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PROBLEMATIC SOCIAL MEDIA USE, SOCIAL COMPARISON, AND DEFEAT:
AN INTENSIVE LONGITUDINAL INVESTIGATION

by

NATALIA MACRYNIKOLA

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, the City University of New York

2022

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This manuscript has been read and accepted for the Graduate Faculty in Psychology
to satisfy the dissertation requirement for the degree of Doctor of Philosophy.

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ABSTRACT

Problematic Social Media Use, Social Comparison, and Defeat: An Intensive Longitudinal Investigation

by

Natalia Macrynikola

Advisor: Regina Miranda, Ph.D.

Self-injurious thoughts and behaviors (SITBs) have steadily risen over the past two decades. The simultaneous dramatic increase in social media use has fueled concerns that using social media may be contributing to suicide risk. Although an emerging body of evidence reveals associations between certain patterns of social media use and SITBs, most research studies have not been designed to assess the temporal order of these variables and have neglected to investigate mechanisms underlying such associations. As a result, whether and how social media use may be conferring suicide risk remains unclear. To address this gap, the present study examined a process by which social media use may begin to confer suicide risk among those exhibiting one specific pattern of maladaptive social media use – problematic social media use (PSMU). Specifically, we tested an explanatory mechanism (i.e., social comparison) through which social media use may impact a theoretically based predictor of suicide ideation (i.e., defeat), proposing that this indirect effect may be stronger for those who engage in PSMU.

To examine our hypotheses, we conducted an intensive longitudinal study using ecological momentary assessment methods. A diverse sample of 99 smartphone users (78% cisgender women), ages 18-29 ($M = 23.14$, $SD = 3.20$) was recruited from a public college and the greater New York City area. For 15 days, participants completed five daily brief assessments via text in which they repeatedly reported their most recent amount of social media use, engagement in social comparison during that use, and present-moment feelings of defeat. Data were analyzed using multilevel modeling.

We found a significant indirect effect of social media use on defeat via social comparison on social media at the within-person level, $effect = .003$, $bootstrapped SE = .001$, $CI = .002-.004$, $p < .01$, but not at the between-person level. This indirect effect was slightly stronger at higher (versus lower) levels of PSMU at the within-person level, but not at the between-person level.

These results suggest that after a person spends more time than they typically do on social media, they experience greater defeat than usual, partly due to engaging in more social comparison on social media than usual. This effect is very slightly stronger for people who exhibit higher (versus lower) levels of PSMU because social comparison has a slightly more negative impact on defeat for these individuals. Based on these findings, further examination of the impact of patterns of social media use on defeat and on SITBs is warranted. Elucidating the specific user- and technology-centered social media factors that may confer risk for SITBs will help inform interventions that promote using social media in more adaptive ways.

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Introduction

Suicide is the second leading cause of death in the United States among young adults (NIMH, 2019). In the past decade, rates of suicide have steadily risen (Hedegaard, Curtin, & Warner, 2018), along with suicidal thoughts and behaviors (NIMH, 2019). Simultaneously, a cultural phenomenon has unfolded, with social media becoming increasingly prevalent. Today, social media use is ubiquitous, across the lifespan, but especially among young adults. In fact, 90% of young adults, ages 18 to 29, are social media users, with most of them reporting using social media at least once a day (Perrin & Anderson, 2019). Young adults, 18 to 25, are also the demographic group that has experienced the greatest increase in suicidal thoughts and behaviors (SITBs) over the past decade (NIMH, 2019).

Given this concomitant rise in social media use and psychological distress, particularly among youth, there has been growing concern that social media may be contributing to SITBs (e.g., Twenge et al., 2019). Scant research has directly examined this question, however. Although cross-sectional studies suggest associations between certain patterns of social media use and suicidal thoughts and behaviors, these studies are not designed to assess causality, precluding conclusions about whether patterns of social media use are, in fact, conferring suicide risk (*see* Macrynika et al., 2021). More prospective longitudinal research is needed to investigate whether and how problematic patterns of social media use may lead to suicide-related outcomes. To address this gap, the present study sought to examine a process by which social media use may confer risk for an empirically supported predictor of suicide ideation (i.e., defeat), particularly among those who engage in one specific maladaptive pattern of social media use (i.e., problematic social media use, also known as PSMU or social media addiction). The overarching goal of this research is to extend our knowledge on the harmful psychological

effects of social media use, examining one potential pathway through which social media use may ultimately confer suicide risk.

Organization of This Introduction

The underlying assumption guiding this research is that if social media use indeed imparts risk for suicide ideation, it would do so through theoretically derived factors, such as defeat, that have been empirically shown to facilitate suicidal thoughts. Therefore, we begin by discussing contemporary psychological theories of suicide, which have shed light on such factors in the past two decades.

Following this discussion, we will provide a succinct overview of the literature on social media and psychopathology, placing PSMU in its context. We will then discuss the theoretical and empirical basis of PSMU, including psychological factors involved in the onset and maintenance of this behavioral addiction. Having provided a snapshot of the psychological profile of those who engage in PSMU, we will then propose a mediating process likely to be involved in conferring risk for defeat, particularly for those who score higher on measures of PSMU. We will then place these variables in the context of a contemporary model of suicide, introducing the specific predictions that were tested in this study.

Psychological Theories of Suicide

Before introducing theories of suicide, it is helpful to define the terms used across theories. Three terms are used in the literature to talk about SITBs: suicide ideation, suicide attempt, and suicide. Suicide ideation is defined as considering, thinking about, planning, or having a desire to end one's life (Cha et al., 2018; NIMH, 2019). Ideation can range in severity, with passive suicide ideation involving a wish to be dead, and active suicide ideation reflecting a more active desire to die by suicide (e.g., having thoughts about killing oneself and thinking

about a specific method by which to die). A suicide attempt involves carrying out a behavior intended to end one's life that does not result in suicide; it is formally defined as "a non-fatal, self-directed, potentially injurious behavior with an intent to die as a result of the behavior" (NIMH, 2019). This "intent to die" differentiates suicide attempts from accidental death or non-suicidal self-injury, both of which do not necessarily involve a wish to die. Finally, suicide is defined as death that has occurred as a result of self-directed injurious behavior carried out with the intent to die. Suicide ideation, suicide attempts, and suicide fall under the category of SITBs.

A current focus in suicide research is understanding the factors that differentiate those who transition to engaging in suicide ideation from those who progress from ideation to attempts. This focus came about because, after decades of research on SITBs, little improvement was made in the prediction (and thus prevention) of suicide (Franklin et al., 2017). Part of the problem was that, historically, theories of suicide proposed factors that predicted "suicidality" as a general construct (Klonsky, May, & Saffer, 2016) – a construct that included suicide ideation and attempts. In contrast, contemporary models of suicide differentiate between the unique predictors of the development of ideation and the unique predictors of the progression from ideation to attempts. Referred to as ideation-to-action frameworks, these theories have garnered empirical support in the past two decades. Three will be reviewed here to provide a concise overview of the social, cognitive, and intrapersonal influences proposed to play a role in facilitating the transition into different suicidal states. Given that the present dissertation research focuses on the development of suicide ideation, not attempts, we will focus more extensively on the part of these theories that discuss the transition to suicide ideation rather than the progression to suicide attempts.

The oldest ideation-to-action framework is the Interpersonal Theory of Suicide (Joiner, 2007; Van Orden et al., 2010). This theory proposes that the desire for suicide arises in the presence of two painful psychological states that involve the self in relation to others: thwarted belongingness and perceived burdensomeness. Thwarted belongingness is defined as an unmet need to belong, and the need to belong is a fundamental human need (Baumeister & Leary, 1995); perceived burdensomeness is the perception that one is a liability to others, which may include but is not limited to friends and family (Van Orden et al., 2010). The Interpersonal Theory of Suicide proposes that when either of these two psychological states is present, passive suicide ideation develops, and when these two states are present simultaneously (and their presence is perceived as stable and unchanging by the individual experiencing them), ideation escalates into an active form (Van Orden et al., 2010). However, ideation does not transition into an attempt unless one has acquired capability to enact suicidal behavior through exposure of painful and provocative events that lead to pain habituation and erosion of the innate fear of dying (Van Orden et al., 2010). Significant empirical evidence has supported much of what this theory proposes: A recent systematic review of 58 research studies of the theory found support for the main predictions regarding suicide ideation (Ma, Batterham, Calear, & Han, 2016). This theory highlights the important role that interpersonal vulnerabilities play in conferring suicide risk.

In contrast, the Cognitive Model of Suicidal Behavior (Wenzel & Beck, 2008) emphasizes the role of cognition in suicide risk. The theory posits that cognitive processes associated with suicidal acts (i.e., suicide ideation) are triggered when a suicide schema (defined as a cognitive structure that biases interpretation of events) is activated (Wenzel & Beck, 2008). Examples of such schemas are ones that are associated with chronic hopelessness or perceptions

of unbearable. These schemas are activated by dispositional vulnerabilities, prolonged cognition associated with psychiatric disturbance, and stressful life events. Then, other aspects of cognition, such as attentional bias and attentional fixation on suicide as the only escape, are posited to eventually precipitate suicidal behavior (Wenzel & Beck, 2008). Indeed, significant research has shown that cognition plays a key role in suicide risk (for a systematic review, see Cha et al., 2019). Cognitive risk factors such as hopelessness (Tsypes & Gibb, 2016), brooding rumination (Tsypes & Gibb, 2016), and dysfunctional attitudes (Chioqueta & Stiles, 2007) have been shown to predict suicide ideation above and beyond depressive symptoms. Additionally, biased processing of information related to SITBs has been shown to predict short-term risk for a suicide attempt (Cha, Najmi, Park, Finn, & Nock, 2010). This theory thus adds another dimension to our understanding of what increases risk for suicide ideation: maladaptive cognitive patterns that, when activated, can amplify distress and lead to ideation.

A third theory of suicide ideation and behavior that has been empirically supported in the past decade is the Integrated Motivational-Volitional (IMV) Model of Suicidal Behavior (O'Connor, 2011; O'Connor & Kirtley, 2018). The IMV is a diathesis-stress model that proposes that suicide risk progresses in three phases. In the first (pre-motivational) phase, individual vulnerabilities or early background factors confer elevated risk for suicide ideation by predisposing one to have a more adverse psychological response in the face of stressors. In the second (motivational) phase, two intrapersonal factors are instrumental in the development of the desire to die by suicide: defeat and entrapment (O'Connor, 2011). In the context of adversity, when the experience of defeat (i.e., failed struggle) turns into entrapment (i.e., failed escape), it leads to the perception of suicide as the only solution, triggering suicide ideation (O'Connor & Kirtley, 2018). In the third and final (volitional) phase, suicidal desire turns into behavioral

enaction. Additionally, an important component of the IMV is its emphasis on the role of social and cognitive moderators that facilitate the course of suicide risk along these three phases, influencing the likelihood that one stage will escalate to the next – that is, that defeat will turn into entrapment, entrapment into suicide ideation, and ideation into a suicide attempt. A growing number of empirical tests of the IMV have lent support for its predictions: Defeat and entrapment have been found to be robust predictors of suicide ideation (Dhingra, Boduszek, & O’Connor, 2016; Dhingra, Boduszek, & O’Connor, 2015), with entrapment mediating the association between defeat and ideation, both cross-sectionally (Wetherall, Robb, & O’Connor, 2018) and longitudinally (Owen, Dempsey, Jones, & Gooding, 2018).

It is clear from these prevailing models of SITBs that the development of suicide ideation is multi-determined. However, scant research has examined the social, cognitive, and interpersonal predictors of suicide ideation in the social media context. Yet if patterns or aspects of social media use indeed confer suicide risk, they likely impact the social, cognitive, and intrapersonal processes that predict suicide ideation. In this study, we focused on examining one such intrapersonal influence as an outcome of social media use: defeat, as will be discussed further below. We now turn to the research on social media use and psychopathology to set the stage for the discussion of PSMU.

Social Media and Psychopathology

Before discussing the research on social media and mental health, it once again becomes important to define key terms – in this case, “social media.” Although the exact definition of social media is still under debate in the field, one commonly accepted definition is as follows: Social media are “Internet-based, disentrained and persistent channels of masspersonal communication facilitating perceptions of interactions among users, deriving value primarily

from user-generated content” (Carr & Hayes, 2015). This definition suggests that to be considered “social media,” digital platforms must have five characteristics: be Internet-based, disentrained (i.e., supporting asynchronous communication), socially-driven (i.e., facilitating the perception of interactions), user-generated (i.e., enabled through interaction with others), and masspersonal (i.e., including ability to broadcast communication to large audiences). Such social media, widely used today, include such platforms as Facebook, Instagram, TikTok, and Snapchat.

Some of the earliest social media platforms that began to change the way young people communicate were MySpace, which launched in 2003 and was one of the first to introduce the concept of the personal profile, and Facebook, which launched in 2004. The subsequent decade proved important in revolutionizing the way young people connect, with the release of the smartphone in 2007 and the introduction of new social media year after year (e.g., Tumblr in 2007, Instagram in 2010, and Snapchat in 2011). These innovations gradually increased the ubiquity of social media use: While only 5% of American adults used social media in 2005, half of all Americans reported using social media by 2011, with that number rising to 72% in 2019. Today, social media use is highly prevalent across the lifespan – even among older populations, as roughly two-thirds of adults ages 50-64 and nearly half of adults ages 65 and older report using at least one social media site, with the majority of each site’s users reporting daily use (Perrin & Anderson, 2019).

Research on Social Media Use and Depression

Early on, the rapid growth of social media use led to growing concern about the potential mental health costs of such use, with the American Academy of Pediatrics warning parents that excessive Facebook exposure could lead to “Facebook depression,” defined as “depression that

develops when youth “spend a great deal of time on social media, such as Facebook, and then begin to exhibit classic symptoms of depression” (O’Keeffe & Clarke-Pearson, 2011). Others voiced concerns that Facebook may be creating “iDisorders” (Rosen, Whaling, Rab, Carrier, & Cheever, 2013). Such claims, however, were premature, given that most of the early research on social media and depression was cross-sectional, with mixed findings. For example, some studies found associations between social media use and depressive symptoms (Morrison & Gore, 2010; Selfhout et al., 2009; Pantic et al., 2012) while others found no such evidence (Jelenchick, Eickhoff, & Moreno, 2013) and still others found the inverse – that overall social media use was associated with indicators of well-being in the context of Facebook (Nabi, Prestin, & So, 2013; Valenzuela, Park, & Kee, 2009).

While most of the studies in this field have continued to be cross-sectional in nature, methodological improvements have been made in recent years. More longitudinal and experimental studies have been conducted, and the way social media is examined has, in some cases, become more nuanced. Rather than examining overall use of social media, some researchers have begun to examine specific characteristics of social media use (e.g., patterns) and of the individual (e.g., personality traits) that may differentially impact psychological outcomes of social media use. Such nuanced studies have abandoned the question “Is social media use maladaptive?” in favor of the question “When is social media use maladaptive and for whom?” This shift has led to an emerging body of research that has yielded more consistent and informative findings about social media use and depression. Three broad findings have emerged from this literature.

First, frequency or time spent on social media alone does not consistently predict depression directly – and when it does, it does so with small effect sizes (Yoon, Kleinman,

Mertz, & Brannick, 2019). This is likely because social media use is complex, and its outcomes may depend on various characteristics of the use and of the user. Thus, more specific behaviors and patterns of social media use tend to be more strongly and consistently predictive of depression. One example of those is problematic social media use, or PSMU, which is a pattern of compulsive social media use that is considered a behavioral addiction and has been consistently associated with depression (Hussain & Griffiths, 2018). Studies have shown that a higher frequency of social media use is one aspect of this problematic pattern (Hormes, Kearns, & Timko, 2014; Kuss et al., 2018; Marino, Finos, Vieno, Lenzi, & Spada, 2017); thus, cross-sectional studies finding a link between frequency of social media use and depression may have been tapping into a broader maladaptive pattern of PSMU. Another example of a maladaptive pattern of social media use is passive use (i.e., scrolling through social media content without interacting with others in the digital space), which has been found to predict declines in affective well-being over time (Frison & Eggermont, 2015; Verduyn et al., 2015). In contrast, research suggests that using social media actively (i.e., interacting with others on social media) tends to be more adaptive (*see* Verduyn et al., 2017), although not always, given that valence of digital interactions also matters. That is, low-quality interaction is also linked with depression, as reporting more negative and fewer positive interactions on Facebook has been found to predict increases in depression over time (Davila et al., 2012). Taken together, these findings suggest that perhaps frequency of social media use alone is too crude a metric to directly predict depression and other psychological outcomes of social media use. *How* one uses social media may influence the experience and outcomes of such use.

Second, frequency of social media use at times indirectly predicts depression, through processes that have also been found to link other maladaptive patterns of social media use to

negative psychological outcomes. Social comparison and envy are two of those processes. Social comparison has been found to mediate the association of Facebook (Steers, Wickham, & Acitelli, 2014) and Instagram use (Lup et al., 2015) with depression. Envy, which tends to be a result of social comparison, is greater in response to viewing attractive Facebook profiles, particularly among depressed individuals (Appel, Crusius, & Gerlach, 2015). Envy has also been found to mediate the association between passive Facebook use and depression (Tandoc, Ferrucci, & Duffy, 2015). These findings suggest that time spent on social media may be maladaptive to the degree that it leads to other negative social-psychological processes, such as social comparison. For some individuals, such as passive Facebook users, the more time spent on social media, the more likely they are to engage in these negative mental processes. Thus, testing indirect paths from time spent on social media to mental health outcomes, such as depression, may be more informative in regard to elucidating the ways social media use may exert a negative impact.

Third, individual characteristics play a role in determining social media use outcomes. In the aforementioned findings, for example, valence of interaction was *perceived* as negative. Negative interactions may not actually occur as frequently as they are perceived to be negative: In one study in which researchers objectively coded responses on social media statuses containing negative emotions, greater depressive symptoms were positively associated with actual social support but negatively associated with perceived social support on those statuses (Park et al., 2016). This discrepancy between actual and perceived support may also apply to perception of quality of interactions, as individual vulnerabilities may lead to biased perception of interactions. For example, depression also predicts increases in reporting of negative peer experiences on Facebook (Frison, Subrahmanyam, & Eggermont, 2016). Taken together, these

findings suggest that individual vulnerabilities may play a key role in determining one's psychological experience and outcome of social media use.

Research on Social Media Use and SITBs

Although there is far less research on social media use and SITBs than there is on social media use and depression, the emerging literature suggests that some patterns of social media use are also associated with SITBs. Frequency of social media use tends to be positively associated with SITBs cross-sectionally (Harris, McLean, & Sheffield, 2014; Kim 2017; Sampasa-Kanyinga & Lewis, 2015), as does SITB-related social media content exposure and engagement (Macrynika et al., 2021), distress disclosure on social media (Macrynika et al., 2021), and cyberbullying and cybervictimization (Nesi et al., 2021). However, mixed findings have also emerged in this literature. Some studies have found that frequency of social media use is not associated with SITBs (e.g., Jasso-Medrano & Lopez-Rosales, 2018). Other studies have found no association between other patterns of social media use and SITBs, including social media addiction, digital interaction, help-seeking online, and suicide forum use (Macrynika et al., 2021).

Research also suggests that what youth are exposed to in their time on social media may influence the impact of social media use on SITBs. For example, using social media to find and attend to suicide-related information may increase risk for suicide ideation (Dunlop et al., 2011) and attempts (Liu, Huang, Yu, Li, & Zhu, 2020). Beyond the direct impact of viewing and engaging with suicide information online, however, little research has examined other, more commonplace aspects of the digital space and the psychological processes they elicit that may confer risk for SITBs on vulnerable individuals. For example, non-suicide-related content and interactions that youth are exposed to on social media may impact suicide ideation in similar

ways that research has shown they impact depression – e.g., by giving rise to social comparison (see Yoon et al., 2019). Recent evidence suggests that suicidal youth do, in fact, engage social comparison online, often at higher rates than do non-suicidal youth: In a sample of psychiatrically hospitalized youth in an inpatient facility, girls with a prior suicide attempt (versus girls without) were significantly more likely to report comparing themselves negatively to peers on social media in the previous two weeks (Nesi, Wolff, & Hunt, 2019). The possibility that commonplace aspects of social media that youth are regularly exposed to and their relationship to SITBs through such mediating processes as social comparison has yet to receive sufficient empirical attention. Moreover, most of the studies in this literature have not been guided by prevailing theories of SITBs. As such, key social, cognitive, and intrapersonal influences that these theories suggest influence the development of suicide ideation have scarcely been examined in the context of social media use.

Summary of Research

In summary, findings from the literature on social media and depression suggest that certain patterns of social media use are associated with depression to the degree that they give rise to such maladaptive processes as social comparison. Findings also highlight the role of individual vulnerabilities on one's experience on social media, given their impact on perception and processing of what occurs on social media. Similarly, studies in the more nascent literature on social media and SITBs have found associations between maladaptive patterns of social media use and SITBs, along with a slew of mixed findings. Most of these studies are cross-sectional and have not been guided by theory, neglecting an examination of key psychological processes and individual differences that may explain and strengthen associations between aspects of social media use and SITBs.

Problematic Social Media Use (PSMU): Features and Prevalence

Problematic social media use, or social media addiction, is broadly defined as a failure to regulate one's use of social networking sites, which leads to negative consequences (Andreassen, 2015; LaRose, Kim & Peng, 2010). Given the ubiquity of social media and the accompanying cultural changes of the past two decades, social media use is now a normal behavior.

Pathological, or problematic, forms of social media use emerge, however, when individuals start to lose control over their use and as a result incur negative outcomes in various life domains (Andreassen, 2015).

Behavioral addictions, such as PSMU, mirror the qualities of chemical addictions. The components model of addiction (Griffiths, 2005) suggests that cutting across these different forms of addiction are six common components: salience (persistent preoccupation with use), mood modification (used as a way to produce a shift in mood), tolerance (need for increasing amounts to sustain former effects), withdrawal (psychological or physiological costs to reducing use), conflict (when use creates social, occupational, or other types of dysfunction, including intrapsychic conflict regarding use), and relapse (reverting to old patterns of use after a period of reduction). These components, in the context of social media, are what define PSMU (Andreassen, 2015).

Although PSMU is not currently recognized as an official diagnosis in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (American Psychiatric Association, 2013), it is considered a public health concern (World Health Organization, 2014). PSMU appears to be a cross-cultural phenomenon, with prevalence rates varying around the world – from 4.5% among adolescents in Hungary (Bányai et al., 2017) to 12% among young adults in China (Wu, Cheung, Ku, & Hung, 2013), for example. In the United States, a recent nationally

representative study of PSMU found a prevalence rate of 14% among young adults, ages 19 to 32, using a conservative scoring approach to classify PSMU, and 44% using a liberal scoring approach (Shensa et al., 2017).

PSMU has been consistently associated with stress and with various forms of psychopathology, including depression, anxiety, and attention deficit disorder (*see* Hussain & Griffiths, 2018). More recently, it has been examined in the context of SITBs in adults and adolescents, but only in three such investigations of which we are aware – two cross-sectional (Jasso-Medrano & Lopez-Rosales, 2018; Walburg, Mialhes, & Moncla, 2016) and one longitudinal (Brailovskaia et al., 2020). These studies yielded mixed findings. Longitudinally, Facebook addiction predicted suicide-related outcomes (assessed with a one-item rating on a 6-point Likert scale from no suicide ideation/attempt to suicide attempt) one year later in adults (Brailovskaia et al., 2020). However, baseline suicide-related outcomes were not adjusted for, precluding an appropriate conclusion about the impact of addiction on suicide-related outcomes one year later. Two cross-sectional studies found positive bivariate associations between PSMU and suicide ideation (i.e., current ideation in one study and past-two-week ideation in the other); when depression was accounted for, however, the relationship was either no longer significant (Walburg et al., 2016) or became inverse (Jasso-Medrano & Lopez-Rosales, 2018).

These mixed findings are surprising, given the consistency with which PSMU has been positively associated with other forms of psychopathology, including depression and anxiety (*see* Hussain & Griffiths, 2018). However, two methodological considerations may help explain them. First, given that ideation tends to fluctuate more than depressive symptoms in short periods of time, assessing it only once may not give an accurate estimate of one's suicide ideation, which may artificially inflate the variability in responses and show a weaker association with PSMU

than might depression. Second, like all addictions, PSMU likely imparts reinforcing short-term benefits (e.g., avoidance of painful emotions) but takes a toll in the long term. A cross-sectional study may be more suited to capture short-term benefits rather than longer-term psychological costs; longer periods of assessment, or more frequent assessments, might help elucidate these mixed findings.

These considerations highlight the need for more longitudinal studies, short-term and long-term, to assess whether social media use among those with PSMU affects suicide ideation or its proximal predictors. Additionally, no studies of which we are aware have examined potential mediating paths or moderating influences; yet testing such influences may help to disentangle these effects. To choose likely candidates to test, it is important to first understand the psychological profile of individuals likely to engage in PSMU, as the factors that lead to the onset and maintenance of the addiction may also impact what happens during social media use and play a role in imparting suicide risk. We thus now turn to theoretical perspectives of PSMU to leave the reader with a better understanding of the individual who tends to engage in PSMU.

Theoretical Perspectives of PSMU

Three conceptual models have been used to explain the development and maintenance of PSMU. These include the cognitive-behavioral model (Davis, 2001), the socio-cognitive model (LaRose, Lin, & Eastin., 2003), and the social skill model (Caplan, 2005). Although these three theoretical perspectives were developed to explain problematic *Internet* use – rather than PSMU specifically – they either conceptualize PSMU as a form of *Internet-specific* addiction (e.g., Davis, 2001) or have been adapted to apply to PSMU (e.g., Caplan, 2005; LaRose et al., 2003). Such adaptations emerged in light of consistent findings that those who report negative outcomes associated with their online use are especially likely to be attracted to the social uses of the

Internet (e.g., Caplan, 2002; McKenna & Bargh, 2000; Morahan-Martin & Schumacher, 2000; Young 1998).

First, the cognitive-behavioral model proposes that abnormal patterns of social media use arise from maladaptive cognitions about the self and others. These cognitions stem from a negative self-view, particularly in relation to others, exemplified by themes of self-doubt, low self-efficacy, and negative self-appraisal (Davis, 2001). As such, social media-related cognitions about the self and others may involve such thoughts as “I am worthless offline, but online I am someone” and “Nobody loves me offline; the Internet is the only place I am respected.” Such cognitions lead one to turn to the digital space to attain more positive responses from others – responses they do not tend to elicit in their offline lives – and in so doing, these cognitions are strengthened and reinforced, paving the way toward PSMU (Davis, 2001). Additionally, the model proposes that those who tend to ruminate will experience more severe, persistent PSMU. An overarching takeaway from this model is that psychosocial problems and maladaptive thinking patterns increase risk of developing PSMU.

A second account of PSMU was put forth by the socio-cognitive model (LaRose et al., 2003), informed by Bandura’s (1991) social-cognitive theory of self-regulation. The socio-cognitive model is based on two key constructs from Bandura’s social-cognitive theory: self-efficacy and self-regulation. Self-efficacy is the belief that one is able to successfully execute a course of action to obtain a desired goal (Bandura, 1991). Self-regulation involves monitoring one’s behavior (self-monitoring), judging it against personal standards, and applying self-reactive incentives to moderate it (self-reactive outcomes; Bandura, 1991).

The socio-cognitive model proposes that deficient self-regulation begins when individuals start using social media to relieve boredom, loneliness, or seek validity of social

identity; through classical conditioning processes, these motivations become a conditioned response to dysphoric mood states. As one becomes more skilled in obtaining rewards from the digital context, digital self-efficacy strengthens, strengthening too the expectation that digital use will improve mood. Both then drive online behavior, gradually turning digital use into a habit. With habit strength, self-monitoring naturally lessens, as less conscious self-control is needed to obtain the same outcome. With less attention to self-monitoring, self-reactive incentives are less likely to be applied to moderate behavior, which paves the way for decreased self-regulation, and in turn, addiction. In other words, according to the socio-cognitive model, the seed for PSMU is planted when an individual starts expecting use to improve mood. Strengthened by digital self-efficacy, this outcome expectation motivates the behavior of regularly turning to digital use to improve mood. As habit strength increases, failure in monitoring one's behavior results, fueling addiction.

Similar to the cognitive-behavioral model, psychosocial distress also plays a role in the socio-cognitive model, as individuals start relying on social media use to relieve negative states and gain social validity. However, use in this model becomes addictive as attention to one's own behavioral patterns decreases. Thus, according to this model, aside from psychosocial distress driving PSMU, deficient attention to and awareness of one's behavior also plays a role in maintaining it. A major contribution of this theory is a more explicit introduction to what the earlier cognitive-behavioral model only alluded to as a potential contributing factor to PSMU: the role of mood modification motivation.

A third theory, which drew from and extended previous models, is the social skill model (Caplan, 2010). The first introduction of the model (Caplan, 2003) proposed two central ideas. First, those who suffer from psychosocial problems, such as loneliness or depression, perceive

their own social competence more negatively than those who do not suffer from such problems; as such, they develop a preference for online (versus face-to-face) social interaction, as computer-mediated communication seems less threatening, and they feel more competent when interacting with others online. Second, such a preference motivates turning to the online space for interaction, which is reinforced over time and gradually turns into compulsive use, worsening (or creating new) psychosocial problems (Caplan, 2003). An update to this theory to reflect new literature led to an emphasis of a third idea: that what leads to deficient self-regulation (defined as having cognitive and behavioral symptoms of cognitive preoccupation and compulsive use) is mood regulation motivation, and that the relationship of mood modification motivation with negative outcomes of problematic use is mediated by deficient self-regulation. A growing research base has lent empirical support to this model in its entirety (Assunção & Matos, 2017; Fioravanti, Flett, Hewitt, Rugai, & Casale, 2020; Lee, Cheung, & Thadani, 2012; Moretta & Buodo, 2018).

From these theories, a primary theme emerges: that interpersonal and mood regulation difficulties tend to precede, and set the stage for, PSMU. Indeed, PSMU has been consistently associated with relational difficulties, including unmet belonging needs (Fioravanti et al., 2020; Kircaburun et al., 2019; Pelling & White, 2009; Tras, Ozetemel, & Baltaci, 2019), perceived social isolation (Meshi, Cotten, & Bender, 2020), relationship dissatisfaction (*see* Ryan, Chester, Reece & Xenos, 2014), and loneliness and motives to reduce it (Balakrishnan & Shamim, 2013; Teppers, Luyckx, Klimstra, & Goossens, 2014; Wan, 2009). PSMU has also been associated with other factors involved in psychosocial problems, including low self-esteem (Blachnio, Przepiorka, Benvenuti, Mazzoni, & Seidman, 2018; Griffiths & Dancaaster, 1995; Hong, Huang, Lin, & Chiu, 2014; Wilson, Fornasier, & White, 2010), anxious attachment (Worsley, McIntyre,

Bentall, & Corcoran, 2018), and depressive symptoms (Bányai et al., 2017). Moreover, a recent longitudinal study found that increases in depressive symptoms predicted increases in PSMU over time (Raudsepp & Kais, 2019), supporting the idea that psychosocial vulnerabilities precede, and may set the stage for, problematic patterns of habitual social media use.

What has been far less examined so far in the literature is how these psychosocial vulnerabilities may influence what occurs *during* social media use, contributing to negative outcomes of such use. This possibility is examined in the following sections, which propose that normative processes during social media use may be amplified – and contribute to suicide risk – due to the psychosocial vulnerabilities of those who engage in PSMU.

Social Comparison and PSMU

If certain patterns of social media use confer suicide risk, one pathway through which they may do so is social comparison on social media. According to social comparison theory, the process of social comparison involves using other people as information sources to assess how well one is doing (Festinger, 1954). This process is adaptive, as it provides useful information so one can navigate the social world, and it has been proposed as a core feature of human evolution (Gilbert, Price, & Allan, 1995). However, research from the literature on social media and well-being has indicated that social comparison on social media, which tends to naturally occur online, is mostly maladaptive. The idealized nature of posts and salience of comparative information (e.g., shares, friend count) facilitates upward comparisons (Kross et al., 2013) – i.e., comparisons to targets perceived as superior. Such comparisons create distorted perceptions that others' lives are better than one's own (Chou & Edge, 2012), feelings of inferiority (Appel et al., 2015), and envy (Fox & Moreland, 2015). Additionally, social comparison online is longitudinally associated with depressive symptoms above and beyond prior depressive

symptoms (Nesi & Prinstein, 2015) and prospectively predictive of rumination (Feinstein et al., 2013).

Little research has examined social comparison on social media in relation to suicide-related predictors. Only one study of which we are aware has examined the association of online social comparison with suicide ideation (Kingsbury et al., 2021), and little research has investigated social comparison *offline* and suicide ideation (e.g., Wetherall, Robb, & O'Connor, 2018). These studies have shown, cross-sectionally, an association of social comparison – on social media (Kingsbury et al., 2021) and offline (Wetherall et al., 2018) – with suicide ideation. Additionally, research suggests that vulnerable youth may be particularly likely to engage in frequent social comparison online. Results from a nationally representative survey of 1,337 young adults suggest that youth with moderate to severe depressive symptoms (versus young adults without) were more likely to report engaging in negative social comparison on social media (Rideout & Fox, 2018). Female youth low in popularity are particularly likely to engage in social comparison on social media (Nesi & Prinstein, 2015). Additionally, a recent study of psychiatrically hospitalized youth found that girls with a prior suicide attempt or an internalizing disorder (versus girls without) were significantly more likely to report comparing themselves negatively to peers on social media in the past two weeks (Nesi et al., 2019). Taken together, these studies suggest that social comparison may be an important target for investigation in the social media context and may influence psychological factors that are proximal to suicide ideation.

In addition, there is reason to believe that those who engage in PSMU may be particularly vulnerable to social comparison on social media and its negative effects. One reason is that given their tendency to spend more time on social media, those who engage in PSMU may face greater

exposure to content that prompts social comparison than those who do not engage in PSMU. Thus, it is plausible that one reason PSMU may be harmful is simply that it leads to greater exposure to comparative information on social media.

What may also increase vulnerability to both greater frequency and more negative effects of social comparison is the host of interpersonal and mood-related vulnerabilities involved in PSMU that theory and research suggest drive motivations for social media use. As discussed in the previous section, these vulnerabilities associated with PSMU include relational difficulties, neuroticism, low self-esteem, and depression. It has been suggested in the literature that these factors involve a component of uncertainty about the self—uncertainty about the self or self-concept in the case of depression and low self-esteem, and instability of mood state in the case of neuroticism (*see* Gibbons & Buunk, 1999). Relational difficulties also involve a component of uncertainty regarding belonging. Social comparison theory suggests that an interest in social comparison generally increases in contexts of uncertainty (Festinger, 1954), and thus it stands to reason that factors that involve uncertainty are likely to increase the drive for social comparison (Gibbons & Buunk, 1999). In line with this idea, research has shown that these specific vulnerabilities associated with PSMU are also associated with greater and more negatively impactful social comparison. First, low belonging offline is associated with more social comparison online (Bachner-Melman, Zontag-Oren, Zohar, & Sher, 2018) and drives the perception that others are more connected than oneself (Whillans, Christie, Cheung, Jordan, & Chen, 2017). Second, neuroticism is associated with increased social comparison on Facebook (Chow & Wan, 2017; Rozgonjuk, Ryan, Kuljus, Täht, & Scott, 2019) and with a greater likelihood of experiencing more negative feelings following social comparison (Van Der Zee, Buunk, Sanderman, Botke & Van Den Bergh, 1999). Third, those with low self-esteem have

been shown to be particularly interested in social comparison (Wood & Lockwood, 1999). Fourth, depressed individuals are known to be more interested in, and sensitive to, social comparison information (Ahrens & Alloy, 1997; Swallow & Kuiper, 1990) and to react more negatively to comparisons than non-depressed controls (Bäzner, Brömer, Hammelstein, & Meyer, 2006; Swallow & Kuiper, 1993). Even those who are not currently depressed but have at least one lifetime depressive episode show a similar negative reaction to such comparisons (Bäzner et al., 2006).

Taken together, these insights suggest that due to this specific cluster of psychosocial vulnerabilities involved in PSMU, individuals with PSMU may be particularly vulnerable to more frequent and more negatively impactful social comparison on social media. Through social comparison, social media use may then begin to pave the way for proximal predictors of suicide ideation, particularly for those who engage in PSMU.

Social Comparison and PSMU in the Context of the IMV Model of Suicidal Behavior

To investigate how social media use may set the stage for increased suicide risk and particularly for those with PSMU, we tested these ideas in the context of the Integrated Motivational-Volitional (IMV) model of suicidal behavior (O'Connor & Kirtley, 2018). As described earlier in this dissertation, the IMV model is an empirically supported diathesis-stress model that explains how an individual transitions to suicide ideation and to suicidal behavior. This model was chosen for this study because it focuses on the intrapersonal processes that govern the transition into ideation. We propose that these intrapersonal processes are most relevant to the pathway through which social media use may have its harmful psychological impact, particularly on those who engage in PSMU.

According to the IMV, in the first (pre-motivational) phase, early background factors or individual vulnerabilities confer elevated risk for suicide ideation by setting the stage for a later suicidal crisis. The diathesis-stress hypothesis proposes that the impact of certain events is greater among those who possess certain vulnerabilities (O'Connor, 2011). Thus, in the context of this study, for those who engage in PSMU (and carry the psychosocial vulnerabilities associated with PSMU), exposure to social media information that elicits comparison will take a greater toll, leading to greater frequency of social comparison and to a more negative subsequent psychological impact. In other words, we propose that what makes social media use harmful is an interaction between aspects of the digital environment and individual vulnerabilities – specifically, exposure to comparative content that is by its nature likely to elicit negative social comparison, on one hand, and psychosocial vulnerabilities involved in PSMU that make one more vulnerable to more frequent and more negatively impactful social comparison, on the other.

In the second (motivational) phase of the IMV model, suicide ideation emerges through its proximal predictors: appraisals of defeat and entrapment (O'Connor & Kirtley, 2018). According to the IMV model, to transition to suicide ideation in the motivational phase, one must first experience defeat, which then turns into a sense of entrapment (a perception that no escape is possible from these circumstances). Entrapment, in turn, elicits suicide ideation as a desire to escape (O'Connor & Kirtley, 2018). Defeat and entrapment are drawn from the idea of “arrested flight” – a state of failed struggle (i.e., defeat) with no possibility of escape (i.e., entrapment) – which is an evolutionary psychology concept originally used to explain certain behavioral states that were observed in people with depression (O'Connor & Kirtley, 2018). Based on these ideas, we proposed that if social media use confers suicide risk, it would first

predict defeat. We also proposed that social comparison on social media would facilitate this process, particularly for those who engage in PSMU.

The Present Study

The goal of the present study was to extend previous findings by examining whether brief periods of increased engagement with social media predict defeat, a proximal predictor of suicide ideation. Guided by the IMV model of suicidal behavior, we proposed that greater social media use would lead to defeat. We also predicted that this effect would be mediated by engagement in social comparison during time spent on social media, and this mediated effect would be strengthened at higher levels of PSMU.

We hypothesized that the effects of social comparison on defeat would be evident shortly after social comparison had taken place on social media. This assumption was based on social rank theory, which suggests that perceived drops in social rank create immediate changes in physiology and behavior that reflect defeat (Price et al., 1994), as well as empirical evidence that supports this idea (Beasley, Sabatinelli & Obasi, 2012; Gilbert & Allan, 1998). To examine this hypothesis, we used ecological momentary assessment (EMA) methods to assess social media use, social comparison on social media, and defeat in short intervals multiple times a day for 15 days. This repeated assessment method allowed us to examine variables close to the time that they occurred and in the correct temporal order, reducing the threat of recall bias and enabling us to examine state-level changes in defeat.

Although repeated moments of defeat can also accumulate into chronic defeat and influence more trait-like depressive behavior (Price et al., 1994), we did not examine the impact of accumulated online social comparisons on trajectories of trait-level defeat in this study. This choice was made based on findings from some research with animal models that show that

chronic social stress takes at least 20 days to exhibit effects on more trait-like depressive pathology (Kudryavtseva & Avgustinovich, 1998; Kudryavsteva, Bakshtanovskaya, & Koryakina, 1991). Considering such findings, we did not believe that the 15-day period of our short-term longitudinal investigation would be long enough to obtain evidence of accumulated effects of social comparison on trait levels of defeat. Therefore, we did not examine changes in trajectory of defeat over time in the present study.

The specific aims for the present study were as follows:

Aim 1: To examine whether social comparison on social media mediates the relationship between social media use and defeat. We hypothesized that more time spent on social media since the last assessment would predict more social comparison on social media during that time, which would, in turn, predict higher levels of defeat at the present assessment, adjusting for defeat at the last assessment.

Aim 2: To examine whether this relationship is moderated by PSMU. We hypothesized that this mediated effect would be strengthened by greater trait-like levels of PSMU.

Method

Participants

Participants were 99 smartphone owners between the ages of 18 and 29 ($M = 23.14$, $SD = 3.20$) who indicated that they used social media regularly (i.e., at least once weekly). Participants were recruited between March 2021 and August 2021 from a public college in New York City ($n = 57$; 58%) as well as from the greater community in New York City through online ads posted on the website Craigslist.com ($n = 42$; 42%). Approximately 78% of the sample identified as cisgender women, 20% as cisgender men, and 1% as Questioning. The sample was racially and ethnically diverse, with 36% identifying as Asian, 32% as White, 11% as Latinx or Hispanic, 8% as Black or African American, 5% as biracial or multiracial, 1% as American Indian or Alaskan Native, and 1% identified as Other; 5% indicated a preference for not reporting race. Regarding sexual orientation, 79% identified as heterosexual, 14% as bisexual, 3% as pansexual, 2% as gay or lesbian, and 2% as asexual. In addition, 75% of participants indicated they were born in the U.S., and 25% reported they are first-generation immigrants.

Power

To estimate a sufficient sample size for detecting effects in this study, we conducted a power analysis using the Power Curves for Multi-level Studies tool (Kleiman, ND). We found that for a 15-day EMA study with five assessments per day, a sample size of 80 is needed to produce a model with 80% chance of detecting a medium-sized effect ($d = .50$), assuming a response rate of approximately 80%.

Participant Recruitment and Screening

To be eligible for the study, participants had to meet three inclusion criteria listed in the ads: be between the ages of 18 and 29, use social media regularly (i.e., at least once a week), and

own a smartphone with a texting plan and an Internet connection so as to be able to complete daily surveys sent through automated texts. If potential participants self-identified as meeting these criteria, they were invited to contact the research team and were subsequently scheduled for an appointment for a baseline session held virtually on Zoom, a videoconferencing platform.

Procedures

During the baseline session, several procedures took place. First, participants were once again screened for eligibility; the research staff verbally confirmed inclusion criteria and checked identification to ascertain age and location. Participants were then oriented to study procedures, were asked to provide informed consent, and were given a link to a baseline questionnaire.

After completing this questionnaire, participants were introduced to the EMA procedures in more detail, and a sample text message containing a survey link was sent to participants' smartphones. Participants were then reminded they would be receiving five daily texts, each containing a link to a brief survey, for the following 15 days. The research staff gave participants a choice of a 12-hour time frame in which to receive these texts every day (i.e., either 9 a.m. to 9 p.m., 10 a.m. to 10 p.m., 11 a.m. to 11 p.m., or noon to midnight). Finally, participants were instructed that at the end of the 15-day EMA period, they would receive an email containing a link to a final questionnaire.

In the EMA portion of the study, which began the day after the baseline session, participants received five texts per day, with each text containing a link to the brief questionnaire assessing variables of interest (i.e., minutes spent using social media since the last assessment/alert, current level of defeat, amount of time spent engaging in social comparison on social media in those minutes reported). These text messages were programmed by the research team to be sent out automatically through the website OhDontForget.com; questionnaire data

were collected through the website Qualtrics.com. Text message times for all four timeframes were generated using a random time generator tool online; each text time was configured to be between 1.5 to 2.5 hours apart. The majority of text message times were the same for each timeframe, except for the few that were at the beginning and end of each 12-hour timeframe. Thus, two people who chose the same time frame received text messages on the same randomly generated times each day. On the day after the EMA portion of the study ended, participants received an email with a link to the follow-up questionnaire and were instructed to complete it within three days.

For the baseline session, participants were compensated with either course credit (if completing the study to meet their introductory psychology research requirements) or a \$5 Amazon gift card, sent to them upon completion of the baseline session. For the EMA portion of the study, participants were compensated with either course credit or a \$5 Amazon gift card, provided that they completed approximately half of the assessments in total, plus an additional \$1 per day in the form of an Amazon gift card for every day they completed all 5 of the daily assessments. For completing the final post-EMA-period questionnaire, participants were given either course credit or a \$5 Amazon gift card. In total, the maximum that participants could earn was \$30. Compensation for the EMA portion of the study and the final questionnaire were sent to participants at the end of the study. At the end of all questionnaires, including the EMA assessments, a list (or a link to a list) of local counseling centers and their contact information was provided. An Institutional Review Board approved all study procedures.

Measures

Baseline & Follow-up Questionnaire Measures

A questionnaire containing several measures was completed by participants at baseline (one day before the start of the EMA period) and at follow-up (within three days after the end of the EMA period).

Demographics. Demographic data collected included sex, gender identity, race/ethnicity, sexual orientation, and age. These questions were asked only at baseline.

PSMU. The Bergen Social Media Addiction Scale (BSMAS; Andreassen, Pallesen, & Griffiths, 2017) is a six-item scale that measures level of social media addiction by assessing each of the six components of addiction (i.e., salience, mood modification, withdrawal, tolerance, conflict, relapse), as defined in the addiction components model (Griffiths, 2005). The BSMAS is a modified version of the validated Bergen Facebook Addiction Scale (BFAS; Andreassen, Torsheim, Brunborg, & Pallesen, 2012). Modifications from the BFAS were minimal: The term “Facebook” was replaced with “social media” across the six items, and instructions were adapted so that social media is defined as “Facebook, Twitter, Instagram, and the like.” The scale’s six items assess addiction over the past year and are rated on a five-point Likert scale, from 1 (very rarely) to 5 (very often). Total scores range from 6 to 30. Currently, there is no agreed-upon cutoff score for PSMU, with various classification schemes having been proposed (e.g., Andreassen et al., 2012; Bányai et al., 2017; Gul, Solmaz, Gul, & Oner, 2018; Pontes, Taylor, & Stavropoulos, 2018), and many studies using the scale as a continuous measure (Andreassen et al., 2016, 2017). Previous research has demonstrated high internal consistency of the BSMAS ($\alpha = 0.88$; Andreassen et al., 2017). Internal consistency in this sample was acceptable ($\alpha = 0.75$).

Defeat. Defeat was measured with the 16-item Defeat Scale (Gilbert & Allan, 1998), a validated self-report measure that assesses perception of failed struggle. Participants were asked to rate on a 5-point Likert scale the degree to which they agree with several statements (e.g., “I feel defeated by life” and “I feel down and out”). Higher scores on this scale suggest a higher frequency of defeat-related cognitions. This measure is widely used and has demonstrated concurrent validity and high reliability ($\alpha = 0.95$; Wetherall, Robb, & O’Connor, 2018). Cronbach's alpha in this sample indicated high internal consistency reliability ($\alpha = .95$).

Depressive symptoms. The Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) was used to assess depressive symptoms. The CES-D is a 20-item measure that assesses frequency of experiencing symptoms of depression in the past week. The scale is used to measure level of depressive symptoms in the general population. Responses are given on a scale of 0 (rarely or none of the time; less than 1 day) to 3 (most or all of the time; 5-7 days). Item scores are summed, and total scores may range from 0 (no symptoms) to 60 (severe symptoms). The recommended cutoff point for depression is 16. The CES-D has demonstrated concurrent and construct validity and high internal consistency, with Cronbach's alpha coefficients from 0.85 to 0.90 across studies (Radloff, 1977). Cronbach's alpha in this sample showed high internal consistency reliability ($\alpha = 0.87$). The mean CES-D score in this sample was 20.78 ($SD = 11.84$). The depressive symptoms variable was included in the analyses as a Level 2 covariate to adjust for the potential impact of dysphoric mood on participants' ratings of defeat and to examine the effect of the predictors over and above depressive symptoms.

General social comparison offline. The 11-item Iowa-Netherlands Comparison Orientation Measure (INCOM; Gibbons & Buunk, 1999) was used to measure general social comparison offline. The scale assesses the degree to which individuals tend to compare

themselves with other people in their daily lives, using such questions as “I often compare myself with others with respect to what I have accomplished in life” and “I often compare how I am doing socially (e.g., social skills, popularity) with other people.” Participants responded to these statements by rating them on a 5-point Likert scale, from 1 (I strongly disagree) to 5 (I strongly agree). Because this scale appeared at the follow-up questionnaire, we adapted the instructions to emphasize that participants should rate these statements based on how often they compare themselves with others “in general, outside of social media.” The validity and reliability of the INCOM measure has been repeatedly demonstrated in the United States, with Cronbach’s alpha ranging in different samples from 0.78 to 0.85 (Gibbons & Buunk, 1999; Schneider & Schupp, 2014). In the current sample, Cronbach’s alpha was 0.78.

EMA Assessment Measures

Time spent on social media. Time spent on social media since the last momentary assessment was assessed with one item: “Approximately how many minutes have you spent on social media since the last survey?” To provide an answer, participants were prompted to drag a slider bar over a field labeled “minutes,” with the minimum possible choice of minutes being 0 and the maximum possible choice being 90+. Participants were also given a list to check off which types of social media they used to ensure their use actually involved social networking sites as defined in this study.

Defeat. Defeat was measured with three items from the 16-item Defeat Scale (Gilbert & Allan, 1998). Participants were asked to rate the degree to which they agreed with the following statements: “Right now, I feel defeated by life,” “Right now, I feel that I have lost my standing in the world,” and “Right now, I feel down and out.” These items were chosen because they had high factor loadings (0.76, 0.73, and 0.77, respectively) in a student group in the original

validation study (Gilbert & Allan, 1998). Each item was rated on a five-point Likert scale from 1 (I strongly disagree) to 5 (I strongly agree). “Right now,” was added to the beginning of these statements to capture state levels of this construct.

Social comparison on social media. Social comparison during that time that participants indicated they spent on social media since the last momentary assessment was measured with two items from the Iowa-Netherlands Comparison Orientation Measure. For the purposes of this study, we adapted the instructions to say, “Since the last survey, when I was on social media ...” Then, participants were presented with two statements: “... I paid a lot of attention to how I do things compared with how others do things” and “... I compared how I am doing socially (e.g., social skills, popularity) with other people.” Participants rated each statement on a Likert scale from 1 (I strongly disagree) to 5 (I strongly agree). We chose these two statements for the EMA assessments because they had the highest factor loadings in validation studies (INCOM; Schneider & Schupp, 2014).

Data Analytic Plan

A multilevel moderated mediation model was tested using data collected in the 15-day EMA period and from the baseline and follow-up questionnaires. Data in this study are hierarchical in structure, with repeated observations (Level 1) clustered within individuals (Level 2). Because repeated measurements tend to be correlated within persons, the independence assumption that many statistical models rely on is violated (Bauer, Preacher, & Gil, 2006). Such tests would thus produce biased significance tests of the effects if this violation were to be ignored (Bauer et al., 2006). An alternative is to use statistical techniques that account for the shared variance in the hierarchy, such as multilevel modeling (also known as hierarchical linear modeling; Woltman, Feldstain, MacKay, & Rocchi, 2012).

Multilevel modeling accounts for the hierarchy by estimating random effects, a method of capturing the correlations among Level 1 observations (Bauer et al., 2006). Random effects may include random intercepts, which capture differences in the outcome variable across Level 2 units, or random slopes, which reflect differences in the effects of predictors on the outcome across Level 2 units (Bauer et al., 2006). Multilevel modeling thus accounts for variance among variables at different levels of the hierarchy and appropriately deals with the non-independence among observations (Woltman et al., 2012). In addition, with multilevel modeling, it is possible to distinguish whether the association between two variables is due to within- or between-person variance. Within-person variance represents a person's change in a particular variable from one moment to the next; between-person variance represents change in overall variable levels from one person to the next.

In the present study, we hypothesized that there would be an indirect effect of time spent using social media on defeat through social comparison on social media (H1), and that this mediated effect would be strengthened by PSMU (H2). Given that the predictor, mediator, and outcome described in H1 were all Level 1 variables, we first examined a lower-level (1-1-1) multilevel mediation model. This model included the following Level 1 variables: a predictor of time spent on social media since the last momentary assessment/alert (TS), a mediator of social comparison on social media during that time spent on social media since the last assessment/alert (SC), and the outcome of state level of defeat as rated in the present assessment (DF). We then added covariates to the model and examined model fit. Covariates were three: defeat reported in the prior assessment (i.e., the Level 1 defeat variable lagged; DF_{lag}), general offline social comparison (a Level 2 variable assessed once, in the follow-up questionnaire; SC_{off}), and depressive symptoms (a Level 2 variable assessed once, in the baseline questionnaire; Dep).

Finally, to test H2, we then added problematic social media use (a Level 2 moderator, measured once at baseline, PSMU).

Below, the model is first illustrated mathematically to demonstrate its conceptual basis. Then, the process of constructing and examining the full model in SPSS is described, along with other preliminary analyses conducted.

Multilevel Mediation Model at Level 1

In multilevel modeling, a series of equations provide estimates of the effect of X on M, M on Y, and the direct effect of X within a Level 2 unit and between Level 2 units. The effects within a Level 2 unit are also known as within-cluster effects, within-person effects, or Level 1 effects; the effects between Level 2 units are also known as between-cluster effects, between-person effects, or Level 2 effects (Hayes & Rockwood, 2020). Per standard notation (Bauer et al., 2006; Kenny, Korchmaros, & Bolger, 2003), the two mediation equations at Level 1 are as follows:

$$M_{ij} = d_{Mj} + a_j X_{ij} + e_{Mij}$$

$$Y_{ij} = d_{Yj} + c'_j X_{ij} + b_j M_{ij} + e_{Yij}$$

In these equations, the predictors, outcomes, and residuals vary across observations (*i*) and across clusters/persons (*j*). M is the mediator, Y is the outcome, and the *d* coefficients are the person-level intercepts for each equation. In addition, *a_j* is the effect of X on M for each person, *c'_j* is the direct effect of X on Y controlling for M for each person, and *b_j* is the effect of M on Y controlling for X for each person. The error terms, or residuals, are the momentary deviations from the person's mean level of M and Y, denoted by *e_{Mij}* and *e_{Yij}* respectively. Applying this notation to the present study yielded the following mediation equations:

$$SC_{ij} = d_{Mj} + a_j TS_{ij} + e_{Mij}$$

$$DF_{ij} = d_{Yj} + c'_j TS_{ij} + b_j SC_{ij} + e_{Yij}$$

In the first equation, the social comparison variable (SC) is regressed on the time spent on social media variable (TS). This equation suggests that at Level 1, a given SC observation i within cluster/person j is a function of that person's intercept (d_{Mj}), or mean SC across all observations in that person's cluster of data), the effect of TS on SC for that person (a_j), and the observation's deviation from the person's mean SC (e_{Mij}). In the second equation, the outcome variable (DF) is regressed on the mediator (SC) and the time spent on social media predictor (TS). Per this equation, a given DF observation i for j person is a function of that person's intercept (or mean DF across all observations in that person's cluster of data; d_{Yj}), their TS-DF slope (c'_j), their SC-DF slope (b_j), and that observation's deviation from the person's mean DF (e_{Yij}).

It is generally recommended to use within-group centering in multilevel models such as this one because when Level 1 predictors are left uncentered, the estimated coefficients are not easily interpreted (Rockwood, 2017; Zhang, Zyphur, & Preacher, 2009). These mediation equations are thus rewritten here to reflect the use of within-group centering:

$$SC_{ij} = d_{Mj} + a_j (TS_{ij} - TS_{.j}) + e_{Mij}$$

$$DF_{ij} = d_{Yj} + c'_j (TS_{ij} - TS_{.j}) + b_j (SC_{ij} - SC_{.j}) + e_{Yij}$$

Here, each person's mean on X and M ($TS_{.j}$ and $SC_{.j}$, respectively) was subtracted from the values of X and M obtained at observation i . TS and SC are now within-cluster mean-centered. These equations are again re-written below to add a "w" to denote that these coefficients are within-cluster effects (Hayes & Rockwood, 2020). That is, with these two equations, we are able to estimate the within-cluster, or within-person, effects of X on M , M on Y , and the direct effect of X on Y :

$$SC_{ij} = d_{Mj} + a_{wj} (TS_{ij} - TS_{.j}) + e_{Mij}$$

$$DF_{ij} = d_{Yj} + c'_{wj}(TS_{ij} - TS_{.j}) + b_{wj}(SC_{ij} - SC_{.j}) + e_{Yij}$$

Multilevel Mediation Model at Level 2

In the Level 1 equations discussed thus far, the intercepts (d_{Mj} and d_{Yj}) vary randomly across participants, as do the slopes for the mediator (b_j) and the predictor in each equation (a_j , c'_j). This means that each of these coefficients in the Level 1 equations is the outcome variable of a Level 2 (person-level) equation. A separate person-level regression model is thus used to model the variation of each of the regression coefficients.

The Level 2 equations for the intercepts are as follows:

$$d_{Mj} = d_M + a_B(TS_{.j}) + u_{Mj}$$

$$d_{Yj} = d_Y + c'_B(TS_{.j}) + b_B(SC_{.j}) + u_{Yj}$$

Here, d_M is the grand mean of SC across all persons. This is the fixed component of the intercept, and u_{Mj} is the random component, which reflects person-specific deviations from the grand mean of SC. Similarly, d_Y is the grand mean of DF across all persons, and u_{Yj} represents person-specific deviations from the grand mean of DF. a_B , b_B , and c'_B are the effects of X and M at Level 2, also known as the between-cluster effects. They are the Level 2 equivalents of a, b, and c' (Hayes & Rockwood, 2020). Of note, per recommendations on within-group centering (Rockwood, 2017; Zhang et al., 2009), the cluster means have been included as level-2 predictors of the intercept.

For the slopes, the Level 2 equations are as follows:

$$a_{wj} = a_w + u_{aj}$$

$$b_{wj} = b_w + u_{bj}$$

$$c'_{wj} = c'_w + u_{c'j}$$

Here, a_w , b_w , and c'_w are the average within-cluster effects across Level-2 units. The u components capture the deviation between cluster j 's effect and that average. The inclusion of these deviations allows within-cluster effects to vary between clusters (Hayes & Rockwood, 2020).

Just as within-cluster effects can vary across Level 2 units, so can within-cluster indirect effects. The *average* within-cluster indirect effect is of the most interest, and it is defined as $a_w b_w + \sigma$ (Hayes & Rockwood, 2020). This is the effect of X on M multiplied by the effect of M on Y , and σ is the covariance between the random effects of X on M and of M on Y (Hayes & Rockwood, 2020). The between-cluster indirect effect is $a_B b_B$, defined as the effect of the cluster means of X on the cluster means of Y via the cluster means of M (Hayes & Rockwood, 2020).

Multilevel Moderated Mediation Model: Adding PSMU

We hypothesized that PSMU would moderate the effect of X on M (first-stage conditional process model) and that it would also moderate the effect of M on Y (second-stage conditional process model). In other words, we expected that there would be some variability in the random slopes, and that it would be explained by PSMU. With the addition of PSMU, the Level 1 equations in both the first- and second-stage conditional process models remain the same:

$$SC_{ij} = d_{Mj} + a_{wj}(TS_{ij} - TS_{.j}) + e_{Mij}$$

$$DF_{ij} = d_{Yj} + c'_{wj}(TS_{ij} - TS_{.j}) + b_{wj}(SC_{ij} - SC_{.j}) + e_{Yij}$$

However, the Level 2 equations for the slopes are adjusted as follows:

$$\text{First-stage model: } a_{wj} = a_{w0} + a_{w1}(\text{PSMU}_j) + u_{aj}$$

$$\text{Second-stage model: } b_{wj} = b_{w0} + b_{w1}(\text{PSMU}_j) + u_{bj}$$

Here, the a_{w0} and b_{w0} coefficients represent the within-cluster effect of TS on SC and on SC on DE, respectively, for people whose level of PSMU equals 0. (However, in the analyses, the moderator is centered around its mean rather than 0). In addition, a_{w1} and b_{w1} represent the expected change in a_{wj} and b_{wj} resulting from a one-unit increase in $PSMU_j$. The u components represent cluster-level differences in a_{wj} and b_{wj} that are not explained by PSMU. The Level 2 intercept equations are modified as follows:

$$\text{First-stage model: } d_{Mj} = d_M + a_B(TS_j) + g(PSMU_j) + u_{Mj}$$

$$\text{Second-stage model: } d_{Yj} = d_Y + c'_B(TS_j) + b_B(SC_j) + g(PSMU_j) + u_{Yj}$$

Finally, multiplying the conditional effect of X on M by the conditional effect of M on Y produces the indirect effect. Illustrated here is the within-cluster indirect effect:

$$\text{First-stage model: } (a_{w0} + a_{w1}PSMU_j)b_w + \sigma_{a,b} = a_{w0}b_w + a_{w1}b_wPSMU_j + \sigma_{a,b}$$

$$\text{Second-stage model: } (b_{w0} + b_{w1}PSMU_j)a_w + \sigma_{a,b} = a_wb_{w0} + a_wb_{w1}PSMU_j + \sigma_{a,b}$$

Here, $\sigma_{a,b}$ is the residual covariance of a_{wj} and b_{wj} , and $a_{w1}b_w$ (in the first-stage conditional process model) and a_wb_{w1} (in the second-stage conditional process model) represent the within-cluster index of moderated mediation. This means that two clusters, or individuals, differing by 1 unit on PSMU are expected to differ by a_wb_{w1} units on the within-cluster indirect effect of TS on DF through SC. Similar equations are constructed for the between-cluster index of moderated mediation, not repeated here to avoid redundancy.

Multilevel Moderated Mediation Analyses in SPSS

Analyses were conducted in SPSS, using the computational macro MLmed, Beta Version 2.0 (Rockwood, 2019). MLmed is designed to fit multilevel mediation and moderated mediation models; the macro automates the processes required to examine these models, including stacking of the mediational equations so that indirect effects can be computed, as outlined in Bauer et al.

(2006). For the present analyses, Maximum Likelihood estimation was used. For indirect effects, 95% Monte Carlo confidence intervals based on 10,000 samples were calculated in MLmed. MLmed handles missing data in the same manner as the general linear model function of SPSS does, through casewise deletion. However, because the data are stacked, each row of a Level 1 unit's data contains data that may be complete for one equation but not the other. Thus, MLmed would still use part of a Level 1 unit's data if it is sufficient for a given equation.

To test H1, we built the model gradually in several steps. We first included the hierarchical nature of the data by allowing only intercepts to vary across participants (step 1), estimating the effect of including the variance in intercepts. We left the covariance matrix at default (diagonal), which assumes that covariance between intercepts and slopes is 0. To assess whether model fit improved when the variance of slopes is included, we then specified for the slopes to also vary while again leaving the covariance structure at default (step 2). Model fit was assessed by checking whether Akaike's information criterion (AIC) was significantly different than before (i.e., lower than 2 is the minimum level of evidence of improvement; Burnham & Anderson, 2004). Model fit improved; as such, we re-examined this model with the addition of an unstructured (rather than diagonal) covariance matrix (step 3). Model fit did not improve, so we reverted to the model from step 2, which we retained as the final multilevel mediation model without covariates (aka Model 1). We then added the covariates (step 4) and again examined model fit. As model fit improved, this model became the final mediation model adjusted for covariates (aka Model 2).

To test H2, we added the mean-centered moderator to Model 2, first operating on the a-path (step 5) and then on the b-path (step 6). Model fit worsened in step 5 but slightly improved in step 6. Therefore, we retained the model from Step 6 as the final multilevel moderated

mediation model, adjusted for covariates (aka Model 3). Model 1, 2, and 3 statistics are presented in Table 4 and discussed in the next section.

Additional Analyses

Before conducting the multilevel moderated mediation analyses, several other analyses were completed. First, the attrition rate was calculated, and predictors of differential completion rate (more versus less than 77% completion, as described below) were examined using logistic regression.

Second, to account for variance in outcomes explained by demographic differences, we examined age and sex in relation to social comparison on social media and defeat via bivariate correlations. In addition, we examined racial/ethnic differences in key study variables via a one-way ANOVA, with follow-up post hoc *t*-tests with Bonferroni corrections to account for the number of pairwise comparisons. To create groups of approximately equal members, we collapsed race categories into three groups (Asian, White, and Everyone Else). Using Bonferroni corrections, an alpha of 0.05 was adjusted to 0.01 (0.05/4).

Finally, descriptive statistics were calculated, and bivariate correlations were computed to examine associations between variables, as described below. Descriptive statistics for the EMA data were obtained by first calculating a person-specific mean for TS, SC, and DF (i.e., an average of each person's responses across assessments on each variable), and then calculating a mean and standard deviation on each variable, taking into account the sample's TS, SC, and DF means.

Results

Attrition

Of the 99 participants who enrolled in the study, 82 (83% of the sample) had an acceptable completion rate; that is, 78 participants completed at least 80% of the daily assessments, and 4 completed 77% of the daily assessments. The average completion rate in this group was 94% (ranging from 77% to 100%). In addition, all 82 participants completed both the baseline and post-EMA-period questionnaire.

Of the remaining 17 participants in the sample, 2 dropped out after completing the baseline session and 15 only partially completed the EMA assessments, with an average completion rate of 44% (ranging from 12% to 56%). All 17 participants completed the baseline questionnaire, and 9 (52%) completed the final questionnaire.

Completion rate was not significantly associated with demographic variables (i.e., age, race/ethnicity, sex) or with baseline measures of key variables of interest (i.e., average time spent on social media, PSMU, online social comparison, defeat, and depressive symptoms).

Descriptive Statistics & Correlations

The average baseline PSMU score was 19.99 ($SD = 4.49$). The construct of PSMU appeared to be stable, as participants responded similarly approximately two weeks later ($M = 20.05$, $SD = 4.91$). See Table 1.

In the EMA part of the study, the average time spent on social media reported in any one assessment was 23 minutes ($SD = 14.55$). During that time, on average, participants reported moderately engaging in social comparison on social media ($M = 2.58$, $SD = 1.06$). They also reported experiencing moderate levels of defeat, on average ($M = 2.05$, $SD = 0.97$), across assessments. When participants reported having spent time on social media, the most frequently

endorsed social media platform used was Instagram (53%), followed by TikTok (14%) and Facebook (14%). Other platforms endorsed were Twitter (10%), YouTube (4%), and Snapchat (2%). See Table 2.

Correlations among study variables are presented in Table 5. PSMU was correlated with participants' EMA means on TS, $r = .21, p < .05$, and on SC during that time spent, $r = .27, p < .01$. PSMU was also associated with DF, as measured in the EMA portion of the study, $r = .31, p < .01$, and with depressive symptoms, $r = .35, p < .01$. TS was associated with both SC, $r = .29, p < .01$, and DF, $r = .31, p < .01$, as well as with depressive symptoms, $r = .31, p < .01$, but not with SC offline. In turn, SC was strongly associated with DF, $r = .64, p < .01$, and with depressive symptoms, $r = .45, p < .01$, and with SC offline, $r = .45, p < .01$.

Bivariate correlations showed that age and sex were not associated with these outcomes. A one-way ANOVA revealed no differences by race/ethnicity in study outcomes. Therefore, we did not include age, sex, or race as covariates in the multilevel moderated mediation analyses.

MLM Analyses

Multilevel Mediation Model (Model 1)

Toward H1, we first examined Model 1, the final multilevel mediation model without covariates. As seen in Table 4, in Model 1, TS significantly predicted SC, at both the within-person level ($a_W = 0.01, p < .01$) and the between-person level ($a_B = 0.03, p < .01$). This means that on average, within a given person, for every one-unit increase in reported TS in an assessment, there was also greater SC reported in that same assessment (within); across people, for every one-unit increase in overall average levels of TS, there was also an increase in overall average of SC (between). Random effects were significant, which suggests that there was

variability among participants in their intercepts, or average SC ($0.97, p < .01$), and in their slopes, or their effect of TS on SC ($<0.01, p < .01$).

After accounting for the mediator (SC), TS was a significant predictor of DF at the within-person level ($c'_w = 0.01, p < .05$), but not at the between-person level. This suggests that on average, TS still had an impact on DF independently of SC in a given momentary assessment session; however, overall mean levels of TS no longer had a significant effect on overall mean levels of DF when overall mean level of SC was taken into account across people. In addition, SC significantly predicted DF, both at the within-person level ($b_w = 0.33, p < .01$) and at the between-person level ($b_B = 0.59, p < .01$). Random effects were significant, which suggests that there was variability among participants in average DF ($0.53, p < .01$) and in effect of TS on DF ($<0.01, p < .01$) and effect of SC on DF ($0.09, p < .01$).

Finally, in Model 1, there was a significant indirect effect of TS on DF via SC at the within-person level (indirect effect = $.004, p < .01$) and at the between-person level (indirect effect = $.016, p < .01$). See Table 5.

Multilevel Mediation Model, Adjusted for Covariates (Model 2)

To examine whether these effects held when adjusting for covariates, Model 2 was constructed and included three covariates: prior-alert defeat (DF_{lag}) at Level 1, and social comparison offline (SC_{off}) and depressive symptoms (Dep) at Level 2. Model fit improved, with the AIC statistic decreasing from 20437 in Model 1 to 12953 in Model 2.

As seen in Table 4 (see Model 2), after adjusting for covariates, the effect of TS on SC held at the within-person level ($a_w = 0.01, p < .01$) but not at the between-person level, and each of the covariates contributed its own effect on SC. Random effects were significant, suggesting that intercepts and slopes varied among participants.

After accounting for the mediator (SC), TS continued to predict DF at the within-person level ($<0.01, p < .01$) but not at the between-person level. SC remained a significant predictor of DF at both the within-person ($0.31, p < .01$) and the between-person ($0.41, p < .01$) level, with DF_{lag} and Dep (but not SC_{off}) having their own independent additional effects on DF. Random effects were significant, suggesting that there was variability among participants in average DF ($0.34, p < .01$), in the effect of TS on DF ($<0.01, p < .05$), and in the effect of SC on DF ($<0.07, p < .01$).

Finally, in Model 2, the indirect effect of TS on DF via SC remained significant at the within-person level (indirect effect = $.003, p < .01$) but not at the between-person level. See Table 5.

Multilevel Moderated Mediation Model, Adjusted for Covariates (Model 3)

To examine H2, problematic social media use (PSMU) was added as a Level 2 moderator to the adjusted model, yielding Model 3. Model fit improved when adding PSMU as an M-to-Y moderator, as the AIC statistic decreased from 12953 in Model 2 to 12951 in Model 3.

As seen in Table 4 (see Model 3), after adding the moderator, there was a significant interaction of PSMU and SC on DF at the within-person level, such that for people with higher levels of PSMU, SC had a greater impact on DF at a given assessment session ($0.02, p < .05$). See Figure 1. The interaction of PSMU and SC on DF at the between-person level was present as a non-significant trend ($0.02, p = .08$).

As seen in Table 5, in Model 3, the indirect effect of TS on DF via SC remained significant at the within-person level (indirect effect = $.003, p < .01$), but not at the between-person level. Indirect effects were tested at low (1 SD below the mean), average, and high (1 SD above the mean) levels of PSMU, and these effects varied significantly by level of PSMU.

Discussion

Although the literature on social media use and SITBs is limited given the nascence of this field, studies have shown that various patterns of social media use tend to be positively associated with SITBs, although not always (*see* Macrynikola et al., 2021). The factors that explain or strengthen such links, however, have rarely been examined. As a result, why, how, and for whom social media use may confer risk for SITBs and their proximal predictors remains unclear. The present study sought to address this gap by testing an explanatory mechanism (i.e., social comparison on social media) through which social media use may impact a theoretically based predictor of suicide ideation (i.e., defeat), proposing that this indirect effect may be stronger for those exhibiting one maladaptive pattern of social media use (i.e., PSMU). We chose to examine this process in the context of PSMU, because research suggests that several of the psychosocial vulnerabilities involved in the development and maintenance of PSMU may also facilitate online social comparison and its subsequent negative psychological impact.

Our first hypothesis was that social comparison on social media would mediate the relationship between time spent on social media and defeat. This hypothesis was supported at the within-person level but not at the between-person level, where there was only a trend toward significance after adjusting for covariates. These results suggest that after a person spends more time than they typically do on social media, they experience slightly more defeat than they usually do, in part because they engaged in more than their typical amount of social comparison on social media. However, people who tend to spend more time overall on social media do not tend to experience more defeat overall via overall online social comparison than people who spend less time overall on social media.

Our second hypothesis was that this indirect effect of time spent on social media on defeat via social comparison would be stronger for individuals who scored higher (versus lower) on a measure of PSMU. This hypothesis was supported at the within-person (but not between-person) level in the second-stage multilevel moderated mediation model, where PSMU was a cross-level moderator of the b-path (social comparison to defeat), but not in the first-stage model. This finding means that the within-person indirect effect is slightly stronger for people who exhibit higher (versus lower) levels of PSMU, not because they engage in greater social comparison but because social comparison has a slightly greater negative impact on defeat for these individuals.

Given the small size of the indirect effect at the within-person level and its non-significance at the between-person level, these results may appear to suggest that social media use does not need to be a grave concern in relation to defeat after all, regardless of PSMU. However, this conclusion would be premature. A closer examination of the individual parts of the indirect pathway reveals that the indirect effect was small or not significant because the effect of one specific variable (i.e., time spent) on the mediator and outcome was small at the within-person level or not significant at the between-person level. In contrast, social comparison on social media was a consistently robust predictor of defeat at both the within- and between-person levels, and its effect was stronger than that of relevant covariates. These findings prompt several key insights about each of these variables used in this study, in relation to defeat.

Social Media Use, Social Comparison, and Defeat

The first insight that arises from these findings is that perhaps the variable of time spent on social media was too broad and non-specific to yield meaningful results about defeat. In other words, time spent on social media was a weak predictor because this global social media metric

encompasses a range of user behaviors and social network characteristics encountered in that time on social media. Some of these factors may lead to more and some to less adaptive outcomes, thus canceling out one another's effect on defeat. For example, research suggests that Instagram use can predict negative social comparison (Lup, Trub, & Rosenthal, 2015). However, Instagram is also a social network that can drive inspiration (Meier & Schäfer, 2018). These disparate outcomes of psychological engagement with Instagram may be due, in part, to user behavior, such as the way social media was used. Using social media to passively consume content rather than actively interact with others is the social media behavior that has been shown to elicit social comparison and envy (Verduyn et al., 2017). These disparate outcomes may also be due to the composition of one's social network stream. Two Instagram streams can differ substantially, as what appears on a digital stream is dictated by the preferences of each user, who selects accounts to follow. Social comparison online is known to be intensified when the target of comparison is a similar other not known well to the user (Chou & Edge, 2012). This is because in such a situation, it is difficult for the user to contextualize the other's overly idealized posts along with more neutral or negative aspects of the other's life (Weinstein, 2017). Thus, if a user's social network has been customized to display too many overly idealized posts of strangers who are like the user in important domains, this kind of network may be more likely to elicit social comparison than one that has been customized to display updates that inspire creativity. Thus, depending on what the user is doing on social media and the composition of their social network, a user could experience more or less defeat and social comparison online. As such, time spent may have been too broad of a variable, capturing too many user- and technology-centered characteristics, to yield a large effect in this study.

Despite some recent calls to abandon broad conceptualizations of social media use such as social media frequency (Timpano & Beard, 2020), we used a general social media variable in this study for two reasons: First, we conceptualized PSMU as a stable trait-like tendency and assumed it would not vary on a day-to-day basis and opted instead for a broad metric that may vary. Instead, a more optimal approach may have been to capture variability in the more specific tendencies of PSMU. A recent study on problematic *Internet* use found that these specific tendencies do indeed vary in a 24-hour period (Gansner, Nisenson, Carson, & Torous, 2021). Second, we were interested in the *indirect* path of social media use to a suicide-related outcome, rather than the direct effect of social media use to defeat. Direct paths between broad social media use metrics and psychological outcomes have yielded inconsistent findings in the literature (*see* Cunningham, Hudson & Harkness, 2021; Macrynika et al., 2021), and the goal in this study was to elucidate a mediating process that may explain the association of social media use with a SITB-related outcome. Our findings support the existence of an indirect path (at the within-person level) *and* the idea that a broad social media use variable may be too general to yield large effects. Thus, future research should abandon the use of a broad social media use metric and characterize, instead, specific user behaviors and network characteristics that may lead to harmful psychological effects such as social comparison and defeat.

A second insight from this study is that the more specific user-centered variable of social comparison on social media is a robust predictor of defeat. This effect held at both the within- and the between-person levels in this study, after adjusting for several relevant covariates. At the within-person level, social comparison on social media continued to predict defeat after adjusting for prior-alert defeat. At the between-person level, social comparison on social media continued to predict defeat after adjusting for offline social comparison, depressive symptoms, and PSMU.

This finding is understandable in the context of social rank theory, which suggests that perceptions of loss of rank lead to the hardwired defeat response, an experience that motivates submissive behaviors as a method of signaling to dominant others that one no longer wishes to compete for resources (Price et al., 2007). The online environment may be a relatively new venue through which to gain information about the self in relation to others, which – accurately or not – can lead to a negative perception of one’s place in the social hierarchy. Although scant research has examined social comparison in relation to SITBs, two other recent studies support these findings on the link between social comparison and SITBs. In a cross-sectional study of college students in Norway, a one-question measure of tendency to engage in social comparison on social media was associated with higher odds of SITBs (Kingsbury et al., 2021). In another cross-sectional study of mostly young adults, greater offline social comparison predicted entrapment through defeat, after adjusting for depressive symptoms (Wetherall et al., 2018). Moreover, our results showed that social comparisons on social media are a common occurrence. Over the course of 15 days, participants reported having engaged in social comparison on social media in approximately three-quarters of all the assessments in which time spent on social media since the last alert was endorsed. These comparisons predicted subsequent defeat in the moment, over and above prior-alert defeat, raising the question of the psychological impact of accumulated moments of social comparison on social media, which warrants further study.

PSMU, Social Comparison, and Defeat

Turning to the findings on PSMU, the indirect effect of time spent on defeat via social comparison was slightly stronger at higher levels of PSMU at the within-person level, but not at the between-person level. This slightly stronger effect was due to a very small moderation effect of PSMU on the b-path (social comparison to defeat), but not the a-path (time spent on social

media to social comparisons). Our hypothesis that PSMU would moderate both of these paths was based on research suggesting that many of the psychosocial vulnerabilities involved in the development and maintenance of PSMU (i.e., low belonging offline, neuroticism, low self-esteem, depression) are also predictive of more frequent and more negative general social comparison. That social comparison had a slightly stronger effect on defeat at higher (versus lower) levels of PSMU at the within-person level suggests that perhaps engaging in social comparison online takes a slightly greater toll as it confirms preconceived notions of low self-worth and relational value, resulting in a more heightened experience of defeat. Still, it is important to note that this effect was very small at the within-person level.

There are several reasons why our hypotheses on PSMU (i.e., that it would involve greater social comparison and greater defeat) were largely unsupported. One possibility is that perhaps most people, regardless of PSMU, engage in roughly the same amount of social comparison online, given that the social media environment is rife with cues that naturally elicit comparison (e.g., positively biased updates from similar others, visible comments and Likes; Appel, Gerlach, & Crusius, 2016), and that comparison has largely the same negative effect on most people. A second possibility is that the vulnerabilities hypothesized to lead to this effect did not characterize people with higher (versus lower) PSMU to a greater extent in this sample. There is no way to know since we used PSMU as a proxy for these vulnerabilities rather than measuring them directly. A third possibility is that these vulnerabilities did characterize people with higher (versus lower) PSMU to a greater extent in this sample, but some of these traits may be more predictive of social comparison than others. Using PSMU as a proxy may have masked the effects of specific vulnerabilities on social comparison and defeat. Thus, even PSMU may have been too broad a variable to yield a larger effect regarding this research question.

Related to this idea is a fourth possibility: There may be multiple subtypes of PSMU, and time spent on social media is more likely to lead to social comparison for some subtypes than others, as is social comparison on defeat. PSMU is a multi-faceted construct, conceptualized as a disorder of addiction characterized by six different criteria (i.e., salience, tolerance, mood modification, relapse, withdrawal, conflict). A person who scores higher on PSMU may be scoring on different criteria than another, with each PSMU presentation being characterized by different motivations for use. Stemming from different vulnerabilities or traits, these motivations may influence social media behavior, which may, in turn, differentially impact the frequency and outcome of social comparison. For example, PSMU is associated not only with neuroticism but also with extraversion (Andreassen et al., 2012). A person with PSMU who is high on neuroticism may use social media primarily for intrapersonal motives (i.e., to cope with discomfort or a negative mood) and as such may score particularly high on the mood modification criterion of PSMU. In contrast, a person with PSMU who is high on extraversion may be motivated to use social media to enhance offline relationships and as such may score particularly high on salience (i.e., mental preoccupation with social media). This second person may use social media to intentionally connect with friends, and as such may be less likely to use social media passively, which is the specific kind of social media use that tends to elicit greater social comparison (Verduyn et al., 2017). Neuroticism, on the other hand, may motivate social media use for coping with low mood, which may involve greater passive use for distraction. Low mood may, in turn, unintentionally increase vulnerability to noticing comparison information and being negatively affected by it. This example illustrates the potential existence of subtypes of PSMU, whose different motivations and related contextual factors may influence use of and experience of social media, leading to different outcomes in terms of social comparison and

defeat. Indeed, recent research supports the existence of disparate motives as predictors of PSMU, including using social media for the motive of coping with stress and also for perpetrating cyberbullying (van Duin, Heinz, & Willems, 2021) in adolescents. Recent research also supports the idea that different motives may lead to different social media behaviors. In young adults, for example, the motive of fear of missing out (FOMO) has been found to be associated with a more passive use, and to mediate the relationship between passive use of social media and problematic Instagram use (Sun, 2022).

Other recent research supports the existence of subtypes of PSMU. In a recent longitudinal study of adolescent social media use, researchers examined trajectories of social media use, including PSMU, and identified four different subgroups of social media use with unique psychological profiles (Boer, Stevens, Finkenauer, & van den Eijnden, 2021). Two of these subgroups exhibited relatively high levels of PSMU. While both were characterized by lower levels of psychological well-being, each was characterized by unique vulnerabilities, compared to a low-PSMU reference group: one had lower levels of self-regulation (i.e., greater attention deficits and impulsivity), and the other had poorer perceived social competencies (Boer et al., 2021). These unique vulnerabilities may drive different social media behaviors, performed to fulfill different unmet psychological needs. These behaviors and their underlying motivations may then predict different psychological outcomes. In future research, ecological momentary assessment methods could be used to assess in-the-moment motivations for use as well as to characterize the specific behaviors associated with that use and their outcomes. Such findings support the existence of subtypes of PSMU and highlight the need to continue to examine PSMU and its psychological outcomes with a more nuanced approach.

A fifth possibility is that, overall, people who engage in higher levels of PSMU tend to use social media in ways that do not elicit social comparison. Instead, their use may be optimized to drive immediate psychological benefits, which is precisely what might make social media use addictive. Indirect support for this idea comes from recent research capturing daily variability of adolescent problematic *Internet* use (PIU) and its psychological correlates (Gansner et al., 2020). This study showed that daily episodes of PIU ended with drops in anxiety (Gansner et al., 2020), suggesting that participants engaged in PIU in ways that supported momentary well-being. Perhaps many people who engage in PSMU do so in a focused way that minimizes immediate negative stimuli and thus lowers anxiety in the moment (e.g., they turn to inspirational content on Instagram to cope with stress, they chat with specific Facebook friends to derive social support, or they perpetrate cyberbullying to obtain a sense of power and well-being). This may explain why some cross-sectional research has found that after adjusting for depression, the relationship between PSMU and suicide ideation is either inverse (Jasso-Medrano & Lopez-Rosales, 2018) or no longer significant (Walburg et al., 2016). People with PSMU may be turning to social media to address immediate psychological needs, which may be effective in the short term but may take a toll in the long term as the cause of the unmet need remains unaddressed and new problems arise due to PSMU. Indeed, addiction often confers psychological benefits in the short term but takes its toll in the long term (Perales et al., 2020; Volkow & Morales, 2015). Thus, it may be that social media is used by people with PSMU in ways that often limit social comparison and relieve heightened distress in the short term, and like with other addictive behaviors, the harmful effects of PSMU become apparent in the long term. It is important to note that studies on PSMU and SITBs so far have not been designed to examine the long-term impact of PSMU. Only one longitudinal study of PSMU, of which we are aware, has been conducted, and this study

examined the impact of Facebook addiction on SITBs one year later (Brailovskaia et al., 2020). Findings suggested that Facebook addiction did predict SITBs one year later in adults; however, some aspects of the study were slightly problematic, including that SITB-related outcomes were collapsed into one item and baseline SITB-related outcomes were not adjusted for, precluding an appropriate conclusion about the true impact of Facebook addiction on SITBs one year later. This area warrants further study, however, and may be key to understanding whether and how this problematic pattern of social media use may confer suicide risk.

A sixth possibility is that people with PSMU were less accurate in their reporting of social comparison encountered during social media use. Recent research has shown that PSMU is inversely associated with trait mindfulness (Sriwilai & Charoensukmongkol, 2016), which involves awareness of the present moment. If people with PSMU tend to score lower on mindfulness, they may not have been as aware of their own social comparisons and may not have reported on them accurately.

Future Directions: PSMU and SITBs

Findings from this study inspire several future directions that will help move research on social media and SITBs forward. We will begin with some possible future directions for extending research on PSMU and SITBs. The present study is one of only a handful that have examined PSMU in relation to SITB, with the caveat that this was done indirectly in this study, given that suicide risk was not directly assessed. Although the mediating process that was hypothesized to confer defeat (and, ultimately, suicide risk) in this study did not appear to be more strongly related to PSMU, several explanations were considered that inspire future directions.

One priority for future research is to switch the focus from the short-term to the long-term impact of PSMU on SITBs. Only a handful of studies have examined PSMU and SITBs and have yielded mixed results, possibly because these studies focused on short-term outcomes of PSMU. Because PSMU is an addictive behavior, it may confer immediate benefits but take a toll in the long term. Thus, studies are needed that are designed to examine whether and how social media behaviors that people with PSMU engage in confer suicide risk over longer periods of time. The aforementioned longitudinal study showed that relatively high levels of PSMU remained stable over a period of four years (Boer et al., 2021). Thus, it is important to examine not just the short-term but also the long-term impact of such use, particularly in terms of whether this problematic pattern of social media behavior contributes to suicide risk.

A second and related priority is to take a more nuanced approach to the study of PSMU and investigate whether there are subtypes of PSMU that may differentially confer suicide risk. Such an approach would help answer two important questions: “What is a PSMU user doing on social media and for what reason? Is this behavior fulfilling this motivation?” This would help clarify the unique motivations linked with different subtypes of PSMU that may be driving social media behaviors, and whether these behaviors are effectively fulfilling important motivations. The answer may be nuanced, as outcomes of social media use may be protective against SITBs in the short term but contributing to SITBs in the long term. For example, recent research reveals that PSMU is significantly associated with lower offline social support but greater online social support (Meshi & Ellithorpe, 2021). This finding suggests that many people with PSMU may be obtaining social support from social media use in the short term. However, in this same study, offline, but not online, social support was associated with decreased depression, anxiety, and social isolation (Meshi & Ellithorpe, 2021). Although this study was cross-sectional, preventing

conclusions of causality, its hypotheses could be tested longitudinally to examine whether the specific immediate positive outcomes a user with PSMU attempts to obtain online contribute to or detract from quality of life (and suicide risk) in the long term. For someone with PSMU with perceived poor social competencies, for example, engaging in social media use may immediately lower feelings of social isolation. However, attempting to solve the problem of social isolation in this way may take the long-term toll of preventing them from addressing offline interpersonal problems, and in so doing, may gradually contribute to hopelessness about the problem ever changing and contribute to suicide ideation. This is one important future direction, given that converging evidence suggests that PSMU is moderately associated with loneliness (*see* Huang, 2021; Smith & Short, 2022) and that thwarted belongingness is a theoretically and empirically supported predictor of suicide ideation (Van Orden et al., 2010).

A third and related direction is to examine pathways conferring suicide risk that involve aspects of self-regulation. Models of problematic social media and Internet use propose that media use turns into addiction when it becomes an important or even exclusive way to relieve stress, loneliness, or depression (e.g., Caplan, 2010; LaRose et al., 2003; Xu & Tan, 2012). There is empirical support for these predictions, as internal coping motives tend to predict PSMU (Marino, Gini, Vieno & Spada, 2018; Marino, Mazziери, Caselli, Vieno, & Spada, 2018). Moreover, the aforementioned longitudinal study of adolescent social media use found a subgroup with PSMU exhibiting lower levels of self-regulation in the form of greater attention deficits and impulsivity (Boer et al., 2021). Other research has shown that PSMU is linked with aspects of impaired self-regulation, including difficulties in emotion regulation (Drach, Orloff, & Hormes, 2021; Liu & Ma, 2019; Marino, Gini, Angelini, Vieno, & Spada, 2020) and in identifying and describing emotions, also known as alexithymia (Barbar et al., 2021). Although

self-regulation problems may be involved in the development of PSMU as social media use becomes a habitual coping strategy, there is also the possibility that PSMU creates or strengthens impairments in self-regulatory mechanisms, and in so doing, impacts suicide risk. For example, for some people with PSMU, social media use may be serving as an avoidant coping strategy, or a way to avoid discomfort in the present moment. Avoidance may provide relief from anxiety or other forms of distress in the short term but may perpetuate them in the long term. By strengthening a habit of avoidance of psychological discomfort and reinforcing the urge to immediately escape such discomfort, social media use for those with PSMU may be preventing opportunities to strengthen the self-regulation and problem-solving skills required to alleviate discomfort in more permanent ways. There may be a vicious cycle, where people with low self-regulation develop PSMU, PSMU reinforces or further weakens aspects of self-regulation, motivating more PSMU to cope with new stressors. In so doing, PSMU may indirectly confer suicide risk by detracting from one's ability to cope with significant distress and resolve it in more effective and lasting ways. Future studies could use ecological momentary assessment methods to examine motives of coping with discomfort and the individual differences that motivate them, as well as whether PSMU impacts aspects of self-regulation in the long-term, and in so doing, confers suicide risk.

Future Directions: Social Comparison and SITBs

We will now discuss some potential future directions related to the mediation part of the model tested in this study. One of the main findings of this study was that social comparison on social media has a robust effect on defeat, suggesting that engaging in social comparison may be one indirect avenue through which social media use may confer suicide risk. Defeat leads to suicide ideation through entrapment, according to the IMV model of suicidal behavior

(O'Connor & Kirtley, 2018). Given the robust effect that social comparison on social media had on defeat, it may be fruitful to examine the complete pathway from social comparison to suicide ideation through defeat and entrapment in future research. In addition, although this study focused more on the immediate impact of social comparison on defeat, there may be a cumulative effect of moments of defeat on suicide ideation. It has been proposed that when defeat becomes chronic, it can lead to entrapment, paving the way for suicide ideation (Wetherall et al., 2018; Williams, 1997; Dixon, 1998). On social media, repeated social comparisons that are unflattering to the self could gradually shape the perception of lower social rank and confer risk for suicide ideation by leading to a chronic experience of defeat that turns into entrapment. No study has examined this possibility, as no long-term prospective longitudinal study of social comparison on social media and SITBs of which we know has been conducted. However, this possibility is worth investigating, given that several studies have shown that negative social comparison on Facebook can take a psychological toll over longer periods of time, predicting an increase in depressive symptoms a year later in high school students (Nesi & Prinstein, 2015) and three weeks later in young adults (Feinstein et al., 2013). Given that frequent social media use is now commonplace and data suggesting that individuals with (versus without) a previous suicide attempt tend to engage in social comparison online more frequently (Nesi et al., 2019), this line of inquiry on the long-term impact of these comparisons is worth investigating in future studies.

Another fruitful line of inquiry pertains to individual differences that differentially predict the likelihood and negative impact of social comparison. Findings from this study and from prior research suggest that certain factors may increase the likelihood of social comparison on social media. Mood-related intrapersonal variables, in particular, may facilitate greater social

comparison online. In this study, within-person prior-alert defeat had a greater impact on social comparison than did time spent on social media, suggesting that experiencing defeat may invite social comparison. Findings from other research support this idea, as individuals with depression and suicidal thoughts or behavior appear to experience a greater degree of social comparison online. In an experimental study in which participants with and without depressive symptoms viewed positively and negatively biased profiles of similar others (Appel et al., 2015), those with depressive symptoms perceived themselves as more inferior than did controls, especially after viewing a set of more attractive profiles (Appel et al., 2015). In another study, psychiatrically hospitalized girls with (versus without) a prior suicide attempt were significantly more likely to report engaging in negative social comparison on social media in the past two weeks (Nesi et al., 2019). SITBs were also associated with greater odds of social comparison on social media in a large study of Norwegian young adults (Kingsbury et al., 2020). What is less clear is why individuals with greater depressive symptoms or SITBs are more likely to engage in social comparisons and potentially feel worse afterward. Testing theory-based predictions about the specific vulnerabilities involved in SITBs that increase the tendency to compare can help elucidate why these individuals may be incurring more negative experiences online. For example, thwarted belongingness in suicidal individuals may draw attention to interpersonal information that is in line with this salient unmet psychological need. Indeed, prior research suggests that female youth low in popularity are more likely to engage in social comparison (Nesi & Prinstein, 2015).

Another factor that has been shown to increase the likelihood of online social comparison online and its negative impact is the tendency to engage in *offline* social comparison. In an experiment, people with higher tendencies to engage in social comparison offline felt worse after

viewing positive (versus neutral or negative) posts on Instagram (de Vries et al., 2018). In contrast, those who tended not to engage in offline social comparison felt greater positive affect after viewing the positive (versus neutral or negative) posts (de Vries et al., 2018). Similarly, in a study about women's body image, women who had a greater (versus lower) tendency to make appearance-related comparisons offline experienced less body image satisfaction after spending 10 minutes on Facebook (Fardouly, Diedrichs, Vartanian, & Halliwell, 2015). These findings suggest that people with greater tendencies to engage in social comparison offline may feel worse after online comparison. Some researchers suggest that this is simply because online comparison tendencies reflect offline comparison tendencies. Indeed, a cross-sectional study of young adults found that negative offline social comparison predicted depressive symptoms over and above social comparison on Facebook (Faranda & Roberts, 2019). However, other research has demonstrated that online comparison may differ from offline comparison and yields its own effect on mental health outcomes. In a three-week prospective longitudinal study, the association between Facebook social comparison and offline social comparison was only moderately correlated at time 1 and nonsignificant at time 2 (Feinstein et al., 2013). In addition, after controlling for offline social comparison, Facebook social comparison predicted increases in depressive symptoms through increases in rumination; in contrast, the direct effect of offline social comparison on depressive symptoms and its indirect effect through rumination were both non-significant (Feinstein et al., 2013). These findings suggest that engaging in social comparison on social media may have a specific and unique effect on psychopathology over and above the tendency to engage in offline comparison. Similarly, in the present study, at the between-person level, social comparison offline was no longer a significant predictor of defeat once social comparison on social media was taken into account. Social comparison on social

media, instead, better explained variability in defeat. Future studies could examine whether social comparison offline may act as a moderator in such associations to investigate whether tendency to engage in offline social comparison is an individual vulnerability that may yield a more negative psychological outcome after time on social media.

In summary, in the context of the IMV model of suicidal behavior, what is clear from the findings in this study is that social comparison on social media is a pre-motivational vulnerability factor that affects defeat, a motivational-phase predictor of suicide ideation. Future studies should investigate moderators that clarify who is more vulnerable to greater social comparison on social media and to experiencing a more negative subsequent impact after comparison that may influence suicide risk. Some potential moderators discussed are cognitive and intrapersonal variables associated with SITBs, such as rumination, thwarted belongingness, and offline tendencies to engage in social comparison. Another moderator that has been suggested in the literature as a potential driver of defeat through social comparison is perfectionism, and especially the socially prescribed kind whereby an individual believes that others have impossibly high expectations for that individual's behavior. In recent research, this kind of perfectionism has been linked to defeat through social comparison offline (Wetherall, Robb, & O'Connor, 2018). As the authors suggested, those with perfectionistic or highly self-critical traits may be more likely to perceive defeat (Wetherall et al., 2018). The online space may be a relatively new avenue that is rife with cues that increase vulnerability for the kinds of perceptions that lead to defeat. It is certainly worth examining in future studies of online social comparison.

Future Directions: Social Media Use and SITBs

The literature on social media use and SITBs is still nascent and can benefit from the lessons learned from the literature on social media use and well-being. One of these lessons is that it is best that future studies on social media use and SITBs abandon the global metric of “social media use.” This variable is too broad and will likely always lead to inconsistent direct effects and small indirect effects, slowing down research progress. In the literature on social media use and well-being, the research question that has guided most studies is this: “Does frequent social media use worsen mental health?” This is akin to a patient asking a doctor, “Does frequent eating worsen physical health?” To answer this question, a doctor would need to assess various eating- and patient-related factors. Such important contextual nuances would inform a more precise and accurate answer and recommendations. Similarly, in future social media and SITB research, instead of focusing on frequency of social media use in isolation, it will be more informative to investigate specific media- and user-related factors to understand the impact of social media use on suicide risk. These factors include a) what kinds of social media activities one is engaging in, b) of each kind, how much and how often, c) how this use fits into the individual’s overall social context, d) whether the person has individual psychological vulnerabilities that may mean that some of those activities might affect them differently than another person, and e) when the user tends to turn to certain social media activities and why. Asking such questions will help elucidate the conditions under which social media use confers risk for and/or protects against SITBs.

There is an opportunity to use ecological momentary assessment methods to gain a better understanding of user-centered contextual variables (e.g., motivations, behaviors, mood) and technology-centered contextual variables (e.g., type of media used at any given moment, network

characteristics). It would be particularly helpful to apply such methodology to examine how social media may be used differently and have different consequences for people with and without suicide ideation and behavior. This approach may be informative, given some research suggesting that people with and without depressive symptoms and SITBs are differentially affected by the social media environments (e.g., Appel et al., 2015; Nesi et al., 2019). It may be that specific social media stimuli or experiences that individuals with SITBs seek out have a specific negative impact on them that contributes to suicide risk. There may also be benefits of certain social media uses for suicidal individuals (e.g., deriving belongingness), which should not be ignored. What needs to be clarified is how different uses lead to both positive and negative short-term and long-term outcomes for those with SITBs. For example, a recent review showed that certain patterns of social media use, such as suicide-related social media use and sexting, are associated with SITBs (Marcynikola et al., 2021). A more fine-grained analysis of what motivations people with SITBs are seeking to fulfill on social media, with what behaviors, and what the short- and long-term psychological outcome of such behaviors is, can help clarify whether certain patterns of social media use that people with SITBs may engage in online are actually contributing to suicide risk, rather than just being related to suicide risk. To answer such questions, more prospective longitudinal research is needed, as well as more research that is guided by theory, something that has been found to be lacking so far in social media and SITB research (Macrynika et al., 2021). Research progress can be greatly hampered when hypotheses are not based on already established and empirically supported ideas.

Finally, an additional benefit of ecological momentary assessment studies that examine motivations and uses of social media is that they can simultaneously act as interventions, raising awareness of one's patterns of social media use and their psychological impact. In one study, for

example, participants reported that completing study procedures increased awareness of personal usage and that these insights were worthwhile (Hunt, Marx, Lipson, & Young, 2018). Increasing user awareness of their own motivations and social media behaviors can help encourage mindful use of social media that protects against negative psychological outcomes.

Strengths & Limitations

There are several strengths to this study. First, we moved beyond examining direct associations between time spent on social media and psychological outcomes. Research on social media and well-being, as well as research on social media and SITBs, has often taken this approach, yielding mixed findings in relation to overall well-being (*see* Liu, Baumeister, Yang, & Hu, 2019), depression (*see* Cunningham et al., 2021; Coyne et al., 2020), and SITBs (*see* Macrynika et al., 2021). Instead, we examined an indirect effect to help elucidate a process through which time spent may be indirectly linked with one SITB-related psychological outcome. Second, this study was based on a theoretically informed approach. Studies have often examined SITBs as outcomes but lacked hypotheses grounded in suicide theory (*see* Macrynika et al., 2021), which hampers research progress. This study was based on the IMV model of suicidal behavior, which provided a theoretical basis for social comparison on social media as a facilitator of defeat. Third, we examined a psychological process that cuts across social media channels. Prior research has largely relied on examining individual branded social media platforms (e.g., Facebook), which may limit generalizability of findings over time as the design and popularity of specific platforms changes over time. By focusing on social comparison on social media (versus on one specific platform), this study helped quantify its effect on defeat as it occurs across various social media. Fourth, we employed a stronger study design than is typical in this research area. Most studies have been cross-sectional, which limits interpretations

of causality and may be impacted by memory biases. By using an ecological momentary assessment method, we were able to capture social media use, social comparison, and defeat close to the time that they occurred and in the correct temporal order. We expect that this method may have lowered the threat of recall bias, given evidence suggesting that there is only a modest correlation between self-reported media use and logged measurements of actual use (*see* Parry et al., 2020). Finally, we focused on individual differences by choosing a moderator that may impact both the frequency of the psychological process that served as the mediator and its effect on the outcome. This approach addressed the need to focus on individual differences when examining social media in order to elucidate the conditions under which certain processes on social media are likely to occur.

Despite these strengths, this study also had certain limitations. First, our sample was heavily biased toward cisgender and heterosexual participants. The prevalence of suicide ideation tends to be higher in sexual and gender minority (SGM) versus heterosexual and cisgender youth (Liu, Walsh, Shehan, Cheek, & Carter, 2020; Marshall, 2016), and the effects in this study may have been weaker as a result of under-sampling SGM participants. Minority stress theory suggests that the disparity in such mental health outcomes as suicide ideation is partly due to prejudice and discrimination and the consequent internalized stigma and expectation of rejection that individuals of SGM status face (Meyer, 2003). Internalized stigma may have a priming effect, promoting more frequent and more harmful social comparisons on social media, increasing vulnerability to defeat in individuals of SGM status.

Second, we did not completely address causality, given that we did not manipulate time spent on social media. Third, objective measures of variables assessed were not included in this study. Although we expect that the EMA method lowered the possibility of recall bias, it may not

have altogether eliminated it. Responses may still have been subject to self-report bias. For example, although time spent on social media and social comparison occurred before the assessment of present-moment defeat, they were assessed at the same time as defeat, and feelings of defeat at time of assessment may have biased memory, leading to inaccurate estimates of time spent on social media and social comparison. Moreover, some studies suggest that distressed individuals have more biased responses than less distressed individuals. For example, individuals with elevated depressive symptoms reported using social media more (Hunt et al., 2018) and perceiving less social support after posting on social media (Park et al., 2016), despite no actual differences in objective use (Hunt et al., 2018) or objective assessments of social support garnered on social media (Park et al., 2016). Self-report measures may therefore produce artifacts and lead to inflated estimates.

In addition, we did not examine suicide ideation as an outcome. The outcome examined in this study was defeat, which is a proximal predictor of suicide ideation (O'Connor & Kirtley, 2018). However, not all people who experience defeat progress to the onset of ideation, which precludes any definitive conclusions about the impact of the social media process examined in this study on suicide ideation. Had we examined suicide ideation as an outcome, we may have seen an increase in ideation to the degree that defeat turned into entrapment. In line with the propositions of the IMV, one potential moderator that may have eased this progression from defeat to entrapment is rumination (O'Connor & Kirtley 2018), as it would have facilitated mental elaboration on defeat. There is a possibility, however, that this would be the case mostly on mainstream social media, such as Instagram and Facebook, where posts tend to be positively biased. Other social media, such as community forums, may make vulnerable individuals less susceptible to harmful social comparisons and more likely to obtain social support. If this

support then decreased thwarted belongingness, social media could be protective against suicide ideation. Indeed, there is evidence that suicidal individuals have greater online relationship building intentions when spending time online, and these intentions are inversely associated with perceived offline social support (Harris et al., 2014). Research also suggests that individuals at higher (versus lower) suicide risk report a greater use of online forums (Harris et al., 2014). Given these findings, even in a state of entrapment, if a suicidal individual uses social media to successfully elicit momentary social support, entrapment may not turn into suicide ideation. Thus, social media may facilitate suicide ideation to the extent that vulnerable individuals use mainstream social media that elicit harmful social comparisons; to the extent that they use social media to obtain social support that they lack offline, however, social media may be protective against ideation. Future studies should examine these hypotheses, testing the full IMV model, from defeat to entrapment to suicide ideation.

A final limitation is that we used PSMU as a proxy for the individual vulnerabilities hypothesized to strengthen the mediated process we investigated. This approach may have weakened or masked effects, as some of these vulnerabilities may not have characterized or affected people with higher (versus lower) PSMU to a greater extent. An alternative approach would have been to measure the specific vulnerabilities and to examine them as moderators, using PSMU as a predictor instead. Although we conceptualized PSMU as a stable trait-like tendency, which influenced the decision to examine it as a moderator, recent research suggests that PSMU does vary on a daily basis (Gansner et al., 2021). Given this finding, it likely would have been appropriate to examine PSMU as a predictor, capturing its daily variability and contribution to state-like changes in defeat. We might also have assessed intervals of social media use in a more precise way, assessing motives underpinning the desire to use social media

as well as social media behaviors during use. This would have allowed us to examine how momentary motives may have differentially influenced social media behavior and its outcomes. These are fruitful avenues to be explored in future research.

Conclusion

The present study examined a theoretically informed pathway through which social media use may begin to confer suicide risk, particularly for those who engage in one specific pattern of social media use, PSMU. Findings from this study suggest that after one spends more time on social media than is typical for them, they experience slightly more defeat than is typical for them, in part because they engaged in greater social comparison on social media than they usually do. This process was found to be only very slightly stronger for people with greater PSMU. Given the consistency with which certain patterns of social media use have been linked with negative psychological outcomes, including SITBs, it is imperative to continue examining their impact on the mental health of people who may be vulnerable to SITBs. Fine-grained investigative approaches can shed light on the specific motivations and vulnerabilities that lead to certain patterns of social media engagement, such as PSMU, and may interact with aspects of social media use to confer suicide risk in the long term. Clarifying such factors can help inform interventions for vulnerable individuals who may unintentionally be using social media in ways that perpetuate their distress in the long term and potentially reinforce SITBs.

Table 1

Descriptive Statistics

Variables	M (n)	SD
<i>Questionnaire Data</i>		
PSMU (pre)	19.99 (99)	4.49
PSMU (post)	20.05 (91)	4.91
Defeat (pre)	41.56 (99)	12.69
Defeat (post)	43.55 (91)	13.50
Dep. sym. (pre)	20.84 (99)	11.82
Dep. sym. (post)	21.08 (89)	12.14
SC on SM (pre)	38.12 (98)	6.55
SC offline (post)	40.01 (85)	6.48
<i>EMA Data</i>		
Time on SM	22.83 (98)	14.55
SC on SM	2.58 (98)	1.06
Defeat (EMA)	2.05 (98)	0.97

Table 2

Social media platforms that participants reported having spent time on since the last EMA assessment (n = 3353)

Social Media Platform	Frequency	Percent
Instagram	1791	53
TikTok	473	14
Facebook	457	14
Twitter	331	10
YouTube	127	4
Snapchat	66	2
Other, not specified	58	2
Reddit	15	<1
Chat (e.g., WhatsApp, WeChat)	12	<1
Twitch	11	<1
Facebook & Instagram	5	<1
Dating Sites (e.g., Bumble, Tinder)	3	<1
Tumblr	2	<1
TikTok & Instagram	1	<1
LinkedIn	1	<1
Total	3353	100

Table 3

Correlations Among Study Variables

	<i>M (SD)</i>	1	2	3	4	5	6
1. PSMU (pre)	19.99 (4.49)	–					
2. TS (EMA)	22.83 (14.55)	.21*	–				
3. SC (EMA)	2.58 (1.06)	.27**	.29**	–			
4. DF (EMA)	2.05 (0.97)	.31**	.31**	.64**	–		
5. Dep (pre)	20.78 (11.84)	.35**	.32**	.45**	.65**	–	
6. SC off (post)	40.01 (6.48)	.31**	.13	.45**	.36**	.34**	–

Note. PSMU (pre) = problematic social media use, measured at baseline; TS (EMA) = time spent on social media since the last alert; SC (EMA) = social comparison during reported TS since the last alert; DF (EMA) = level of defeat at time of current alert, as measured at baseline; Dep (pre) = depressive symptoms, measured at baseline; SC off = general social comparison offline, measured at follow-up
* $p < .05$ ** $p < .01$

Table 4

Time Spent on Social Media as a Multilevel Predictor of Social Comparison on Social Media (SC) & SC as a Multilevel Predictor of Defeat

Predictor	Model 1 <i>Coeff. (SE)</i>	Model 2 <i>Coeff. (SE)</i>	Model 3 <i>Coeff. (SE)</i>
<i>Outcome: SC</i>			
Fixed effects			
Intercept	1.81 (0.24)**	2.21 (0.25)**	2.21 (0.25)**
Within-person TS	0.01 (<0.01)**	0.01 (<0.01)**	0.01 (<0.01)**
Within-person DF _{lag}	–	0.18 (0.03)**	0.18 (0.03)**
Between-person TS	0.03 (0.01)**	0.01 (0.01)+	0.01 (0.01)+
Between-person SC _{off}	–	0.05 (0.02)**	0.05 (0.02)**
Between-person Dep	–	0.02 (<0.01)**	0.02 (0.01)**
Random effects			
Intercepts (variance) SC	0.97 (0.14)**	0.75 (0.11)**	0.75 (0.12)**
Slopes (variance) TS->SC	<0.01 (<0.01)**	<0.01 (<0.01)**	<0.01 (<0.01)**
Slopes (variance) DF _{lag} ->SC	–	0.03 (0.01)**	0.03 (0.01)**
<i>Outcome: DF</i>			
Fixed effects			
Intercept	0.44 (0.22)+	0.94 (0.23)**	0.91 (0.23)**
Within-person TS	0.01 (<0.01)*	<0.01 (<0.01)**	<0.01 (<0.01)**
Within-person SC	0.33 (0.03)**	0.31 (0.03)**	0.31 (0.03)**
Within-person DF _{lag}	–	0.28 (0.03)**	0.28 (0.03)**
PSMU x SC -> DF	–	–	0.02 (0.01)*
Between-person TS	<0.01 (0.01)	<0.01 (0.01)	<0.01 (0.01)
Between-person SC	0.59 (0.07)**	0.41 (0.07)**	0.42 (0.07)**
Between-person SC _{off}	–	<0.01 (0.01)	<0.01 (0.01)
Between-person Dep	–	0.04 (0.01)**	0.04 (0.01)**
PSMU	–	–	-0.05 (0.04)
PSMU x SC -> DF	–	–	0.02 (0.01)+
Random effects			
Intercepts (variance) DF	0.53 (0.07)**	0.34 (0.06)**	0.33 (0.05)**
Slopes (variance) TS->DF	<0.01 (<0.01)**	<0.01 (<0.01)*	<0.01 (<0.01)*
Slopes (variance) SC->DF	0.09 (0.02)**	0.07 (0.01)**	0.06 (0.01)**
AIC	20437	12953	12951

Note. Model 1 = multilevel mediation model without covariates. Model 2 = multilevel mediation model, controlling for covariates. Model 3 = multilevel moderated mediation model, controlling for covariates.

* $p < .05$ ** $p < .01$ + $p < .10$

Table 5

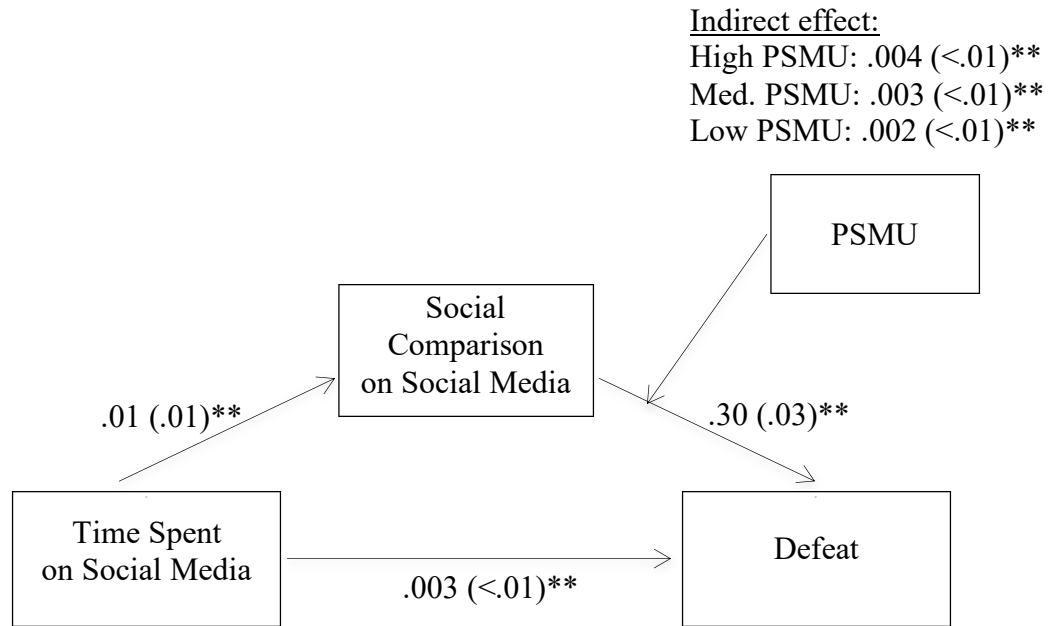
Indirect effects from time spent on social media to defeat through social comparison on social media (SC)

	Indirect Effect	Lower Limit	Upper Limit	<i>p</i>
<i>Within-person</i>				
SC (Model 1)	.004 (.001)**	.002	.005	<.01
SC (Model 2)	.003 (.001)**	.002	.004	<.01
SC (Model 3)	.003 (.001)**	.002	.004	<.01
<i>Between-person</i>				
SC (Model 1)	.016 (.005)**	.007	.026	<.01
SC (Model 2)	.006 (.004)+	-.001	.013	.09
SC (Model 3)	.006 (.003)+	-.001	.013	.09

p* < .05 *p* < .01 +*p* < .10

Figure 1

Interaction of social comparison on social media and PSMU on defeat at the within-person level



Note. Time spent on social media significantly predicts social comparison and defeat. The within-person indirect effect of time spent on social media on defeat via social comparison on social media was significant. ** $p < .01$.

APPENDIX

Baseline and Post-Assessment Measures

Bergen Social Media Addiction Scale (BSMAS)

How often during the last year, have you ...

- ... spent a lot of time thinking about social media or planned use of social media?
- ... felt an urge to use social media more and more?
- ... used social media in order to forget about personal problems?
- ... tried to cut down on the use of social media without success?
- ... become restless or troubled if you have been prohibited from using social media?
- ... used social media so much that it has had a negative impact on your job/studies?

Defeat Scale

Below is a series of statements, which describe how people can feel about themselves. Read each item carefully and circle the number to the right of the statement that best describes how you have felt in the last 7 days. Use the scale below. Please do not omit any item.

0	1	2	3	4
Never	Rarely	Sometimes	Mostly (a lot)	Always

1. I feel that I have not made it in life
2. I feel that I am a successful person
3. I feel defeated by life
4. I feel that I am basically a winner
5. I feel that I have lost my standing in the world
6. I feel that life has treated me like a punch bag
7. I feel powerless
8. I feel that my confidence has been knocked out of me
9. I feel able to deal with whatever life throws at me
10. I feel that I have sunk to the bottom of the ladder
11. I feel completely knocked out of action
12. I feel that I am one of life's losers
13. I feel that I have given up
14. I feel down and out
15. I feel that I have lost important battles in life
16. I feel that there is no fight left in me

Center for Epidemiologic Studies Depression Scale (CES-D)

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

During the Past Week

	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
1. I was bothered by things that usually don't bother me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I did not feel like eating; my appetite was poor.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I felt that I could not shake off the blues even with help from my family or friends.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I felt I was just as good as other people.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I had trouble keeping my mind on what I was doing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I felt depressed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I felt that everything I did was an effort.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I felt hopeful about the future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I thought my life had been a failure.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I felt fearful.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. My sleep was restless.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I was happy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I talked less than usual.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. I felt lonely.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. People were unfriendly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. I enjoyed life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. I had crying spells.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. I felt sad.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. I felt that people dislike me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. I could not get "going."	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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