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Bullying Victimization, Negative Emotions, and Digital Self-Harm: Testing a Theoretical Model of Indirect Effects

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ABSTRACT

Research on digital self-harm – the anonymous or pseudonymous posting of hurtful or negative information about oneself on the internet and social media platforms – is in the early stages of development. While scholars have started to focus on the correlates of this behavior, there remains a need to anchor the study of digital self-harm within established theoretical frameworks. Herein, we draw on Agnew's general strain theory to examine whether negative emotions mediate the association between bullying victimization and digital self-harm. Using data collected from adolescents participating in the 2019 Florida Youth Substance Abuse Survey ($N = 9,469$; $M_{\text{grade level}} = 8.78$; 47% Male; 32% White, non-Hispanic), a strong, positive association between bullying victimization and digital self-harm is observed, as well as an indirect association operating through negative emotions. Discussion centers on the implications of the findings for theory and policy, as well as future directions for research on digital self-harm.

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Introduction

Adolescence has been described as a period of “storm and stress” (Arnett 1999; Hall 1904) in which some youth struggle to form a positive sense of self and cope in prosocial ways with the challenges inherent in having to navigate complex and evolving relationships with parents, peers, and romantic partners. The coping mechanisms employed by youth are varied, and while most youth will pass through this period of development largely unscathed, some resort to certain behaviors, including deliberate acts of self-harm, that raise serious concerns. Indeed, physical self-harm during adolescence is associated with suicidal ideation (e.g., Brausch and Gutierrez 2010; Guan, Fox, and Prinstein 2012; Hay and Meldrum 2010) and suicide completions (e.g., Hawton and Harriss 2007; Olfson et al. 2018). Given the increase in suicidal behaviors among adolescents in recent years (Hedegaard, Curtin, and Warner 2018; Miron et al. 2019), research into potential correlates is warranted.

Even as parents, teachers, pediatricians, and other practitioners work to understand the causes and consequences of deliberate acts of self-harm and prevent their occurrence, a new variant has emerged in the form of *digital* self-harm. Defined as the “anonymous online posting, sending, or otherwise sharing of hurtful content about oneself,” (Patchin and Hinduja 2017:761), digital self-harm was first described in a blog post by boyd (2010).¹ Writing at the time, boyd speculated that the behavior may reflect a form of attention-seeking and a possible cry for help. Since boyd's (2010) commentary, academics have started to more systematically explore the demographic and behavioral correlates of digital self-harm, as well as motivations for engaging in the behavior (Englander 2012; Pacheco, Melhuish, and Fiske 2019; Patchin and Hinduja 2017). These early studies reveal, for example, that

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somewhere between 5% and 10% of adolescents engage in digital self-harm. Further, the motivations for engaging in the behavior, as stated by youth themselves, are varied and include self-hatred, depressive symptoms, and attention-seeking (Pacheco, Melhuish, and Fiske 2019; Patchin and Hinduja 2017). Of additional interest, digital self-harm is correlated with bullying victimization, deviant behavior, negative emotions, and physical self-harm (Patchin and Hinduja 2017). Given such findings, there is a clear need to more deeply understand digital self-harm. As Patchin and Hinduja (2017:766) recently commented, “Researchers should continue to shed light on the epidemiological precursors and enduring associated outcomes of digital self-harm.”

There is also a need to situate the study of the etiology of digital self-harm within established theoretical frameworks. One theoretical perspective that appears to be well-suited to understanding the distal and proximal correlates of digital self-harm is Agnew’s (1992) general strain theory (GST), a social-psychological theory that places emphasis on the various strains and stressors adolescents experience and the emotional and behavioral mechanisms used to alleviate or cope with these strains. Indeed, GST has proven to be a useful framework for understanding a variety of behaviors, including delinquency and substance use (Agnew 2006a), cyberbullying (Lianos and McGrath 2018), disordered eating (Piquero et al. 2010), suicidal ideation (Bishopp and Boots 2014) and, most pertinent for current considerations, physical acts of deliberate self-harm (Hay and Meldrum 2010).

In the present study we add to the emerging knowledge base on the study of digital self-harm by drawing on the arguments of Agnew’s (1992) GST. Specifically, we empirically investigate the extent to which bullying victimization is associated with digital self-harm and whether this association operates indirectly through negative emotions. To accomplish this, we analyze data collected in 2019 from a random sample of nearly 10,000 Florida middle- and high-school students. Prior to describing the data, our study methodology, and the results of our analyses, however, we first review in greater detail the emergence of digital self-harm and prior research addressing the topic. Following this, we review the arguments of Agnew’s (1992) GST. As part of this, we review past research supporting the assertion that bullying victimization and negative emotions are central to understanding the etiology of self-harming behavior.

Literature review

The nature, extent, and evolution of self-harm

Physical self-harm among adolescents, such as cutting or burning oneself, has long been a major public health concern. Self-harm can be a result of psychological, psychiatric, social or familial factors (Evans, Hawton, and Rodham 2004) and can be done with or without suicidal intent (Brausch and Gutierrez 2010). Estimates of prevalence rates for deliberate self-harm and non-suicidal self-injury among adolescents vary widely, from about 7% to 47%, depending on how self-harm is measured and what time frame is used for reports (Cipriano, Cella, and Cotrufo 2017; Muehlenkamp et al. 2012).

Research demonstrates that self-injurious behaviors often originate in adolescence and that such behaviors can have lasting developmental consequences (Gardner et al. 2019; van der Kolk, Perry, and Herman 1991). Of particular concern is the connection between self-harm and suicide (Andover and Gibb 2010; Muehlenkamp and Kerr 2010; Nock et al. 2006; Whitlock et al. 2013). While most acts of self-harm do not result in death, and most youth who participate in self-harming behaviors do not subsequently commit suicide, evidence does show a positive correlation between self-harm and suicidal activities, particularly among youth with repeated self-harming behaviors over a longer period of time (Nock et al. 2006; Plener et al. 2009).

Pertinent to our focus, there is much evidence that bullying victimization is a frequent precursor to self-harming behaviors (Barker et al. 2008; Gower and Borowsky 2013; Hay and Meldrum 2010). For example, in a cohort study of 2,141 children in the UK, Fisher et al. (2012) found that more than half of those who had self-harmed at age 12 had previously been the victim of frequent bullying. This relationship persisted even after controlling for many other personal (emotional and behavioral)

and environmental (familial) factors. Furthermore, in a recent meta-analysis that included over 150,000 adolescents and 68 effect sizes, Heerde and Hemphill (2019) reported that both bullying and cyberbullying victimization were significantly associated with deliberate self-harm.

Digital self-harm (also referred to as self-cyberbullying, self-trolling, and digital Munchausen) is the 21st Century manifestation of injurious behavior directed at one's self. While it has long been possible to misrepresent one's self online for a variety of purposes (both devious and defensible), the development of websites, applications ("apps"), and messaging services that championed anonymity over the last decade enabled new, easier opportunities for self-directed harm in online environments. Digital self-harm was noticed by someone connected to one of the first such sites, Formspring.me (boyd 2010). On that platform, users asked anonymous questions of others and responses were posted to public pages. Upon reviewing reports of abuse, administrators at Formspring.me noticed that some of the hurtful comments were posted by the person who was reporting them. "They appeared on Formspring.me as anonymous but they were written by the owner while logged into their own account" (boyd 2010). Boyd documented these early incidents and speculated that they were a cry for help or the individual wanted to "look cool" or "trigger compliments."

Englander (2012) was the first to systematically explore such acts of digital self-harm among a convenience sample of university students in 2011. Nine percent of participants said they had "falsely posted a cruel remark 'against' themselves, or cyberbullied themselves, during high school" (p. 2). The most commonly reported reason was "to get another kid's attention." Building on this early work, Patchin and Hinduja (2017) studied digital self-harm among a nationally-representative sample of 5,593 12–17 year-olds in the United States. They found that 6.2% of respondents had anonymously posted something online about themselves that was mean and 5.3% had "anonymously cyberbullied myself online" (p. 763). In addition, participation in digital self-harm was positively associated with physical self-harm, school bullying victimization and cyberbullying victimization, deviance, drug use, and depressive symptoms. Male and non-heterosexual youth were also more likely to report having engaged in digital self-harm. Finally, Pacheco, Melhuish, and Fiske (2019) recently surveyed an online sample of 1,110 13–17-year-old New Zealand youth about experiences with digital self-harm in the past year. Six percent of respondents said they had engaged in digital self-harm, with nearly two-thirds having done so more than once. Top reasons reported for engaging in the behavior were "making a joke, wanting to show resilience, looking for friends' sympathy, and seeking reassurance of friendship" (Pacheco, Melhuish, and Fiske 2019:1).²

The relevance of Agnew's general strain theory

While important progress has been made to illuminate the nature and extent of digital self-harm among adolescents, much is still unknown. The current study seeks to extend this scholarship by exploring whether Agnew's (1992) general strain theory (GST) is useful in explaining the relationship between bullying victimization and digital self-harm. More than 25 years ago, Agnew (1992) conceptualized a revised strain theory that offered a more nuanced and comprehensive conceptualization of classic strain theories. Whereas earlier versions primarily considered economic sources of strain (i.e., lacking the necessary financial resources to achieve one's material goals; Merton 1938), Agnew's GST identified three sources that were broader in scope: (a) failure to achieve positively valued goals; (b) loss of positive-valued stimuli; and (c) presentation of negative stimuli. Whereas Agnew's first source of strain closely resembles that of traditional strain theories, the latter two sources opened GST to a much wider spectrum of strain producing circumstances – such as the death of a parent (loss of positive stimuli) or being sexually abused (presentation of negative stimuli) – than previous incarnations of the theory. Decades of empirical scrutiny have yielded robust support for the basic tenet of

²While we have reviewed three studies on digital self-harm herein, it is important to note that the study by Patchin and Hinduja (2017) is the only one that has been published in a peer-reviewed journal.

GST of a positive association between strain and antisocial behaviors (Agnew 2006b; Agnew and Brezina 2019).

Importantly, according to GST, strain does not lead directly to delinquency, crime, and other maladaptive behaviors. Rather, Agnew (1992) hypothesized that strain resulting in negative emotions such as anger or frustration, a compulsion toward corrective action, or that is perceived to be unjust, is more likely to result in a corrective deviant or maladaptive response (see also, Baron 2004; Mazerolle et al. 2000; Rebellon et al. 2012). Moreover, the resultant action may not be delinquent behavior, but some other instrumental maladaptive coping response (e.g., running away from home to avoid parental abuse or skipping school to avoid bullying). In short, not all youth who experience strain will engage in deviance, and not all deviant responses will take the same form.

Many scholars have identified bullying victimization as a potent source of strain among school-aged youth that could lead to various forms of deviance (Baker and Pelfrey 2016; Cullen et al. 2008; Hinduja and Patchin 2007; Keith 2018; Walters and Espelage 2017). For example, Brady, Baker, and Pelfrey (2019) found that victims of both traditional bullying and cyberbullying were more likely to use drugs and carry a weapon at school. Moreover, a multitude of studies find that bullying victimization is associated with greater depressive symptoms (e.g., Reed, Nugent, and Lyle Cooper 2015; Takizawa, Maughan, and Arseneault 2014; Turner et al. 2013), another possible deviance-inducing negative emotion according to GST (Jang and Johnson 2005; Piquero and Sealock 2004; Song, Wenzel, and Cho 2019). A recent meta-analysis by Moore et al. (2017) is illustrative of this fact. Specifically, across 92 effect sizes examined, individuals who experienced bullying victimization were 2.21 times more likely to exhibit depressive symptoms relative to individuals not exposed to bullying (OR = 2.21; 95% CI = 1.34–3.65). Moreover, this effect was found to be stronger among individuals who were more frequently bullied, which is indicative of a dose-response association.

Likewise, several studies find that individuals who exhibit more negative emotions like depressive symptoms are at a greater risk of engaging in physical self-harm (e.g., Bakken 2019; Hay and Meldrum 2010; Madge et al. 2011; Patchin and Hinduja 2017), an association that has been acknowledged for some time. More than a decade ago, Fliege et al. (2009) conducted a systematic review of the literature concerning the risk factors of self-harming behavior and identified nearly two dozen cross-sectional and longitudinal studies reporting a positive association between depressive symptoms and self-harm. As noted by Fliege et al. (2009:489) when summarizing the literature, “Self-harmers experience more frequent and more negative emotions in their daily lives than persons who do not self-harm. This heightened experience of negative emotion may be a principal reason for deliberate self-harm, as self-harm may acutely alleviate emotional distress.” Importantly, just as physical self-harm may be engaged in to alleviate emotional distress by providing a cathartic release, so too may digital self-harm. The act of posting negative information about oneself may serve as a distraction from negative emotional states. Thus, GST might be equally well-suited to explaining both traditional *and* digital forms of self-harm.

Finally, it is noteworthy that some researchers have, guided by the arguments of Agnew’s (1992) GST, explicitly investigated the extent to which the association between bullying victimization and physical self-harm is mediated by negative emotions. Specifically, Hay and Meldrum (2010) analyzed data collected on a convenience sample of 426 adolescents from Florida, finding that approximately 45% of the effect of ‘traditional’ bullying victimization on physical self-harm was mediated by negative emotions. They further found that approximately 25% of the effect of cyberbullying victimization on physical self-harm was mediated by negative emotions. Such findings are consistent with Agnew’s (1992) assertion that the effect of strain on maladaptive and deviant coping should be mediated by negative emotions.

To summarize, there is ample theoretical and emerging empirical evidence to suggest that youth who experience bullying are at a greater risk to experience negative emotions which in turn are associated with an increased risk for self-harming behaviors. Therefore, a reasonable next step is to further explore the viability of GST in helping to understand the precursors of digital forms of self-

harm by examining the potential influence of bullying victimization and negative emotions on engaging in this behavior.

The current study

The suitability of Agnew's (1992) GST as a foundation for investigating the correlates of digital self-harm is supported by several observations. First, GST has proven to be successful at explaining a wide range of maladaptive behaviors (Agnew 2006b; Bishopp and Boots 2014; Hay and Meldrum 2010; Piquero et al. 2010). Second, recent research provides evidence that adolescents who engage in digital self-harm report greater exposure to bullying and greater depressive symptoms (Patchin and Hinduja 2017), patterns which conform to Agnew's (1992) assertions that strain and negative emotions should be positively associated with maladaptive coping behavior. Third, and as noted above, prior research finds that the effect of bullying victimization on physical self-harm is partially mediated by negative emotions (Hay and Meldrum 2010). Given the positive correlation between physical self-harm and digital self-harm observed in prior research (Patchin and Hinduja 2017), coupled with the possibility that digital self-harm might offer the same cathartic release as physical self-harm, a similar pattern of mediation is anticipated when focusing on digital self-harm as an outcome.

Accordingly, we use GST as the theoretical backdrop to test a model of mediation that seeks to identify both distal and proximal correlates of digital self-harm by focusing on the interrelationships between bullying victimization, negative emotions, and digital self-harm. Specifically, we test the hypothesis that bullying victimization will be positively associated with digital self-harm, and that this association will be mediated by negative emotions. The model to be tested reflecting this hypothesis is presented in Figure 1. As shown, a positive association between bullying victimization and negative emotions is anticipated, as well as a positive association between negative emotions and digital self-harm. The dashed line running between bullying victimization and digital self-harm reflects the anticipated indirect association between the two constructs.

To be clear, this is not the first study to examine whether bullying victimization and negative emotions are associated with digital self-harm. As previously discussed, Patchin and Hinduja (2017) found that single-item indicators of both bullying victimization (school and cyber) and depressive symptoms are positively associated with digital self-harm when controlling for age, race, and sex. We build on this work in two important ways using newly collected data on a large, statewide representative sample of Florida youth. First, we anchor the study of digital self-harm within an established theoretical framework—Agnew's (1992) GST—and examine whether negative emotions mediate the association between bullying victimization and digital self-harm, something which heretofore has not been considered. Second, the current investigation makes several methodological improvements over the study by Patchin and Hinduja (2017). These include: the use of multi-item measures of bullying victimization and negative emotions (as opposed to single-item indicators); a multivariate analysis that accounts for several individual and social background factors in addition to demographic variables; the utilization of a large statewide representative sample with a relatively high response rate (as opposed to a 15% response rate); and the use of a modeling strategy (structural equation modeling) that enables the construction of latent variables and the ability to account for measurement error.

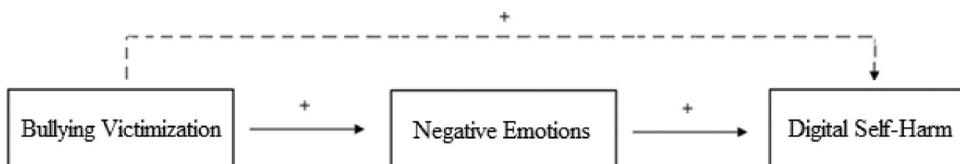


Figure 1. Proposed empirical model.

Materials and methods

Participants and procedures

Data for the current study are drawn from the 2019 Florida Youth Substance Abuse Survey (FYSAS). The FYSAS is a repeated cross-sectional study of public middle school and high school students in the state of Florida that has been conducted every year since 2000. Though the primary focus of the FYSAS is generating statewide estimates of adolescent self-reported substance use, the FYSAS survey instrument includes items that tap into several attitudinal, behavioral, and social aspects of the lives of Florida youth. A stratified, two-stage cluster sampling methodology is used to recruit students for the FYSAS. In the first stage, separate groups of middle schools and high schools are randomly selected. All public middle schools and high schools in Florida are included in the sampling frame, except adult education, correctional, or special education schools. The probability of selection for each school is proportional to the size of the school's enrollment, meaning larger schools have a higher chance of being selected than smaller schools. In the second stage, survey coordinators are instructed on how to randomly select classrooms from within the selected schools to fulfill the survey quota for each school.

Using this methodology, 93 middle schools and 82 high schools were selected to participate in the 2019 FYSAS. Of these 175 schools, only five declined participation. Administration of the surveys took place in February 2019, with some of the participating schools using paper-and-pencil surveys and others collecting the data using a newly developed internet-based system for the FYSAS.³ Classroom teachers, as well as the instructions on the first page of the survey, assured students that participation is voluntary and they did not have to answer any questions they did not want to answer. There is no statewide policy in Florida regarding the requirement of active versus passive consent, and the 2019 FYSAS State Report indicates that passive parental consent was used in most of the participating schools.⁴ No known incentives were provided to students for their completion of the survey.

The participation rate among the sampled middle school and high school students was 70.6% and 67.8% ($n = 10,424$ surveys). These surveys were subjected to five validation tests pertaining to (1) unrealistic reporting of drug use, (2) unrealistic reporting of antisocial behavior, (3) affirmative responses to use of a fictitious drug on the survey, (4) inconsistency in responses (e.g., reporting using a drug in the past 30 days but reporting no lifetime use of the drug), and (5) completing less than 25% of the survey. These validation tests lead to the exclusion of 605 surveys, resulting in a sample size of 9,819. The 2019 FYSAS paper-and-pencil survey instrument is 10 pages long, and some students did not complete the entire survey. Of the 9,819 participants, we were able to analyze data on 9,469 using structural equation modeling with a maximum likelihood robust (MLR) estimator (the details of which are described in a later section). For additional details about the sampling methodology and validation procedures of the FYSAS, readers are referred to the 2019 FYSAS State Report.⁵ The Institutional Review Board of Florida International University approved analyses of the data (IRB-18-0137-AM01).

Measures

Digital self-harm

Based on prior research (Patchin and Hinduja 2017), participants were provided a definition of digital self-harm: "This is when someone anonymously posts mean or hurtful information about themselves on the internet or on social media (Snapchat, Instagram, Facebook, Twitter, etc.)." Participants were then asked to respond to the question, "In the past 30 days, how many times (if any) have you

³According to the 2019 FYSAS State Report, 59 of the 170 participating schools administered the surveys via the new internet-based system. No variable was available to distinguish whether a student completed the survey online or on paper. The inability to control for the mode of administration is a limitation that should be kept in mind when interpreting the results, as this could have influenced response patterns.

⁴No specific breakdown of the percent of schools that required active versus passive consent is provided in the 2019 FYSAS State Report.

⁵The report can be accessed at <https://www.myffamilies.com/service-programs/samh/prevention/fyasas/2019/>.

anonymously posted hurtful information about yourself on the internet or on social media?” Responses options were: “0 Times” (= 0), “1–2 Times” (= 1), “3–5 Times” (= 2), “6–9 Times” (= 3), and “10 or More Times” (= 4).⁶ Thus, this ordinal measure captures the frequency of having engaged in digital self-harm in the prior 30 days (mean = 0.10, SD = 0.47). In addition, we assessed the robustness of the results when using responses to a second question on the survey where the reference period for engaging in digital self-harm was listed as the past 12 months rather than the past 30 days (mean = 0.18, SD = 0.64). Of note, 6% of participants reported having engaged in any amount of digital self-harm within the past 30 days, and 10% reported having done so at least once within the prior 12 months. Table 1 provides the descriptive statistics for each of the two digital self-harm measures, as well as all other measures described below.

Bullying victimization

To measure bullying victimization, participants were first provided the following definition: “Bullying happens when someone hurts or scares another person on purpose. The person being bullied has a hard time defending himself or herself. Usually, bullying happens over and over.” Immediately following this description, participants responded to three items tapping physical, verbal, and cyber-bullying victimization: “How often has someone hit, kicked or shoved you, caused you physical harm/

Table 1. Descriptive statistics.

Variable	N	Mean/%	Standard Deviation	Min	Max	Factor Loading
<i>Digital Self-Harm</i>						
30-day ordinal	9,386	0.10	0.47	0	4	–
12-month ordinal	9,399	0.18	0.64	0	4	–
<i>Bullying Victimization</i>						
Physical	9,425	0.50	0.86	0	4	0.702
Verbal	9,421	1.11	1.20	0	4	0.810
Cyber	9,411	0.42	0.80	0	4	0.739
<i>Negative emotions</i>						
Sometimes I think that life is ...	9,469	0.93	1.03	0	3	0.889
At times I think I am no good at all	9,469	1.26	1.08	0	3	0.928
All in all, I am inclined to think ...	9,469	0.98	1.02	0	3	0.913
In the past year, have you felt ...	9,469	1.33	1.14	0	3	0.835
<i>Control Variables</i>						
Grade level	9,469	8.78	1.92	6	12	–
Male	9,376	47%	–	0	1	–
Race/Ethnicity	9,415					
White		32%	–	0	1	–
Black		19%	–	0	1	–
Hispanic		38%	–	0	1	–
Other Race		11%	–	0	1	–
Family drug problems	8,753	33%	–	0	1	–
<i>Self-control (items reverse-coded)</i>						
I often do what brings me pleasure ...	8,900	1.98	0.90	0	3	0.661
I'm more concerned with what ...	8,859	2.04	0.86	0	3	0.637
I sometimes find it exciting ...	8,920	2.11	0.92	0	3	0.766
Excitement and adventure are ...	8,869	2.06	0.88	0	3	0.736
When I'm really angry, other ...	8,893	1.88	1.02	0	3	0.746
When I have a serious disagreement ...	8,930	1.70	1.04	0	3	0.705
<i>Authoritative parenting</i>						
The rules in my family are clear	8,807	2.43	0.73	0	3	0.653
When I am not home, one of my ...	8,685	2.26	0.94	0	3	0.610
If you skipped school, would you ...	8,610	2.19	1.05	0	3	0.592
My parents ask me what I think ...	8,578	1.73	0.96	0	3	0.626
Do you enjoy spending time ... mother	8,569	2.41	0.83	0	3	0.781
Do you enjoy spending time ... father	8,453	2.18	0.99	0	3	0.678
Would your parents know if you ...	8,545	2.32	0.87	0	3	0.687

⁶The 2019 administration of the FYSAS is the first year that this question appeared on the survey.

injury, or taken your money or belongings?,” “How often have you been taunted, teased, experienced name-calling, or been excluded or ignored by others in a mean way?,” and “How often has someone sent mean emails, text messages, IM’s or posted hurtful information on the Internet about you?” Responses to each of the three items were: “Never” (= 0), “Once or Twice” (= 1), “A Few Times” (= 2), “Many Times” (= 3), and “Every Day” (= 4). A latent factor was created measuring bullying victimization ($\alpha = 0.68$).⁷ The three-item measure of bullying victimization has been employed in prior research (e.g., Meldrum et al. 2020).

Negative emotions

Negative emotions was measured using responses to four items: “Sometimes I think that life is not worth it,” “At times I think I am no good at all,” “All in all, I am inclined to think that I am a failure,” and “In the past year, have you felt depressed or sad MOST days, even if you felt OK sometimes?” Response options were: “NO!” (= 0), “no” (= 1), “yes” (= 2), and “YES!” (= 3). A latent factor was created measuring negative emotions ($\alpha = 0.90$). This four-item measure has been used in several previous studies (e.g., Chen, Forsyth, and Biggar 2019; Chilenski et al. 2019), and as will become evident, it is strongly associated with both bullying victimization and digital self-harm.

Control variables

Demographics

To isolate the effect of bullying victimization on negative emotions, as well as the effects of bullying victimization and negative emotions on digital self-harm, several control variables were included in the analysis. These include an ordinal measure of *grade level* (with scores ranging from 6–12), a dichotomous measure for *Male* (Male = 1, Female = 0), and a series of dichotomous variables measuring race/ethnicity reflecting *Black/African American*, *Hispanic/Latino*, *Other Race*, and *White* (the omitted reference group). We also include a dichotomous variable we label *family drug problems* reflecting each participant’s response to the question, “Has anyone in your family ever had a severe alcohol or drug problem,” (Yes = 1, No = 0). This measure is included given that it represents a type of family strain that, according to Agnew’s (1992) arguments, could both contribute to depressive symptoms and increase the likelihood of maladaptive behaviors, which may include digital self-harm.

Self-control

All models include self-control in the analysis given that past research indicates it is negatively correlated with the risk of various forms of victimization (Pratt et al. 2014) and that it is also negatively correlated with negative emotions and physical self-harm (e.g., Hay and Meldrum 2010). In this study, self-control is a six-item measure reflecting the impulsivity, risk-seeking, and short-temper dimensions as described by Gottfredson and Hirschi (1990) and operationalized by Grasmick et al. (1993). The specific wording of the items was: “I often do whatever brings me pleasure here and now, even at the cost of some distant goal,” “I’m more concerned with what happens to me in the short run than in the long run,” “I sometimes find it exciting to do things for which I might get in trouble,” “Excitement and adventure are more important to me than security,” “When I’m really angry, other people better stay away from me,” and “When I have a serious disagreement with someone, it’s usually hard for me to talk calmly about it without getting upset.” Response options for each item were: “Strongly Disagree” (= 0), “Disagree” (= 1), “Agree” (= 2) and “Strongly Agree” (= 3). The items were reverse-coded and a latent factor was created measuring self-control, where higher scores reflect greater self-control ($\alpha = 0.80$).

⁷While the alpha value of 0.68 is just below the traditional threshold of 0.70, the factor loadings for the three items (see Table 1) each exceeded 0.70, indicating that the items are sufficiently representative of a latent general bullying victimization construct.

Authoritative parenting

We include a seven-item measure of authoritative parenting reflective of parental monitoring, discipline, and warmth used in prior research (Meldrum et al. 2020). We account for the construct given its previously identified negative association with negative emotions and physical self-harm (Hay and Meldrum 2010). The specific wording of the items was: “The rules in my family are clear,” “When I am not at home, one of my parents knows when I am and who I am with,” “If you skipped school, would you be caught by your parents?” “My parents ask me what I think before most family decisions affecting me are made,” “Do you enjoy spending time with your mother?” “Do you enjoy spending time with your father?” and “Would your parents know if you did not come home on time?” Response options for each item were: “NO!” (= 0), “no” (= 1), “yes” (= 2), and “YES!” (= 3). A latent factor was created measuring authoritative parenting, where higher scores reflect greater authoritative parenting ($\alpha = 0.77$).

Analytic method

To investigate the relationships of interest we used structural equation modeling of latent variables for bullying victimization, negative emotions, self-control, and authoritative parenting, and observed variables for digital self-harm and the demographic variables using the statistical package Mplus 8 (Muthen and Muthen 2007). Several fit indices are used to evaluate model fit. In addition to the conventional χ^2 test statistic, the root mean square error of approximation (RMSEA; Steiger 1990) is used, as it takes into account the sample size to correct for the tendency of the χ^2 to reject models with large samples. Values less than 0.05 are good, values between 0.05 and 0.08 are acceptable, and values greater than 0.10 indicate poor model fit. We also used the nonnormed fit index (NNFI; Bentler and Bonett 1980), which takes into account the number of parameters in a model to adjust for the tendency for fit indices to increase as the size of the model increases. Values of 0.90 to 0.95 are considered acceptable and values greater than 0.95 are considered good. We also utilized the comparative fit index (CFI; Bentler 1990), which has the same goodness of fit criteria as the NNFI. We utilized the maximum likelihood robust (MLR) estimator in Mplus 8 to produce parameter estimates and standard errors. This estimator is used for three reasons: estimates are robust to non-normality, it corrects for the non-independence of observations that are clustered within schools, and it allows us to include cases that are missing data across items.⁸ Ordered probit was used for the portion of the structural model predicting the manifest indicator of digital self-harm.

Results

Table 2 presents the results of the structural equation model estimated to examine the relationships of interest. The fit indices for the RMSEA (0.052), NNFI (0.920), and CFI (0.937) each indicate an adequate fit of the data to the model. Two endogenous variables are specified: a latent factor of negative emotions and a manifest indicator of digital self-harm in the past 30 days. As hypothesized, the first portion of the model estimating the effect of bullying victimization on negative emotions reveals a substantively large, positive effect ($\beta = 0.420$, $p < .001$) when accounting for the measured covariates; adolescents who experience greater bullying victimization are more likely to report negative emotions. Several of the covariates are also positively associated with negative emotions, including grade level ($\beta = 0.043$, $p < .001$), family drug problems ($\beta = 0.067$, $p < .001$), and being Hispanic or an “other” race/ethnicity ($\beta = 0.080$ and 0.055 , respectively, $p < .001$), relative to being White. Conversely, being male ($\beta = -0.222$, $p < .001$),

⁸Because the model estimates parameters using full information maximum likelihood, it does not exclude a case just because it contains missing data on some of the variables included in the analysis. Rather, the model simply uses the information available for those cases. Thus, even though the N sizes listed in Table 1 are not equal across all items, the models we estimate are based on an N of 9,469 because 9,469 cases have information on at least some variables (i.e., grade level and negative emotions).

Table 2. Full information maximum likelihood estimates for structural model of negative emotions and ordinal measure of digital self-harm in the past 30 days.

Predictor	Endogenous Factors	
	Negative Emotions	Digital Self-Harm
Grade	0.020*** (0.006)	0.023* (0.012)
Male	0.043 -0.395*** (0.017)	0.045 -0.074 (0.042)
Family Drug Problem	-0.222 0.127*** (0.019)	-0.036 0.011 (0.043)
Black ^a	0.067 -0.004 (0.074)	0.005 0.245 (0.123)
Hispanic ^a	-0.002 0.145*** (0.038)	0.095 0.192* (0.084)
Other Race/Ethnicity ^a	0.080 0.158*** (0.049)	0.094 0.158 (0.186)
Self-Control	0.055 -0.325*** (0.015)	0.049 -0.056 (0.036)
Authoritative Parenting	-0.241 -0.252*** (0.015)	-0.037 -0.133*** (0.039)
Bullying Victimization	-0.186	-0.087
Direct Effect	0.532*** (0.017)	0.412*** (0.042)
Indirect Effect	0.420	0.289 0.207*** (0.018)
Negative Emotions	-	0.145 0.388*** (0.033)
R-Squared	0.465	0.345
Likelihood Ratio χ^2		7286***
Root Mean-Square Error of Approximation (RMSEA)		0.052
Bentler-Bonett Non-Normed Fit Index (NNFI)		0.920
Comparative Fit Index (CFI)		0.937

Notes: N = 9,469; ^a White is reference group; For each variable: row 1 = unstandardized coefficient; row 2 = standard error in parentheses; row 3 = standardized coefficient; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

greater self-control ($\beta = -0.241$, $p < .001$), and exposure to greater authoritative parenting ($\beta = -0.186$, $p < .001$) are negatively associated with negative emotions. The R^2 value of 0.465 indicates that approximately 47% of the variation in the latent factor of negative emotions is explained by the structural model.

Moving to the second portion of the structural model, we consider the direct effect of negative emotions on digital self-harm in the past 30 days and the indirect effect of bullying victimization on digital self-harm operating through negative emotions. The estimates provide partial support for the hypothesized model. Specifically, a positive effect of negative emotions on digital self-harm is observed ($\beta = 0.345$, $p < .001$) when accounting for the measured covariates. Likewise, a positive, indirect effect of bullying victimization on digital self-harm operating through negative emotions is found ($\beta = 0.145$, $p < .001$). It is worth emphasizing, however, that a direct effect of bullying victimization on digital self-harm is also observed ($\beta = 0.289$, $p < .001$). Based on the recommendations of Ditlevsen et al. (2005), we calculated the proportion of the effect of bullying victimization on digital self-harm being mediated

through negative emotions by dividing the standardized indirect effect by the standardized total effect (0.145/0.434). Using this method, 33% of the effect of bullying victimization on digital self-harm is mediated by negative emotions in these data.

In addition to the main effects of interest, the model reveals that three of the covariates also have statistically significant effects on 30-day digital self-harm. Specifically, adolescents who are older ($\beta = 0.045, p < .05$) and those who are Hispanic ($\beta = 0.094, p < .05$) are more likely to engage in digital self-harm. Conversely, those who are exposed to greater authoritative parenting ($\beta = -0.087, p < .001$) are less likely. The R^2 value of 0.378 indicates that approximately 38% of the variation in the observed measure of digital self-harm in the past 30 days is explained by the structural model.

Supplementary analyses

We assessed the robustness of the results when modeling digital self-harm in the past 12 months as the dependent variable rather than the past 30 days. The estimates for this second structural equation model are presented in full in [Appendix A](#), but we can note here that the same pattern of results emerge as they relate to the interrelationships between bullying victimization, negative emotions, and digital self-harm. First, bullying victimization is positively associated with negative emotions ($\beta = 0.420, p < .001$). Second, negative emotions are positively associated with digital self-harm ($\beta = 0.350, p < .001$). Third, bullying victimization exhibits both a direct effect on digital self-harm ($\beta = 0.300, p < .001$) and an indirect effect on digital self-harm operating through negative emotions ($\beta = 0.147, p < .001$). Finally, 33% of the effect of bullying victimization on digital self-harm in the past 12 months is mediated by negative emotions (.147/.447).

Regarding the covariates, nearly identical results were obtained for the portion of the structural model predicting negative emotions given that the same set of predictors and same outcome was modeled. Regarding the effects of the covariates on digital self-harm in the past 12 months, Males ($\beta = -0.053, p < .01$), those with greater self-control ($\beta = -0.069, p < .001$) and those exposed to greater authoritative parenting ($\beta = -0.072, p < .001$) are less likely to have engaged in digital self-harm in the past 12 months. Conversely, Blacks ($\beta = 0.061, p < .05$) are more likely to have engaged in digital self-harm, relative to whites.

Discussion

Recent estimates indicate that nearly one in five adolescents (17%) engage in self-harm (Gillies et al. 2018) and that such behavior is associated with an increased risk of suicide (Olfson et al. 2018). Given the correlation between physical self-harm and digital self-harm found in prior research (Patchin and Hinduja 2017), identifying the potential causes of digital self-harm and placing them within established theoretical frameworks is critical for advancing research on the topic and for informing prevention efforts. In the current study, we sought to achieve this aim by drawing on Agnew's (1992) GST and assessing the extent to which negative emotions mediate the association between bullying victimization and digital self-harm. In this final section, we first describe the main findings and associated theoretical and policy implications. This is followed by a discussion of the limitations of the current study and associated avenues for future research.

Findings

The first finding is that 6% of Florida adolescents reported having engaged in digital self-harm within the prior 30 days and 10% reported having done so within the prior 12 months. The 12-month estimate is notable, as it is slightly higher than what has been reported in prior research. Specifically, Englander (2012) reported 9% of a U.S. sample of college freshmen said they engaged in digital self-harm *at some point during high school*, Patchin and Hinduja (2017) reported a *lifetime prevalence* of approximately 6% among a U.S. national sample of middle-school and high-school students, and

Pacheco, Melhuish, and Fiske (2019) reported a *one year prevalence* rate of 6% among New Zealand youth. Yet, in light of certain limitations of prior work, including a low response rate (Patchin and Hinduja 2017) and the use of relatively small, non-representative samples (Englander 2012; Pacheco, Melhuish, and Fiske 2019), the 12-month estimate generated in the current study may be a more accurate representation of the current past year prevalence of digital self-harm among adolescents. Still, given that the racial and ethnic demographic composition of Florida youth is not reflective of the U.S. as a whole, there remains the possibility that the true prevalence rate in the population of youth within the U.S. might be slightly higher or lower. Regardless, the fact that approximately one in ten adolescents in the current sample reported engaging in digital self-harm in the prior 12 months raises concern and legitimizes the need to understand the factors associated with this maladaptive behavior.

The second finding is that there exists a strong, positive association between bullying victimization and digital self-harm. This is not only consistent with what was reported by Patchin and Hinduja (2017), but it also parallels the results of studies linking bullying victimization to physical self-harm (Arseneault, Bowes, and Shakoor 2010; Barker et al. 2008; Hay and Meldrum 2010). In addition, bullying victimization was strongly associated with negative emotions, an association observed in many prior studies (see the recent meta-analysis by Moore et al. 2017). By all accounts, then, and consistent with the arguments of Agnew's (1992) GST, bullying victimization appears to be a very salient form of strain that contributes to negative psychological and behavioral outcomes, including digital self-harm.

The third finding is that negative emotions are positively associated with digital self-harm. This, too, is consistent with what was reported by Patchin and Hinduja (2017). Yet, the association uncovered in the current study is notable given that it was observed when using a multi-item latent measure of negative emotions and in a multivariate model that accounted for several potential sources of confounding influence beyond demographics. Importantly, this pattern also parallels the large number of studies documenting a positive association between negative emotions and physical self-harm (Fliege et al. 2009; Hay and Meldrum 2010; Madge et al. 2011).

The fourth finding of this study is that one-third of the association between bullying victimization and digital self-harm operates indirectly through, or is mediated by, negative emotions. Of note, this was found to be the case regardless of the way digital self-harm was operationalized (i.e., 30-day vs. 12-month). While the indirect effect observed is consistent with our hypothesis, a direct effect of bullying victimization on digital self-harm was also found. This raises questions as to other possible mechanisms through which this association might be explained and that could be the focal point of future research.

Theoretical and policy implications

The findings of this study have implications for both theory and policy. Regarding theory, the findings are strongly supportive of Agnew's (1992) GST. While most tests of GST have focused on the mediating role of negative emotions in accounting for the association between strain and delinquent behavior, Agnew made clear that his theory was intended to explain a wide variety of maladaptive behaviors. In concert with past GST research focused on maladaptive deviant behaviors other than delinquency and substance use (Bishopp and Boots 2014; Hay and Meldrum 2010; Piquero et al. 2010), the findings of the current study support the contention that GST is a suitable theoretical framework for identifying the etiology of many outcomes in general, and digital self-harm specifically.

From a policy standpoint, the findings of the current work point to the need to take seriously the emergence of digital self-harm as a maladaptive behavior among adolescents. This need is perhaps amplified even more so given recent increases in online, "remote," and "virtual" school stemming from the COVID-19 epidemic. With more, and younger, youth spending greater amounts of time online, coupled with the social and emotional consequences of home isolation, there is the potential for increases in digital self-harm. Of course, combatting and preventing the occurrence of digital self-harm will require, in part, raising awareness of the behavior. While bullying and physical self-harm are widely

recognized as issues among parents, teachers, and practitioners, public awareness of digital self-harm is, at the present time, likely to be much lower. In addition, given the relatively strong association between bullying victimization and digital self-harm observed in this study, bullying prevention programs, many of which have proven to be effective at reducing bullying behavior (see reviews by Evans, Fraser, and Cotter 2014; Gaffney, Ttofi, and Farrington 2019; Polanin, Espelage, and Pigott 2012), seem critical for reducing the occurrence of digital self-harm in addition to physical self-harm. Indeed, it appears, based on the findings of the current study, there are clear parallels between the etiologies of physical self-harm and digital self-harm. Thus, programmatic efforts to prevent one may also serve to curtail the other.

Limitations and future research

With these implications in mind, it is important to recognize certain limitations of this study and associated directions for future research. First, the analyses were based on the use of cross-sectional data. While this is commonplace in studies examining newly emerging topics, correct temporal order in the associations between bullying victimization, negative emotions, and digital self-harm cannot be asserted here based on the data analyzed. It is worth emphasizing, however, that the results were consistent across both 12-month and 30-day operationalizations of digital self-harm. Nonetheless, examining the relationships of interest through longitudinal models is an important avenue for future research. Likewise, it is important to keep in mind that while the sample included nearly 10,000 students from across Florida, no students from private schools, special education schools, or correctional schools were included in the sampling frame. Thus, the point estimates generated from the analyses might be slightly different if such students were included in the study.

A second limitation concerns our inability to control for certain demographic characteristics, such as gender identity and sexual orientation. Past research finds that LGBTQ youth are not only at a greater risk of exposure to bullying victimization than heterosexual youth (Berlan et al. 2010; Kahle 2017), they are also more likely to report engaging in digital self-harm (Patchin and Hinduja 2017) and physical self-harm (Tsypes et al. 2016) than heterosexual youth. Given these patterns, it is possible that the association between bullying victimization and digital self-harm found in the current study might be upwardly biased due to the inability to account for differences based on gender identity and sexual orientation. In this regard, at the time of the writing of this paper there are no known plans for the FYSAS to include measures of gender identity or sexual orientation. Thus, new data collection efforts are warranted to address this limitation.

A third limitation pertains to the measurement of bullying victimization, which relied on single-item indicators to represent physical, verbal, and cyber forms of victimization. It would have been preferable to have multiple indicators measuring each of the forms of bullying victimization, but it was not possible with the available data. As noted earlier, however, the three items loaded highly on the single latent construct (all factor loadings above 0.70). Further, the positive association between bullying victimization and digital self-harm found herein is consistent with what Patchin and Hinduja (2017) observed. A final limitation also pertains to the measurement of bullying victimization and the fact that the definition provided to participants does not capture ‘power imbalance,’ which the literature on bullying (e.g., Cuadrado-Gordillo 2012) suggests is something youth consider in determining what is and is not bullying behavior.

In addition to these limitations, each of which calls attention to the need for additional research to validate the current findings, there are several other ways in which future research can advance our understanding of the causes and consequences of digital self-harm. First, it will be important for future studies employing longitudinal data to identify the temporal ordering of physical self-harm and digital self-harm. It could be, for example, that some youth may engage in digital self-harm in place of physical self-harm. Alternatively, these behaviors might occur in sequence, where one precedes the other. Regardless, given the correlation between physical self-harm and digital self-harm (Patchin and Hinduja 2017), unpacking the sequencing and co-occurrence of these behaviors is critical. Further,

research is needed to investigate the association between digital self-harm, suicidal ideation, and suicide attempts.

It would also be instructive to consider the extent to which the overlap between physical and digital self-harm can be accounted for by bullying victimization and negative emotions. To the extent the overlap between the two forms of self-harm is fully accounted for by bullying victimization and negative emotions, this would elevate the importance of programming previously described that has proven effective at reducing bullying victimization and its downstream consequences, including negative emotions like depressive symptoms. Examining other types of strain beyond bullying victimization as potential causes of digital self-harm, such as discrimination and maltreatment, is another avenue for future research to consider. Similarly, given that our measure of negative emotions largely centered around depressive symptoms, future work might consider other negative emotions, such as anger, that may also serve to mediate the association between bullying victimization and digital self-harm.

Finally, future research should investigate the extent to which the associations examined in the current study are conditioned by other variables, such as gender and race/ethnicity, given that some prior studies provide evidence that the effect of bullying victimization and other forms of strain on maladaptive behavior varies across demographic characteristics (Cullen et al. 2008; Habersaat et al. 2020; Hay, Meldrum, and Mann 2010). Likewise, given past research suggesting that the effect of bullying victimization on physical self-harm is moderated by things such as self-control and authoritative parenting (Hay and Meldrum 2010), future research should consider whether these same variables moderate the effect of bullying victimization on digital self-harm.

Conclusion

Research on the prevalence, causes, and consequences of digital self-harm remains in a very early stage of development. Herein, we utilized data collected on a large sample of Florida youth to better understand the etiology of digital self-harm. While the results reveal clear parallels between digital and physical self-harm with regard to their distal and proximal correlates (see Hay and Meldrum 2010), additional research is needed in order to better understand the short and long-term effects of digital self-harm, its various manifestations, and to identify youth who engage in the behavior and ensure they receive appropriate services and social support. Central to such considerations appears to be the enduring and deleterious effects of bullying victimization, underscoring the importance of continued efforts to prevent its occurrence.

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Declaration of Conflicting Interests

The authors have no conflicts of interest to disclose.

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Appendix A. Full Information Maximum Likelihood estimates for structural model of negative emotions and ordinal measure of digital self-harm in the past 12 months.

<i>Predictor</i>	Endogenous Factors	
	Negative Emotions	Digital Self-Harm
Grade	0.020*** (0.006) 0.043	0.014 (0.010) 0.027
Male	-0.394*** (0.017) -0.221	-0.105** (0.036) -0.053
Family Drug Problem	0.127*** (0.019) 0.067	0.057 (0.035) 0.027
Black ^a	-0.004 (0.069) -0.002	0.156* (0.063) 0.061
Hispanic ^a	0.145*** (0.038) 0.080	0.100 (0.052) 0.049
Other Race/Ethnicity ^a	0.158*** (0.049) 0.055	0.029 (0.111) 0.009
Self-Control	-0.325*** (0.015) -0.241	-0.105*** (0.029) -0.069
Authoritative Parenting	-0.252*** (0.015) -0.186	-0.110*** (0.028) -0.072
Bullying Victimization		
Direct Effect	0.534*** (0.017) 0.420	0.429*** (0.035) 0.300
Indirect Effect	-	0.210*** (0.016) 0.147
Negative Emotions	-	0.394*** (0.029) 0.350
R-Squared	0.465	0.416
Likelihood Ratio χ^2		7279***
Root Mean-Square Error of Approximation (RMSEA)		0.052
Bentler-Bonett Non-Normed Fit Index (NNFI)		0.920
Comparative Fit Index (CFI)		0.937

N = 9,469; ^a White is reference group; For each variable: row 1 = unstandardized coefficient; row 2 = standard error in parentheses; row 3 = standardized coefficient; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.