyber-aggression perpetration was measured in grade 11 using a single item, based on The Bullying Prevention Initiative Student Survey, which has good validity (Williams & Arredondo Mattson, 2006). The item read: "About how often in the last 6 months have you told

lies or made fun of some students using the internet (email, instant messaging, text messaging, or websites)?" Responses were indicated on an eight point scale from (1) None to (8) 31 or more times. The item correlated with problem behaviors measured at grade 11 such as cheating at school (r (1362) =.49, $p < .001$), and stealing money from a store (r (1362) =.39, $p < .001$).

Cyber-Aggression Victimization

Cyber-aggression victimization was measured in grade 11 using one item, also based on The Bullying Prevention Initiative Student Survey and with strong validity (Williams & Arredondo Mattson, 2006). The item read: "About how often in the last 6 months has a student or group of students told lies or made fun of you using the internet (email, instant messaging, text messaging, or websites)?" The item also correlated with problem behaviors measured at grade 11, including cheating at school (r (1362) =.16, $p < .001$), and stealing money from a store (r (1362) =.09, $p < .01$), though the associations were less strong than for cyber-bullying. Perpetration and victimization were also correlated positively (r (1362) =.32, $p < .001$).

Plan of Analyses

Analyses were conducted using latent growth curve modelling (LGM) in Mplus 6.1 (Muthen & Muthen, 2010). Although the most commonly used procedure is listwise deletion, this procedure would have eliminated 709 participants from the analyses. As such, we estimated all models using Maximum Likelihood estimation and robust standard errors. The advantage of the FIML procedure is that it uses all the information of the observed data (Enders, 2010). Sandwiched estimation was used to account for school-level clustering and all covariates were grand mean centered. Preliminary latent growth models (LGM) examined overall patterns of problem behavior change for each outcome from grades 8-10. -2 Log likelihood values were used to determine the best-fitting unconditional model. Unconditional models determined the

average pattern of change over time in the risk factor of interest and whether there was significant variability within the sample in level (intercept) and change in risk factors across time (slope). Predictors were then added, including paths from gender and pubertal timing to the intercept and slope of the risk trajectory, as well as to cyber-aggression perpetration and victimization at grade 11. Of primary interest, the grade 8 risk factor (intercept) and trajectory of risk across time were modelled as predictors of subsequent cyber perpetration and victimization simultaneously; (see Figure 1). Thus, the coefficient for each intercept and slope on perpetration, for instance, controls for the simultaneous effects of intercept and slope on victimization. Wald's statistics were examined to test the composite hypothesis that the set of predictors significantly contributed to each of the models (Singer & Willett, 2003). For all models, omnibus Wald's tests indicated that the predictors had an overall effect. For final unconditional and conditional models, fit was assessed based on several indices, and all had acceptable fit such that SRMR < .05; CFI > .95; and RMSEA $\leq$ .07 (Wu, West, & Taylor, 2009).

Results

Descriptive statistics are presented in Table 1. As would be expected developmentally, problem behavior and depressed mood increased across grades 8-10. Self-esteem, on the other hand, decreased across grade 8-10.

Results for the unconditional problem behavior model are summarized in Table 2, Model 1. These results indicate that the average level of problem behavior in grade 8 was moderately low, 1.13, with an average growth in problem behavior of .24 per year. In the unconditional model, there was neither significant variation in grade 8 problem behavior nor in growth rates of problem behavior across grades 8-10. The full LGM for problem behavior (Model 2) showed that gender (being male) and earlier pubertal timing were associated with higher levels of

problem behavior in grade 8. Steeper problem behavior trajectories across grades 8-10 (slope) predicted higher cyber-perpetration and cyber victimization in grade 11. Together, the covariates contributed significantly to model fit (Wald's $X^2 = 578.56$, $df = 12$, $p < .001$).

Table 3, Model 1, describes the LGM's for depressed mood. The mean reported depressed mood score in grade eight was 2.40 with significant increases in depressed mood thereafter, at a rate of .07 per year. There was significant heterogeneity in grade 8 depressed mood and in depressed mood slope. The full model for depressed mood indicated a positive relationship between higher grade 8 depressed mood (intercept) and gender (being female) as well as earlier pubertal timing. Higher grade 8 depressed mood predicted higher subsequent grade 11 cyber-aggression perpetration and victimization. Together the covariates significantly contributed to the fit of the final model (Wald's $X^2 = 191.790$, $df = 12$, $p < .001$).

Finally, the unconditional model for self-esteem indicates that the average reported self-esteem score is 4.44, and there are significant declines is self-esteem thereafter, at a rate of .23 per year. Significant heterogeneity also exists in self-esteem intercept and slope. The full LGM for self-esteem shows that females have significantly steeper decreases in self-esteem across grades 8 to 10 relative to males (slope). In this model, females had higher reported cyber-perpetration and victimization relative to males. Notably, steeper declines in self-esteem across grades 8-10 (slope) predicted higher cyber aggression in the form of both perpetration and victimization. Together, the covariates contributed significantly to the model (Wald's $X^2 = 181.12$, $df = 12$, $p < .001$).

Discussion

It is well documented that adolescence is a time of increased involvement in problem behavior, and adolescents often experience decreases in emotional well-being across the high

school years (Moffitt, 1993; Rhodes et al., 2004). Moreover, research consistently describes adverse consequences of cyber-aggression, including problem behavior, depressed mood, and lowered self-esteem (e.g. Ybarra et al., 2007; Ybarra & Mitchell, 2004a; Ybarra et al., 2006). However, no research to date has examined how the developmental course of these risks relates to subsequent perpetration and victimization of cyber-aggression. The current study provides an important foundation for understanding how developmental change in key risk factors across grades 8-10 are linked to cyber-aggression involvement in grade 11. Specifically, steeper latent within-person increases in problem behavior predicted increased later cyber-perpetration and victimization. Steeper age related declines in self-esteem also predicted both subsequent perpetration and victimization. Although trajectories of depressed mood were unrelated to cyber-aggression, higher mean levels of depressed mood in grade 8 predicted higher cyber perpetration and victimization three years later, above and beyond any change in depressed mood in the intervening years. Together, these findings highlight the multi-finality that can emerge from comparable developmental patterns of problem behavior and emotional well-being; similar developmental pathways predicted both cyber-perpetration and victimization (Cicchetti & Rogosch, 1996; Cook et al., 2010).

One of the key findings from this study is that cyber-aggression perpetration and victimization in late adolescence may be, at least partially, the result of elevated developmental increases in problem behaviors across the preceding three years. Previous research has indicated that cyber-aggression perpetration and victimization are related to higher levels of delinquency (Hinduja & Patchin, 2007; Ybarra & Mitchell, 2004a). Studies of traditional bullying also have documented a prospective mean-level relationship between externalizing and bullying perpetration (Sourander et al., 2010). Our work is consistent with these ideas, but suggests that

the nature of the prospective relationship between problem behavior and cyber-aggression is based on the rate of developmental change in antisocial behavior. In our study, change in problem behavior over time was a far more powerful predictor of cyber aggression relative to a single time point at grade 8, and likely captures a collection of contextual influences by proxy. More specifically, within-person change in problem behavior predicting later cyber aggression likely reflects the shared developmental contexts that propagate both. For example, shifts in peer association toward more risky and less academic friends increase a youth's propensity for engaging in problem behavior (Barber, Stone, Hunt, & Eccles, 2005) and likely also renders youth susceptible to cyber-aggression perpetration. Similar risk contexts also may increase the likelihood of cyber-victimization, assuming that antipathetic peers retaliate against being aggressed (Card & Hodges, 2007). As another example, family environments characterised by low monitoring and support establish a context for accelerating problem behaviour (Racz & McMahon, 2011) and also may afford opportunities for cyber perpetration or victimization, or both. Findings from this study highlight a clear need for research that elucidates the contributions of these and other key developmental contexts to increases in problem behavior and cyber-aggression.

The results also establish a link between rate of decline in self-esteem and subsequent cyber perpetration and victimization, which represents a novel contribution to knowledge. Illustratively, age-related decreases in self-esteem across three years predicted subsequent increased involvement in both cyber-aggression perpetration and victimization. These results for victimization are consistent with work indicating that negative self-perceptions prospectively predict traditional bullying victimization one year later (Salmivalli & Isaacs, 2005). Our study builds on this research and demonstrates a prospective, within-person link between decreased

self-esteem and cyber-victimization. We posit that the relationship between change in self-esteem and subsequent cyber- aggression may be explained by the developmental contexts that provide for both. Illustratively, low self-esteem can include diminished efficacy for social interaction with peers and may therefore covary with lower levels of social confidence and competence. Adolescents with increasingly diminished self-esteem face difficulties in operating effectively in their social worlds, and not surprisingly are likely to be cyber-aggressed.

Notably, research on traditional, or face-to-face, aggression provides little support for a relationship between low self-esteem and perpetration (Salmivalli, Kaukiainen, Kaistaniemi, & Lagerspetz, 1999), and only one cross-sectional study has demonstrated a link between lower mean levels of self-esteem and higher cyber-perpetration (Patchin & Hinduja, 2010). Our study provides unique insight in revealing a prospective, within-person link between self-esteem shifts and perpetration. Low peer status and high peer rejection likely covary with low self-esteem, and both are established correlates of traditional bullying perpetration and aggression (Cook et al., 2010). It is not surprising, then, that youth might choose a cyber-realm for aggressing against their peers. In fact, the connection between traditional perpetration and low self-esteem may be tenuous because traditional aggression requires greater efficacy than cyber-aggression. For instance, cyber-perpetration can occur from one's own home, can be deployed anonymously, and does not require physical strength.

Developmental change in only one of the three risks examined in this study failed to emerge as a significant predictor of cyber-aggression. Trajectories of depressed mood were not significantly related to subsequent perpetration or victimization. However, higher reported depressed mood in eighth grade did predict higher reported perpetration and victimization of cyber-aggression three years later. That is, even taking into account changes in depressed mood,

early depressed mood was related to later cyber-aggression. Accumulated research has established a prospective relationship between internalizing and victimization (Reijntjes et al., 2010). Consistent with this work, our findings suggest that early depressed mood is indeed a risk factor for victimization and also for perpetration. One explanation for the link between depressed mood in grade 8, but not change in depressed mood, and later cyber-aggression is that youth who demonstrate high levels of depressed mood early on stand out as potential victims and, regardless of any change, remain targets for later cyber-aggression. In turn, these same youth may retaliate against their victimization through cyber-aggression. As mentioned earlier in the context of low self-esteem, ICT provides a highly accessible medium for youth who lack the efficacy to perpetrate face to face aggression. At the same time, the finding that early depressed mood predicts later cyber perpetration and victimization again echoes the idea stated previously - that shared risks creates a context for multi-finality.

It is particularly noteworthy that cyber-perpetration and victimization were predicted by similar developmental precursors but were correlated moderately in this study. Taken together, these findings suggest that while some of the same individuals may be both perpetrators and victims of cyber-aggression, the two constructs are distinct e.g. (Jose, Kljakovic, Scheib, & Notter, 2012). A notable gap in current research is how cycles of aggression perpetuate cyber-perpetration and victimization. For example, some cyber-perpetration may be reactive aggression in which adolescents “defend” themselves in the face of victimization. Because it is unclear as to who is initiating the cyber-aggression cycle, current findings are only speculative. Nonetheless, findings from this study demonstrate that cyber-perpetration and victimization represent different constructs, although they emerge from a shared developmental pathway.

Limitations

The results of this study must be considered in light of a number of limitations. The primary limitation of this data is that we could not account for cyber-aggression at an earlier date. Cyber-perpetration or victimization may exert earlier effects on problem behavior and well-being, and we cannot rule out the possibility that such early involvement led to subsequent developmental change in the risks examined in this study. Ideally, research would examine the joint developmental trajectories of cyber-aggression and problem behaviors and well-being. However, until now, no study has examined within-person trajectories of risk in relation to cyber-aggression, and this research provides an important first step. Finally, we only used single-item measures of cyber perpetration and victimization, and future research should attempt to include cyber-aggression scales that would allow for latent measures.

Conclusion

There is a growing body of research that describes the correlates of cyber-aggression. These findings have attracted considerable attention in the media and have led to calls for intervention. However, to date the developmental precursors of cyber-aggression have not been examined and this represents a notable gap in research. Our results suggest that cyber-aggression may be a marker for a developmental progression of risks to which adolescents are particularly susceptible (e.g. Perren & Gutzwiller-Helfenfinger, 2012). These findings suggest that interventions that target traditional problem behaviors in adolescence, as well as emotional well-being, may mitigate later aggression within the cyber-medium. This finding is particularly noteworthy, because there is an established history of best-practice interventions that target problem behaviors and emotional well-being (e.g. Guerra, Williams, Tolan, & Modecki, 2008; Williamson, Modecki, & Guerra, in press); whereas there is little evidence to date of effective intervention with cyber-aggression. This study suggests that developmental increases in problem

behavior and developmental decreases in emotional well-being across adolescence contribute to an increased propensity for later involvement in cyber-aggression, so that existing interventions may usefully target both. As a whole, our findings support a need for a closer examination of the developmental etiology of cyber-aggression.

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Table 1. Construct descriptives over time.

	Grade 8	Grade 9	Grade 10
Problem Behavior	1.38 (.65)	1.63 (.86)	1.87 (1.08)
Depressed Mood	2.41 (.97)	2.45 (1.06)	2.54 (1.09)
Self-esteem	4.43 (1.10)	4.23 (1.18)	4.16 (1.15)

Note: Mean (Standard Deviation).

Table 2. Effects of covariates on problem behavior, and effects of problem behavior on cyber-aggression.

	Problem Behavior	
	Model 1	Model 2
Fixed Effects		
Intercept (Grade 8 Mean)	1.13(.04)***	1.13(.04)***
Gender		.28 (.06)***
Pubertal Timing		.10(.03)***
Linear Slope (Time)	.24(.02)***	.25(.03)***
Gender		-.04(.03)***
Pubertal Timing		.00(.01)
Grade 11 Cyber Perpetration		-.74(.29)*
Gender		.00(.13)
Pubertal Timing		.07(.05)
Intercept (Grade 8 Mean)		.32(.34)
Linear Slope (Time)		1.71(.46)***
Grade 11 Cyber Victimization		.29(.37)
Gender		.34(.25)
Pubertal Timing		.04(.07)

Intercept (Grade 8 Mean)		-.70(.41)
Linear Slope (Time)		2.00(.95)*
Random Effects		
Grade 11 Cyber Perpetration		1.26(.17)***
Grade 11 Cyber Victimization		1.60(.40)***
Intercept (Grade 8 Mean)	.27(.20)	.19(.07)**
Linear Slope (Time)	.07(.04)	.06(.01)***
CFI	1.00	1.00
SRMR	.001	.01

Note. *$p < .05$; **$p < .01$; ***$p < .001$.

Table 3. Effects of covariates on emotional well-being, and effects of emotional well-being on cyber-aggression.

	Depressed Mood		Self-esteem	
	Model 1	Model 2	Model 1	Model 2
Fixed Effects				
Intercept (Grade 8 Mean)	2.40(.04)***	2.42(.03)***	4.44(.05)***	4.43(.06)***
Gender		-.22(.05)***		.13(.08)
Pubertal Timing		.10(.04)*		-.01(.04)
Linear Slope (Time)	.07(.03)*	.08(.03)**	-.23(.03)***	-.21(.03)***
Gender		-.05(.04)		.28(.06)***
Pubertal Timing		-.03(.03)		.01(.04)
Grade 11 Cyber Perpetration		-.99(.33)**		.72(.41)
Gender		.13(.120		.39(.16)*
Pubertal Timing		.05(.04)		.09(.05)
Intercept (Grade 8 Mean)		.40(.14)**		.05(.11)
Linear Slope (Time)		.39(.34)		-1.20(.54)*
Grade 11 Cyber Victimization		-1.01(.31)**		-.67(.52)
Gender		.16(.16)		.63(.32)*
Pubertal Timing		-.06(.06)		-.00(.09)

Intercept (Grade 8 Mean)		.39(.14)**		.05(.11)
Linear Slope (Time)		.62(.39)		-2.11(.77)**
Random Effects				
Grade 11 Cyber Perpetration		1.36(.16)***		1.28(.18)***
Grade 11 Cyber Victimization		1.83(.31)***		1.50(.24)***
Intercept (Grade 8 Mean)	.57(.06)***	.39(.03)***	.70(.10)***	.56(.06)***
Linear Slope (Time)	.20(.03)***	.10(.03)***	.25(.08)**	.10(.04)*
CFI	1.0	.96	.99	.99
SRMR	.01	.03	.045	.03

Note. *$p < .05$; **$p < .01$; ***$p < .001$.

Figure 1.

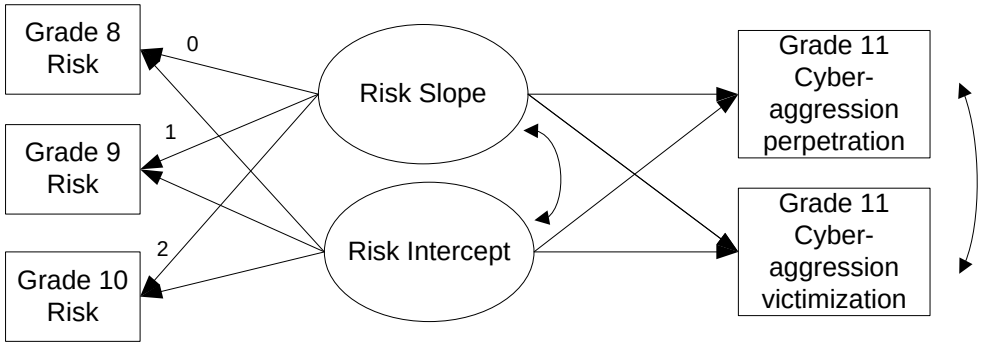

Figure 1. Conditional Path Model, Trajectories of risk predicting cyber-aggression. Covariates (not displayed) include gender and pubertal timing.