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Examining Real-Time Variations in Interpersonal Hopelessness and Suicidal Ideation Using Ecological Momentary Assessment

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EXAMINING REAL-TIME VARIATIONS IN INTERPERSONAL HOPELESSNESS AND SUICIDAL IDEATION USING ECOLOGICAL MOMENTARY ASSESSMENT

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Table of Contents

Illustrations

Tables

Figure

Abbreviations

BHS	Beck Hopelessness Scale
EMA	Ecological momentary assessment
ICC	Intra-class correlation
IH	Interpersonal hopelessness
IH-PB	Hopeless perceptions of burdensomeness
IH-TB	Hopelessness about thwarted belonging
IHS	Interpersonal Hopelessness Scale
ITS	Interpersonal Theory of Suicide
PB	Perceived burdensomeness
RMSSD	Root mean square of successive differences
SI	Suicidal ideation
STB	Suicidal thoughts and behaviors
TB	Thwarted belongingness

Abstract

The Interpersonal Theory of Suicide (ITS; Van Orden et al., 2010) hypothesizes that suicidal ideation (SI) arises from the simultaneous presence of thwarted belongingness (TB) and perceived burdensomeness (PB). For SI to intensify to suicidal desire, hopelessness about the changes in TB and PB must be present (Van Orden et al, 2010). Recent research on the ITS has moved away from a general measure of hopelessness, instead focusing on hopelessness specific to the interpersonal constructs of TB and PB (Tucker et al., 2018). This construct, referred to as interpersonal hopelessness (IH), is further broken down into two correlated but distinct constructs; hopelessness about one's belongingness being thwarted (IH-TB) and about one's perception that they are a burden (IH-PB; Mitchell et al., 2023). Few studies have explored IH, and none to date have explored the temporal stability of IH and its prospective prediction of suicidal ideation (SI) severity. Undergraduates (N = 43) selectively recruited for past-two-week SI completed five ecological momentary assessment surveys per day for 10-days. Intraclass correlations, root mean square of successive differences, and multi-level models were used to examine the data and explore relationships among predictor variables. Results indicated that IH-TB and IH-PB demonstrated greater temporal stability than general hopelessness across assessments. IH-TB, IH-PB, and their interaction were significant predictors of SI severity concurrently and prospectively. However, IH-PB was no longer significantly predictive of SI severity at the next time point when adjusting for general hopelessness. Results show that targeting IH specific to TB and PB may reduce subsequent SI. Targeting IH may require different strategies than targeting general conceptions of hopelessness due to its more stable nature. Future research should replicate these results in larger and more diverse samples and consider the use of shorter ambulatory assessment intervals.

Introduction

Suicide is the 12th leading cause of death in the United States (U.S.) (Ehlman et al., 2022). Even more striking, rates of suicide death pale in comparison to rates of suicidal ideation (SI) and other risk factors for suicide (Piscopo et al., 2016). According to the results of the 2020 National Survey on Drug Use and Health, more than 12 million U.S. adults reported serious thoughts of suicide during the past year (SAMHSA, 2023). The percentage of individuals with serious thoughts of suicide was highest amongst those aged 18-25 (SAMHSA, 2023), an age span that covers most individuals who are enrolled in college (Hansen, 2021). College students are at a marked increase of risk for developing suicidal thoughts and behaviors (STBs), with about one in four college students reporting having experienced SI over the course of their life, and of those with lifetime SI prevalence, over 65% report having SI in the past year (Mortier et al., 2018b). It is therefore evident just how prominent suicidal thoughts and desires are amongst college students.

Suicidologists and public health officials have long focused on suicide and suicide attempts, rather than SI (Jobes & Joiner, 2019). Only in recent decades have researchers focused more heavily on the factors that differentiate SI from suicidal behavior (Khazem & Anestis, 2016). While some scholars argue that suicidal behavior can occur in the absence of past SI, Jobes and Joiner (2019) assert that SI is the essential ingredient in suicide. Meaning, at the moment of death, the idea of suicide is on one's mind. Therefore, SI must be a target intervention to decrease both suicide-related suffering and death (Jobes & Joiner, 2019).

One theory that attempts to explain how suicidal thoughts emerge and intensify is the Interpersonal Theory of Suicide (ITS; Joiner, 2005; Van Orden et al., 2010). This theory suggests differential factors that predict the presence of SI and factors that transition SI to suicidal

behaviors (Van Orden et al., 2010). The theory employs the distinction between passive and active SI; Passive SI may present with cognitions such as "I wish I was dead," whereas active SI represents an active desire to take one's life (e.g. "I want to kill myself") (Van Orden et al., 2010). One hypothesis of the ITS is that passive SI is caused by the experience of thwarted belongingness (TB) or perceived burdensomeness (PB) (Van Orden et al., 2010). TB is conceptualized as feelings of social isolation and a lack of reciprocated social caring, while PB includes intense feelings of self-hate and a belief that one burdens the lives of others or communities. For passive SI to shift into active SI, there must be a simultaneous presence of both TB and PB, as well as hopelessness about future changes in these interpersonal constructs (Van Orden et. al. 2010).

Hopelessness is defined as a system of negative expectancies concerning oneself and their future (Beck et al., 1974). Evidence supports the hypothesized role of hopelessness within the ITS. A study of undergraduate students found that high levels of hopelessness intensified the relationship between SI/plans/urges and the interaction of TBxPB (Hagan et al., 2015). Additionally, Talley and colleagues (2015) found a greater risk for active SI in a sample of undergraduate women who endorsed proxy measures of TB and PB, co-occurring with feelings of hopelessness. Despite these findings, there is also evidence to suggest hopelessness may in fact not moderate the relationship between SI and TBxPB as hypothesized (Van Orden et al., 2010). In a study of German psychiatric inpatients, hopelessness was not found to be a moderator of the relationships between active SI and either TB or PB (Forkman et al. 2021). In a sample of adolescents and young adults, Roeder and Cole (2019) found that while hopelessness, PB, and TB seemed to predict SI separately, they do not predict SI when examined concurrently.

One potential explanation for these conflicting set of findings could be these investigations' use of a general measure of hopelessness. In a review and meta-analysis of the ITS, Chu and colleagues (2017) outlined the need for a measure of hopelessness specific to the interpersonal constructs defined in the ITS. Studies have often utilized an indirect approach to measure the hypotheses of the ITS by measuring general hopelessness, which frequently yields insignificant results (Chu et al., 2017). To fill this gap in the literature, Tucker and colleagues (2018) sought to create a measure of hopelessness specific to perceptions of TB and PB. In their study, Interpersonal Hopelessness (IH) was positively correlated with TB, PB, SI, and suicide risk. Additionally, the three-way interaction between IH, TB, and PB predicted both SI and suicide risk (a measure of recent suicidal thinking, historical suicidal behaviors, and belief in a future suicide attempt), while general hopelessness did not interact with TB and PB to predict SI or suicide risk. These findings support the idea that hopelessness specific to these interpersonal constructs is central to the development of suicidal desire outlined in the ITS (Tucker et al., 2018).

The continued need for more research on IH was highlighted by Joiner et al.'s (2021) review regarding the state of the ITS literature. Outside of the paper by Tucker and colleagues (2018), no other studies have tested the IHxTBxPB interaction proposed in the ITS (Joiner et al., 2021). It is thus important to explore more deeply this construct and to evaluate it within the ITS and in the development of strong suicidal thinking and potential interventions targeting this construct. Additionally, given the recent findings of a superior two-factor solution for IH (Mitchell et al., 2023), it is important to explore both domains of IH—hopeless perceptions of burdensomeness (IH-PB) and hopeless beliefs that one is thwarted in their belonging (IH-TB). Finally, one area needing further exploration is the temporal dynamics of IH. Prior research has

shown that common risk factors for SI such as hopelessness, burdensomeness, and loneliness, vary considerably over the course of the day (Kleiman et al., 2017). While general hopelessness can fluctuate in the span of hours, it is unclear whether the domains of IH follow a similar pattern or remains stable over time.

The current investigation explored the temporal dynamics of IH and its prospective relationship with SI. Given the dynamic nature of hopelessness (Kleiman et al., 2017) and the strong correlations between general hopelessness and IH (Tucker et al., 2018), it was hypothesized that both IH-TB and IH-PB would vary considerably over the course of the day. Given that few psychosocial predictors of SI demonstrate stable patterns when measured over the course of the day (Kleiman et al., 2017), we hypothesized that IH-TB and IH-PB would follow similar patterns to general hopelessness. Additionally, based on findings that show correlations between active SI and both general hopelessness (Kleiman et al., 2017) and IH (Tucker et al., 2018), it was hypothesized that higher levels of IH-TB and IH-PB will be concurrently and prospectively related to increased SI severity. Lastly, it was hypothesized that IH-TB and IH-PB would better predict SI both concurrently and prospectively than general hopelessness, given the results of Tucker and colleagues (2018) that demonstrated a stronger relationship between SI and IH compared to general hopelessness.

Literature Review

Suicide Risk in College Students

College students face a unique set of stage-of-life challenges – related to new responsibilities, experiences, and relationships – thus placing them at risk of mental health struggles (Liu et al., 2019). In addition to the stress of academic and social pressures, experimentation with drugs and alcohol and poor sleeping habits can lead to worsening mental health problems (Taub & Robertson, 2013). The transition into college typically occurs during late adolescence and early adulthood, a time period marked by the onset of many common mental disorders (Kessler et al., 2007). Additionally, it is speculated that the major life transitions that accompany going to college can induce new mental health struggles or worsen existing ones (Suicide Prevention Resource Center, 2004). Specifically, college students are at a marked risk of developing STBs, with about one in four reporting the experience of SI in their lifetime, and over 65% of those with historical SI reporting past year thoughts about suicide (Mortier et al., 2018).

Suicide among adolescents and young adults was relatively understudied during the first part of the 20th century (Haas et al., 2003). As suicide rates amongst college students continued to rise, by the 1960's researchers began studying suicide rates at prestigious universities in the United States (Haas et al., 2003). In a review of the literature on college student suicide, Lipschitz (1990) pointed out the inconsistencies in research findings. Up to that point, studies had utilized small and unrepresentative samples of students with wide variations in demographic factors such as location, socioeconomic status, ethnicity, age, and religion (Lipschitz, 1990). Additionally, Lipschitz (1990) noted that no studies to date had samples that were fully representative of the national college student population.

Following this discovery, Silverman and colleagues (1997) sought to advance the understanding of college student suicide risk through the largest examination of college student suicide. The Big Ten Student Suicide Study examined all known suicides ($N = 261$) amongst undergraduate and graduate students attending one of the 12 schools within the Big Ten University Athletic Association from 1980-1990 (Silverman et al., 1997). The most significant finding from this study was a significantly lower rate of suicides across all 12 campuses when compared to the national sample over the 10-year period (Silverman et al., 1997). Silverman and colleagues attribute these findings to more accessible health and mental health care across college campuses, greater support networks and a general sense of community found in college settings, laws against guns on campus, and monitoring of alcohol and drug use. However, certain limitations exist within this study that are pointed out by Haas and colleagues (2003). Only the aggregated data was analyzed within this study, leaving out any individual variation across campuses (Haas et al., 2003). Additionally, no distinctions were made between full and part time students and their rates of suicide. Another concern brought up by Haas (2003) is the exclusion of suicides that may take place after a student is no longer enrolled in school. There is a "disturbingly large" number of students who have died by suicide within 6 months following dropping out of school, which artificially lowers the college suicide rate (Haas et al., 2003, Silverman et al., 1997).

Heading into the early 21st century, colleges across the country were reporting increasing numbers of students seeking counseling services (Gallagher, 2001). Data collected during the 1995 National College Health Risk Behavior Survey showed that 10% of students participating in the survey had seriously considered attempting suicide during the previous year (Kann et al., 1997). A 2005 paper compared these results to the National College Health Assessment survey

data from 2000 and found that 9.5% of students reported seriously considering attempting suicide over the past year (Kisch et al., 2005). An analysis of trends in mood and anxiety symptoms amongst college students from 2007-2018 showed that while the percentage of students who seriously considered suicide decreases slightly until 2014 (<8.6%), by the 2014-2015 school year, the number was rising (Duffy et al., 2019). As of 2018, the percentage of students who have seriously considered suicide over the previous 12 months was 13% (Duffy et al., 2019).

The overall estimated rates of SI and attempts amongst college students are mixed, with estimates ranging between 6.7 - 24% of college students experiencing lifetime SI and 1.5 – 9% having made a suicide attempt at some point in their lives (Liu et al., 2019; Kisch et al., 2005; Downs & Eisenberg 2012). A 2018 meta-analysis by Mortier and colleagues investigated the estimated prevalence of STBs amongst college students across the world (Mortier et al., 2018b). They included studies reporting lifetime or 12-month prevalence of SI, plans, and/or attempts, and found that nearly one in four college students worldwide have experienced some form of SI in their lifetime (Mortier et al., 2018). Of those reporting lifetime SI, 65% reported experiencing it in the 12 months prior to assessment (Mortier et al., 2018). While these results indicate that young people enrolled in college are at a marked risk for developing STBs when compared to the general adult population (e.g. Nock et al., 2008, 2013), it is unclear if college students are at an increased risk when compared to same-aged peers who are not enrolled in college (Mortier et al., 2018b). There are very few studies that have compared rates of STBs in college students and their same-aged peers, but some findings suggest that college students have lower rates of past year suicide attempt status when compared with non-college attending peers (Han et al., 2016). These findings could be explained, in part, by findings that students who report STBs prior to

college age may fail to matriculate into college (Mortier et al., 2018). Regardless of whether college students experience SI at higher rates than their same aged peers, SI amongst college students is of increasing concern.

Risk Factors of Suicide

The identification of individual risk factors, or a set of factors, that can be used to aid in the identification and prediction of STBs is an important aim of the literature on suicide risk (Franklin et al., 2017). Clinically, risk factors are used as a tool for health care professionals to identify patients who may develop suicidal thoughts or engage in suicide behavior in the future (Franklin et al., 2017). Advances in the study of suicide risk factors have allowed researchers to paint a more comprehensive picture of suicide risk and related behaviors (Turecki et al., 2019). Despite these advances, most risk factors identified in the literature are relatively weak and inaccurate at predicting suicide (Franklin et al., 2017). However, the utility of risk factors is not lost; understanding risk factors for suicide helps to inform theory, drive the development of new and innovative treatments, and guide the development of new suicide risk assessments (Franklin et al., 2017).

When analyzing factors related to suicide, it is crucial to define the constructs so as to avoid miscommunication amongst researchers (Franklin et al., 2017). What follows are the definitions of constructs defined in the literature. The construct "correlate" refers to a factor that has a relationship, or association, with another factor (Franklin et al., 2017; Kraemer et al., 1997). The term "risk factor" refers to a specific type of correlate that has a measurable characteristic preceding the outcome and can be used to divide the population into high and low risk groups (Kraemer et al., 1997). The construct "casual risk factor" is a risk factor that changes the probability of the outcome occurring when it is manipulated (Kraemer et al., 1997).

Differentiating between these constructs is critical in the development of STB theory, research, and practice (Franklin et al., 2017). Causal risk factors are predictors that can be targets for intervention. Noncausal risk factors are predictors with less effective intervention targets whose correlates may prove to be poor predictors of outcomes and have poor intervention targets (Franklin et al., 2017).

In addition to understanding the above constructs, it is important to consider suicide phenotypes to understand the suicidal behavior spectrum (Turecki et al., 2019). The first phenotype – SI – is defined as thoughts of ending one's life (Turecki et al., 2019). This can be characterized as passive SI (a wish to die with no plan) or active SI (a desire for suicide; Turecki et al., 2019). Other suicide phenotypes include suicide attempt (self-injurious behavior where the intent or inferred intent is to die) and suicide death (Turecki et al., 2019). Risk factors vary depending on the phenotype (Klonsky et al., 2016). Risk factors for SI include depression, hopelessness, and impulsivity, whereas risk factors for suicide attempts include access to lethal means and knowledge and comfort with lethal means (Klonsky et al., 2016). The transition from SI to suicide attempt is often facilitated by co-occurring psychiatric disorders, decreased restraint, increased capability for suicide, and access to means of suicide (Klonsky et al., 2016).

A multitude of studies have identified strong STB risk factors (e.g. Beck et al., 1989; Coryell & Schlesser, 2001). Some of the risk factors for STBs with the most empirical support include mental disorders, family history of STBs, hopelessness, anticipated or actual losses or life stressors, severe emotional pain or distress, and a history of STBs (Franklin et al., 2017). Often, lists of relatively non-specific risk factors are compiled and distributed by organizations such as the American Psychological Association (APA, 2019), the American Foundation for Suicide Prevention (AFSP, n.d.), and the Centers for Disease Control and Prevention (CDC,

2022). These guidelines often lack specificity, which can create difficulty for both professionals and nonprofessionals in accurate prediction of STBs (Franklin et al., 2017). For example, the AFSP (n.d.) lists depression, anxiety, withdrawing from activities, and sleeping too much or too little as warning signs for suicide. When taken together, these factors often generalize to any individual with mental illness, serious or chronic physical illness, life stressors, or access to lethal means, suggesting they could be at risk of STB's (Franklin et al., 2017). Additionally, single studies often give little insight into what the actual magnitude of a risk factor is, thus contradicting what was found in previous studies (Franklin et al., 2017). The inconsistent findings within the literature indicate that the role of these risk factors is complex and not unidimensional, as there are likely many pathways to STBs (Franklin et al., 2017).

Franklin and colleagues (2017) completed a meta-analysis of the STB literature to identify the characteristics of the STB literature and determine the predictive ability of these risk factors. Of all the studies included, they found that nearly 80% of the risk factors fell into five major categories; biology, screening, cognitive problems and abilities, demographics, or externalizing psychopathology (Franklin et al., 2017). Risk factors related to either internalizing psychopathology or demographic factors accounted for almost half of all the 3,428 risk factor effect sizes that were studied, demonstrating the homogenous nature of the risk factor literature (Franklin et al., 2017). Overall, the study found that within the confines of the existing literature, risk factors for suicide are poor predictors of STB's (Franklin et al., 2017).

Despite the limitations found within the risk factor literature, risk factors may indicate underlying mechanisms of suicide and can lead to the development of etiological models of suicide (Van Orden et al., 2010). Franklin and colleagues (2017) call for further studies on STB risk factors, particularly those including follow-up intervals and repeatedly measured constructs.

Knowledge of suicide risk factors is helpful in developing and refining theories of suicide, creating treatments, and designing accurate risk assessments (Franklin et al., 2017).

The Interpersonal Theory of Suicide

Contemporary theoretical models of suicide have been built to not only highlight important risk factors for assessment and treatment strategies, but guide further study of the phenomenology of suicide. The ITS was originally proposed by Thomas Joiner in his 2005 book, "Why People Die by Suicide" (Joiner, 2005). In sum, the ITS proposes that the most dangerous form of active suicidal desire arises from the concurrent presence of both PB and TB (Van Orden et al. 2010). Additionally, one's capability to engage in suicidal behaviors is separate from one's desire, which, within the theory, is called "acquired capability for suicide" (Van Orden et al., 2010). The overall foundation of this theory is that "people die by suicide because they can and because they want to" (Van Orden et al., 2010, p. 581).

One of the most reliable predictors of STBs is social isolation, or a lack of social connectedness and integration (Van Orden et al., 2010). Baumeister and Leary (1995) describe the fundamental psychological need of social connectedness as the "need to belong" (p.1). Within the ITS, this need for belongingness is referred to as TB (Van Orden et al., 2010). Prior theoretical explanations of suicide have described the human need for social connectedness (Shneidman, 1985; 1987), but the ITS expands upon this idea, proposing that an unmet "need to belong" (Baumeister & Leary, 1995, p.1) is what contributes to the desire for suicide (Van Orden et al., 2010). Additionally, the theory describes TB as a multidimensional construct, a hierarchical latent variable with two secondary factors: loneliness and the absence of reciprocal care (Van Orden et al., 2010). Loneliness is conceptualized as having too few social connections, while the absence of reciprocal care is described as the absence of relationships in which both

individuals express and receive care for one another (Van Orden et al., 2010). When the need for belonging is unmet and an individual feels disconnected from others, the desire for death, or passive SI, develops (Van Orden et al., 2010)

The second construct involved in the ITS is PB. Some of the strongest and most empirically supported risk factors for lethal suicidal behavior are all based around negative life events, namely family conflict, unemployment, and physical illness (Van Orden et al., 2010). Van Orden and colleagues (2010) propose that the feeling underlying each of these events is a perception that one is a burden to others. Perceptions of burdensomeness was a key factor in the family systems theory of adolescent suicidal behavior introduced by Sabbath in 1969. According to the theory, adolescents interpret their role in the family as expendable and that the family would be better off without them (Sabbath, 1969). In line with this work, the ITS broadens the construct of PB to include feelings of burdensomeness towards close others, not limited to family (Van Orden et al., 2010). As with TB, observable indicators for PB are outlined within the ITS. These include: liability and self-hate. Liability is defined as a belief that oneself is flawed to the point of being a liability to others, thus leading to a hatred of the self (Van Orden et al., 2010). The theory proposes that more distal risk factors (e.g., mood disturbances) influence the desire for suicide by increasing one's TB, PB, or a combination of both (Van Orden et al., 2010).

Prior models of suicide suggest that SI results from the combination of multiple co-occurring risk factors, with the likelihood of suicide attempt or death increasing as the number of risk factors increases (Van Orden et al., 2010). Previous theories assume that increased desire for suicide leads to heightened risk for suicide (Van Orden et al., 2010). Conversely, Van Orden and colleagues (2010) posit that a desire to die by suicide is not sufficient on its own to lead to suicide. In addition to suicide desire, there must be a loss of fear associated with death by suicide

(Van Orden et al. 2010). Humans are born with the biological drive to survive and avoid behaviors that may be threatening to one's survival (Van Orden et al. 2010). Therefore, the capability for suicide is acquired, not innate (Van Orden et al. 2010). This acquired capability is composed of two facets: increased physical pain tolerance and reduced fear of death, both of which are dimensional constructs developed through habituation and a mechanism that occurs via "opponent process theory" (Van Orden et al., 2010). Opponent process theory – proposed by Solomon and Corbit (1974) – theorizes that emotions are paired as opposites (i.e., fear and relief) and when an individual experiences one emotion (fear), the other (relief) is temporarily inhibited. However, with repeated exposure, the initial emotion (fear) becomes weaker, and the opposing emotion (relief) intensifies (Solomon & Corbit, 1974). This yields an observed emotional response of decreased fear (Solomon & Corbit, 1974). This theory is applied within the ITS to suicidal behaviors, where the primary emotions are pain and fear, with analgesia and relief as the opponent processes (Van Orden et al., 2010). Building on this opponent process theory, the ITS proposes that with repeated exposure, once painful and feared stimuli become less fear-inducing, and instead intensify the feeling of relief and emotional respite (Van Orden et al., 2010).

The relationships between the constructs of TB, PB, suicidal desire, fear of death, and increased physical pain tolerance are more formally outlined through four hypotheses that make up the basis of the ITS (Van Orden et al., 2010). The first hypothesis of the theory is related to passive SI, or a desire for death without active desire to kill oneself (Van Orden et al., 2010). It hypothesizes that "TB and PB are proximal and sufficient causes of passive SI" (Van Orden et al., 2010, p. 588). This hypothesis asserts that passive SI results from either the experience of TB or PB (Van Orden et al., 2010). The second hypothesis of the ITS is related to the transition from passive suicidal desire to active suicidal desire. It hypothesizes that the combination of complete

TB and PB, *as well as* a hopelessness about these states, leads to the development of an active desire for suicide (Van Orden et al., 2010). The third hypothesis of the ITS proposes that suicidal intent arises from "the simultaneous presence of suicidal desire and lowered fear of death" (Van Orden et al., 2010, p. 581). The fourth hypothesis of the ITS suggests that serious suicidal behavior (defined as lethal or near lethal suicide attempts) arises from a combination of TB, PB, hopelessness about these interpersonal states, a lowered fear of death, and an increased tolerance to physical pain (Van Orden et al., 2010). When compared to nonlethal attempts and SI, lethal suicidal behavior is relatively rare. Therefore, it takes a combination of all of the constructs proposed within the ITS to lead to serious suicide behavior (Van Orden et al., 2010).

The ITS is one of the first theories of suicide that proposes an ideation-to-action framework (Klonsky & May, 2014) and provides a clear framework for understanding suicidal desire, ideation, and behavior. According to the theory, targets for intervention and prevention include TB, PB, and hopelessness about these constructs (Van Orden et al., 2010). While constructs such as fear of death and increased physical pain tolerance are not easy treatment targets, they provide a basis from which to make predictions on who may most benefit from suicide-focused interventions (Van Orden et al., 2010).

Hopelessness and Suicide

Hopelessness is often characterized as one of the most important long-term risk factors for later suicide behavior (Joiner et al., 2005) and has become an important facet of contemporary theories of suicide (e.g. ITS [Van Orden et al., 2010], The Three-Step Theory [Klonsky & May, 2015]). The ITS posits that for passive SI to shift to active SI, both TB and PB must be present at the same time, in addition to hopelessness about any future changes in these constructs (Van Orden et. al. 2010).

The link between hopelessness and suicide has been studied for decades, with many theories noting hopelessness as the crucial component to suicidal behavior (e.g. Beck et al., 1975). Beck and colleagues (1975) defined hopelessness in terms of negative expectations, or a "desire to escape from what [one] considers an insoluble problem" (Beck et al., 1975, p. 1146). Beck (1963) notes that in many of his interactions with patients, suicide is the only solution for their "desperate" and "hopeless" situations. Consequently, Beck's theory for suicide centers around the idea that suicidal behavior emerges from hopelessness and impaired reasoning (Beck et al., 1975). Beck's theory rests on the idea that suicidal behavior develops when an individual has cognitive distortions, misconstrues their experiences in negative ways, and anticipates only negative outcomes for the future (Beck et al., 1975).

Additional theories, such as The Hopelessness Theory of Suicidality (Joiner et al., 2022) emerged as yet another way to explain the role of hopelessness in depression and later suicidal behavior. Abramson et al. (1989) described a type of depression referred to as hopelessness depression, of which hopelessness is a proximal and sufficient cause of depression onset. One of the key symptoms of hopelessness depression is the expectation that the outcome one desires is unlikely to occur, or that a highly aversive outcome will occur instead with no possible solutions that can change the outcome (Abramson et al., 1989). Similar to Beck's theory, it is proposed that STBs are likely symptoms of hopelessness depression (Abramson et al., 1989).

To further test theories and measure the construct of hopelessness, an empirically validated measurement scale was needed. Thus, the Beck Hopelessness Scale (BHS; Beck et al., 1974) was developed to assess feelings of hopelessness. Up until that point, several studies had attempted to create measures that evaluated attitudes about the future (Beck et al., 1974). However, those measures were not designed to specifically target the construct of hopelessness

that was being cited in psychological conditions (Beck et al, 1974). To aid in the construction of the scale, some items were selected from a test on attitudes about the future (Heimberg, 1961) and other items were taken from pessimistic statements made by psychiatric inpatients who were identified, by clinicians, as feeling hopeless (Beck et al, 1974). The original factor analysis revealed three factors best explained the measure, represented affective, motivational, and cognitive aspects of hopelessness (Beck et al., 1974). More precisely, the first factor represented affective states such as hope and enthusiasm, the second factor represented feelings about the future, and the third factor represented a loss of motivation (Beck et al., 1974). However, more contemporary psychometric studies have suggested that a one-factor solution for the BHS may be more appropriate (Aish & Wasserman, 2001).

The development of the hopelessness scale was a necessary step towards formally defining and measuring hopelessness in psychological research. Through the use of this measure, studies were able to demonstrate the role of hopelessness in the relationship between depression and suicidal intent (Beck et al., 1975). In the original validation studies, the BHS was shown to identify those at risk for dying by suicide, with higher scores indicating a higher potential for suicide (Beck et al., 1985; Beck et al., 1990). However, a later review and meta-analysis of the performance of the BHS found that the BHS's capacity to identify suicide potential was much less than that of the earlier studies by Beck and colleagues (McMillan et al., 2007). In spite of this, the meta-analysis showed that BHS scores of nine or higher are indicative of increased suicide risk (McMillan et al., 2007).

Contemporary theories of suicide continue to recognize the importance of hopelessness within suicide frameworks, including the ITS (Van Orden et al., 2010) and the Three-Step Theory of Suicide (Klonsky & May, 2015). However, while hopelessness measured on the BHS

may predict future suicide attempts, the BHS fails to predict who will attempt suicide and who will experience only SI (Acosta et al., 2012; Qiu et al., 2017). Rather, there may be specific types or classifications of hopelessness that more closely related to STBs. For example, hopelessness is considered both a state and a trait; it can be classified as both a short emotional experience (state) and a more stable, enduring feeling (trait) (Burr et al., 2018). Research has shown that state and trait hopelessness are differently associated with SI and attempts (Burr et al., 2018). Additionally, the ITS asserts that active SI arises from the simultaneous presence of TB and PB and a hopelessness about these interpersonal constructs (Van Orden et al., 2010). While some studies support the moderating role of hopelessness within the ITS (Hagan et al., 2015; Talley et al., 2015), other studies show more contradictory findings (Forkman et al., 2021; Roeder & Cole, 2019). It is possible that the inconsistencies can be explained by a facet of hopelessness that is specific to the interpersonal constructs defined within the ITS. Researchers have called for further studies exploring different facets of hopelessness to better understand the constructs' relation to suicide (e.g. Chu et al., 2017).

Interpersonal Hopelessness

Studies investigating the role of hopelessness within the ITS have most commonly relied on the BHS, a self-report measure of general or broad hopelessness (e.g. Hagan et al., 2015; Roeder & Cole, 2019). There has been support for the moderating role of general hopelessness within the ITS, with findings indicating that high levels of hopelessness increase the strength of the relationship between SI, plans, and urges predicted by the interaction term of TBxPB. (Hagan et al., 2015). Additionally, risk for SI was shown to increase when PB and TB were co-occurring with feelings of hopelessness (Talley et al., 2015). However, other studies have concluded that hopelessness does not moderate the relationship between SI and TBxPB (Forkman et al., 2021)

and that when examined concurrently, TB, PB, and hopelessness are not predictive of SI, despite being related to SI separately (Roeder & Cole, 2019). Post-hoc analyses by Roeder and Cole (2019) revealed that the constructs of TB, PB, and hopelessness may all load onto a latent cognitive variable, suggesting that there is a higher order construct predictive of SI. Given these findings, and the inconsistencies found when using a general measure of hopelessness, researchers have called for the creation and testing of measures of hopelessness that are more specific to the constructs outlined in the ITS (Chu et al., 2017).

In line with this aim, Tucker and colleagues (2018) created a measure of hopelessness specific to feelings of TB and PB (i.e., Interpersonal Hopelessness or IH). The Interpersonal Hopelessness Scale (IHS) draws on content from the Interpersonal Needs Questionnaire (Van Orden et al., 2012) developed to measure TB and PB as well as the BHS. Five items on the IHS assess hopelessness about perceptions of burdensomeness, and five items assess hopelessness about feelings of TB (i.e. IH-PB and IH-TB; Tucker et al., 2018). Initial findings have supported the idea that hopelessness specific to these interpersonal constructs is central to the development of suicidal desire that is outlined within the ITS (Tucker et al., 2018).

The initial factor analysis indicated a one-factor solution for the IHS, which suggests that despite TB and PB being distinct constructs, the hopeless cognitions about these interpersonal states may not be readily distinguishable (Tucker et al., 2018). This one factor solution may be reflective of a general feeling of hopelessness related to an individual's ability to connect with and contribute to others (Tucker et al., 2018). However, a more recent study of the IHS includes a larger sample size and expands beyond an exclusively college- student population (Mitchell et al., 2023). The paper by Mitchell et al. (2023) indicates a superior two-factor solution for the IHS. A two-factor solution may instead suggest that hopeless cognitions experienced with TB

and PB are related but distinct, meaning that one may experience hopeless cognitions of being burden on others (IH-PB) and hopeless cognitions of not belonging (IH-TB; Mitchell et al., 2023). The research on IH is limited, and additional studies are warranted to further understand the role of IH in the development of suicidal desire.

Ecological Momentary Assessment/ Variability of Suicide Risk Factors

Outside of the studies by Tucker (2018) and Mitchell (2023), relatively little is known about IH. One area requiring further exploration is the temporal dynamics of IH. Previous research has shown that many common risk factors for SI can vary considerably over the course of the day, including general hopelessness (Kleiman et al., 2017). However, it is unclear whether IH follows similar patterns as general hopelessness.

Studies that measure moment-to moment fluctuations in SI risk factors often use Ecological Momentary Assessment (EMA), a method of assessment that relies on capturing self-reported data in real-world settings in real-time (Schiffman, 2007). The flexibility of EMA allows for the documentation of behavior and experiences over time, with less opportunity for retrospective bias in reporting (Schiffman, 2007). Until recently, suicide research relied heavily on retrospective report measures of STBs (Davidson et al., 2016). These retrospective reports often cover wide periods of time (i.e. “Have you experienced suicidal thoughts in the past year?”); The lack of specificity in these measures can preclude researchers from understanding the everyday nature of STBs (Kleiman & Nock, 2018). Historically, the use of EMA in suicide research was limited due to concerns about participant safety and uncertainty surrounding risk monitoring (Davidson et al., 2016). More recently, suicidologists have recognized the need for precise measurement tools in suicide research and subsequently have developed solutions to these concerns (i.e., safety plans, automatic alerts to call the on-call clinician, ongoing

monitoring of responses, phoning participants daily, etc.) (Davidson et al., 2016), thus allowing for the use of EMA in suicide research.

Until recently, few studies have examined short-term variability in STBs (Davidson et al., 2016). Early EMA studies provided insight into the high variability in moods experienced by individuals with STBs. A study of individuals with borderline personality disorder showed significant mood variability that was impacted by SI (Nisenbaum et al., 2010). Another study, in a sample of individuals at high risk for psychosis, found that the variability of positive and negative affect predicted the frequency of SI, while the variability of negative affect also predicted the severity of SI (Palmier-Claus et al., 2012). Despite these findings, the studies had limitations, one of which was a lack of SI measures at each individual assessment point. Instead, both studies relied on baseline and follow up clinician ratings for SI (Nisenbaum et al., 2010; Palmier-Claus et al., 2012). While these early EMA studies provided insight into the variability of negative mood states in individuals who experiences STBs, understanding the moment-to-moment variability in STBs was lacking.

In one of the first studies to analyze moment to moment changes in STBs, Kleiman et al. (2017) demonstrated the high variability of SI and suicide risk factors such as hopelessness, burdensomeness, and loneliness over the course of a day. One of the most notable aspects of this study was the use of questions assessing suicide desire, intention to die by suicide, and the ability to resist the urge to die by suicide at each time point (Kleiman et al., 2017). This provided a fine-grained view of the fluctuations in suicide cognitions that had been lacking in the previous EMA literature. Additionally, the risk factors of hopelessness, burdensomeness, and loneliness were shown to be correlated with SI, but not prospectively predictive of short-term changes in SI when SI at the previous time point was controlled for (Kleiman et al., 2017). These findings

demonstrate the short-term variability of common suicide risk factors, providing a specificity that was lacking in the research prior to the use of EMA (Kleiman et al., 2017).

In recent years, the use of EMA in suicide research has grown tremendously. In a systematic review of the literature on the use of EMA to study STBs by Sedano-Capdevila et al. (2021), almost 75% of the studies included were conducted within the four years prior to publication. New ways of conducting EMA studies and solutions to problems surrounding safety and efficacy have allowed the use of EMA to be more feasible and accessible to suicide researchers (Sedano-Capdevila et al., 2021). EMA allows for more frequent assessments of individuals within their natural environment and provides numerous data points that give a more nuanced view of the variability of STBs (Davidson et al., 2016). This refinement in research methodology has allowed for further study on numerous risk factors for STBs, including negative affect, sleep disturbances, and hopelessness (Sedano-Capdevila et al., 2021).

Advances in technology have paved the way for future lines of research. EMA can be used in conjunction with passive monitoring of information that is already being collected by smartphones and devices, such as activity monitoring or sleep and wake cycles (Sedano-Capdevila et al., 2021). Additionally, it is possible that EMA allows for the identification of those in need of intervention, referred to as Ecological Momentary Intervention, a similar modality to EMA with therapeutic intent that can be provided “in real time” in response to monitored risk factors (Sedano-Capdevila et al., 2021). While further research is needed to understand the utility and best practices surrounding EMA, it provides a comprehensive and detailed look into the thoughts and behaviors of individuals experiencing SI (Sedano-Capdevila et al., 2021).

Aims and Hypotheses

Chu et al. (2017) outlined the need for further research on individual facets of hopelessness, and how these aspects are related to suicide. Specifically, there is a need for research on hopelessness related to the interpersonal constructs outlined in the ITS. Emerging research has explored IH and its relation to suicide desire (e.g. Tucker et al., 2018; Mitchell et al., 2023), as hypothesized within the ITS (Van Orden et al., 2010). However, it is unclear whether IH is subject to the same moment-to-moment vacillations as general hopelessness, and how these temporal changes relate to SI. EMA provides a suitable platform to explore the moment-to-moment fluctuations in IH and SI. The current study had three primary aims: (1) to determine the variability of IH-TB and IH-PB, (2) to compare the variability of IH-TB and IH-PB to general hopelessness over time, and (3) to test whether IH-PB and IH-TB are better at predicting SI than general hopelessness both concurrently and prospectively.

Given the dynamic nature of hopelessness (Kleiman et al., 2017) and the strong correlations between general hopelessness and IH (Tucker et al., 2018), it was hypothesized that both the TB and PB dimensions of IH will vary considerably over the course of the day. It was also hypothesized that IH-TB and IH-PB would follow similar patterns to general hopelessness. Additionally, based on findings that show increases in SI with increases in general hopelessness (Kleiman et al., 2017) and IH (Tucker et al., 2018), it was hypothesized that higher levels of IH-TB and IH-PB would be associated with higher levels of SI. Lastly, it was hypothesized that IH-TB and IH-PB would better predict SI both concurrently and prospectively than general hopelessness.

Methodology

Procedure

Participants were recruited through SONA, an online participant management tool, at Louisiana State University. Individuals that endorsed past two-week SI on a SONA pre-screening tool (as measured by the Depressive Symptom Index- Suicidality Subscale [DSI-SS; Joiner et al., 2002]), completed at the beginning of each semester, were invited to participate in the study. This selective sampling strategy has been utilized in previous studies (e.g., Moscardini et al., 2023) and provides a study sample that is at a higher risk than the general college student population. Enrollment occurred during three consecutive semesters. Individuals interested in participation met with a research assistant over Zoom, where they were provided detailed information on study procedures and underwent the process of informed consent. After obtaining informed consent, participants were directed to complete baseline measures through an online survey platform (Qualtrics) which included a demographics questionnaire and a measure of historical STBs to better characterize the study sample.

Based on past EMA research related to SI and its risk factors (e.g. Kleiman et al., 2017), and power analyses using the *paramtest* (Hughes, 2017) package in R (R Core Team, 2021), it was determined that the analyses would be adequately powered to detect a moderate effect size with a minimum sample of 30 participants. It was expected that there would be at least 40 unique assessments per person, which equates to a total of k=1200 unique assessments (b=.15, power=.59; b=.2, power=.83; b=.25, power=.93). Evidence suggests higher rates of compliance during smartphone tracking studies when a combination of course credit and monetary compensation is given (Harari et al., 2017). Therefore, participants were compensated up to $35

based on the percentage of survey prompts completed. Additionally, they were awarded up to 6 course credits through the SONA platform.

Baseline Phase

Eligible participants were directed to a university research participation system where they could opt to sign up to participate in the study. Participants met with a graduate research assistant via a video conferencing platform (Zoom) to provide informed consent and were informed of study procedures. After consenting, participants completed a baseline survey through the online survey platform, Qualtrics. Immediately following the completion of the baseline survey, participants downloaded the PIEL EMA application (Jessup et al., 2012) on their smartphones. The PIEL application was used for the creation and distribution of the daily surveys. PIEL is a mobile application designed to gather data from individuals in their everyday lives that allows for survey customization and randomization of survey time prompts (Jessup et al., 2012).

Participants were instructed to open a practice survey, and the research assistant guided the participants on how to use the application to answer daily survey prompts. Participants were informed that their responses would not be monitored throughout the duration of the study. All study participants were provided with local and national mental health resources (e.g., Suicide Prevention Lifeline) should the need for them arise. Participants were also guided through downloading and setting up the Virtual Hope Box mobile application as an additional resource if they experienced suicide-related distress (Moscardini et al., 2023).

EMA Phase

Participants were prompted to respond to brief surveys (34 questions, 3-5 minutes per survey) five times per day for ten days using the PIEL application. Participants received a

notification on their smartphone to complete a survey at a random time during three-hour time blocks (e.g., 9am to 12pm), five times per day between 9am and 11:59pm. Previous suicide-related EMA research has used a comparable number of pseudorandom surveys (e.g., four daily surveys in Kleiman et al., 2017) that varied from two-hour delays (e.g., Stenzel et al., 2020) to four-to-eight-hour delays (e.g., Kleiman et al., 2017). After receiving a survey notification, participants had 60 minutes to begin a survey before it expired. Once a survey was started, participants had up to 30 minutes to complete it. The surveys included questions relating to SI, IH-TB, IH-PB, and general hopelessness. Emails were sent to study participants every other day during the EMA phase with reminders to complete the survey prompts, information on who to contact in the event of a problem, and a reminder of their study completion appointment.

Participants

In total, $N = 52$ participants completed the study. While initial screening was completed at the beginning of each semester, participants could elect to enroll at any point throughout the semester. Therefore, self-reported past two-week SI scores could have changed between the initial screening and study participation. Six participants were omitted from the final analysis for not endorsing SI in the two weeks prior to study participation. An additional three participants were removed for only completing one EMA assessment. The final analyses included $N = 43$ participants. Most participants were White ($N = 27$, 62.79%) and identified as cisgender women ($N = 30$, 69.77%). See Table 1 for complete participant demographics information.

Measures

Demographics

At baseline, participants responded to general questions that asking them to report their sex, age, gender, sexual orientation, race and ethnicity, education level, and income level.

Table 1. Descriptive and demographic data for college student sample (N = 43)

	n(%)	ICC	ICC CI	RMSSD	RMSSD range
Demographics					
Age	*M* = 19.12 (*SD* = 1.29)				
Race/Ethnicity					
% White	27(62.79)				
% Black/African American	9(20.93)				
% Asian/Asian-American	3(6.98)				
% Latino(a)(Latinx)	2(4.65)				
% Biracial	2(14.65)				
Gender					
% Woman	30(69.77)				
% Man	6(13.95)				
% Gender non-conforming	5(11.63)				
% Not listed	2(4.65)				
Sexual Orientation					
% Straight	18(41.86)				
% Gay or Lesbian	3(6.96)				
% Bisexual	13(30.23)				
% Not sure/Not listed	9(20.93)				
DSI-SS Past two weeks					
Total Score	*M*=3.98 (*SD*=1.86)				
SBQR- How often have you thought of killing yourself in the past year?	*M*=4 (*SD*=.98)				
Ambulatory Assessment					
IH-TB	.36(0.32)	.64	.54, .74	.20	.01, .42
IH-PB	.43(0.31)	.53	.43, .65	.24	.01, .41
General Hopelessness	.39(0.31)	.37	.28, .49	.28	.02, .44
SI	.18(0.23)	.44	.34, .56	.19	.01, .44

Note. Some percentages may not equate to 100% because participants could choose more than one option; ICC = Intra-Class Correlation; CI = Confidence Interval; RMSSD = Root Mean Square of Successive Differences; DSI-SS Depressive Symptom Index- Suicide Subscale (range 0-12); IH-TB = Interpersonal Hopelessness - Thwarted Belongingness; IH-PB = Interpersonal Hopelessness - Perceived Burdensomeness; SI = Suicidal Ideation

Interpersonal Hopelessness about Thwarted Belongingness and Perceived Burdensomeness

Self-reported IH-TB and IH-PB were measured during the EMA phase using two questions from the Interpersonal Hopelessness Scale (IHS; Tucker et al., 2018), a questionnaire designed to assess hopelessness specific to the constructs of TB and PB outlined within the ITS. The subscales of the IHS have demonstrated excellent internal consistency (Mitchell et al., 2023), and item content was derived from the Interpersonal Needs Questionnaire (i.e., an assessment of TB and PB; Van Orden et al., 2012) and the Beck Hopelessness Scale (BHS: Beck et al., 1974), both of which have been previously validated. A question from the IH-TB subscale of the IHS, "I expect that people will never care about me," was used to measure IH-TB in the current study, and a question from the IH-PB subscale of the IHS, "I believe I will always fail the people in my life," was used to measure IH-PB (Tucker et al., 2018). The decision to use these items instead of others on the subscale was based on construct representativeness and factor loading strength from the finding demonstrated in Mitchell et al. (2023). Participants responded to statements using a continuous visual analogue slider scale that recorded responses up to two decimal places with anchors of zero *(not at all)* and one *(completely)* at each time point throughout the study.

General Hopelessness

The Beck Hopelessness Scale (BHS; Beck et al., 1974) is a 20-item questionnaire used to measure how hopeless an individual feels about the future. The question "How hopeless do you feel right now?", derived from the BHS, was asked at each time point during the EMA phase, and participants responded to statements using the previously described visual analogue slider scale.

Suicidal Ideation

At each daily prompts during the EMA phase, participants were asked "How intense is your desire to kill yourself right now?" to assess active suicide desire (Kleiman et al., 2017). Participants responded to statements using the previously described slider scale.

Debriefing

Following the 10-day EMA assessment period, all study participants met with a research assistant via Zoom to transfer their data from their cellphones to the researchers via email and arrange for compensation. Participants were encouraged to ask questions or raise concerns about study procedures.

Analytical Strategy

All analyses were conducted in R (R Core Team, 2021) using the RStudio development environment (RStudio Team, 2022). All data analysis code is available at https://osf.io/pwamg/?view_only=a2e3c9529e734798baf08962a6eb96a5. Descriptive statistics were conducted to determine means, standard deviations, range, and skew for variables of interest. Repeated measures correlation was conducted using the rmcorr package (Bakdash & Marusich, 2022) to determine the strength of relations among study variables. Repeated measures correlation takes the non-independence among observations into account without first averaging the data (Bakdash & Marusich, 2017). The analysis results in a examined using correlation coefficient, *r,* that ranges from -1 to 1, where -1 represents a perfect negative correlation and 1 represents a perfect positive correlation. Consistent with previous EMA studies examining SI and risk factors for SI cross-sectionally and longitudinally (e.g., Kleiman et al., 2017; Stenzel et al., 2020), intraclass correlations (ICCs), root mean square of successive differences (RMSSD), and multilevel modeling were used to analyze the data.

The first aim of the study was to investigate the temporal stability of IH-TB, IH-PB, and general hopelessness. To quantify the variability in the measure that can be attributed to between-person variability, ICCs were calculated from intercept only models (e.g., a multilevel model with no predictor variables). Since ICC is a measure of between-person variability, 1 – ICC provides the proportion of variance that is attributed to within-person variability. An ICC value closer to one indicates higher similarity between persons. Using the ICC package (Wolak et al., 2012), ICCs of SI, general hopelessness, IH-TB, and IH-PB were calculated. Additionally, RMSSD was calculated using the psych package (Revelle, 2022) to show the average variability in the measure over time of SI, general hopelessness, IH-TB, and IH-PB. Larger RMSSD values indicate more variability from one time point to the next, on average. Lastly, to visually depict whether general hopelessness and the facets of IH follow similar patterns of change, the data were graphed using GGplot2 (Wickham, 2016).

The second aim of the study was to conduct the first prospective investigation of IH-TB, IH-PB, and SI using EMA. The relationships between predictor variables (e.g., general hopelessness, IH-TB, IH-PB) and SI were assessed using multilevel models. Multilevel models were conducted to account for the nested structure of the data, such that participants' scores at each EMA assessment occasion (lower-level variables) were nested within person (upper-level variables). Models were analyzed using the nlme package in R and maximum log-likelihood estimation was used (Pinheiro, 2022). For all models, participants were set as a random factor, and all predictor variables were within person-mean centered. Eight models were analyzed to examine the associations between the predictors (IH-TB, IH-PB, IH-TBxIH-PB and general hopelessness) and SI. The first set of models examined concurrent SI. Model 1 examined IH-TB and IH-PB predicting concurrent SI. Model 2 added general hopelessness in as a predictor, with

general hopelessness, IH-TB, and IH-PB predicting concurrent SI. Model 3 examined IH-TB, IH-PB, and IH-TBxIH-PB predicting concurrent SI. Model 4 examined IH-TB, IH-PB, IH-TBxIH-PB, and general hopelessness predicting concurrent SI. Deviance change tests using the difference in -2 Log Likelihood model fit statistics and differences in the number of model parameters were conducted to determine statistically significant change in model fit between models.

The second set of models included lagged analyses between predictor variables at T (e.g., general hopelessness, IH-TB, IH-PB, and IH-TBxIH-PB) predicting SI at time T+1 using multilevel modeling. For time-lagged analyses, the last value of each day was not lagged. SI at T was included in the models to control for autocorrelation with SI at T+1. Model 5 examined IH-TB, IH-PB, and SI at T predicting SI at the next time point (T+1). Model 6 added general hopelessness as a predictor, with general hopelessness, IH-TB, IH-PB, and SI at T predicting SI at T+1. Model 7 examined IH-TB, IH-PB, IH-TBxIH-PB, and SI at T predicting SI at T +1. Model 8 examined general hopelessness, IH-TB, IH-PB, IH-TBxIH-PB and SI at T predicting SI at T+1. Again, deviance change tests using the difference in -2 Log Likelihood were conducted to determined statistically significant change in model fit between models.

Results

Data Cleaning

In total, $N = 52$ participants were recruited for the study. Six participants were removed from the final analysis for not endorsing SI in the two weeks prior to study participation. An additional three participants were removed for only completing one EMA assessment. The final analyses included $N = 43$ participants. The total number of assessments completed did not differ based on participant age ($r(41) = .11$, $p = .48$), gender($r(41) = .095$, $p = .54$), race($r(41) = .035$, $p = .83$), or DSSI total score ($r(41) = -.02$, $p = .89$).

Participant Descriptives

Participants completed an average of 42.88 surveys (range 20-50; out of 50 possible) during the 10-day ambulatory phase, resulting in k = 1,844 completed surveys. Participants reported IH-TB ($M = 0.36$, $SD = 0.32$), IH-PB ($M = 0.43$, $SD = 0.31$), SI ($M = 0.39$, $SD = 0.31$), and General Hopelessness ($M = 0.18$, $SD = 0.23$) over the 10-day EMA phase.

Aims One and Two: Variability of IH-TB, IH-PB, and General Hopelessness

Temporal stability and reliability estimates were calculated using ICCs for predictor variables (see Table 1). Results of repeated measures correlations are shown in Table 2. All study variables exhibited moderate positive relationships (r values range = .31 – .44).

Table 2. Repeated measures correlation matrix of study variables

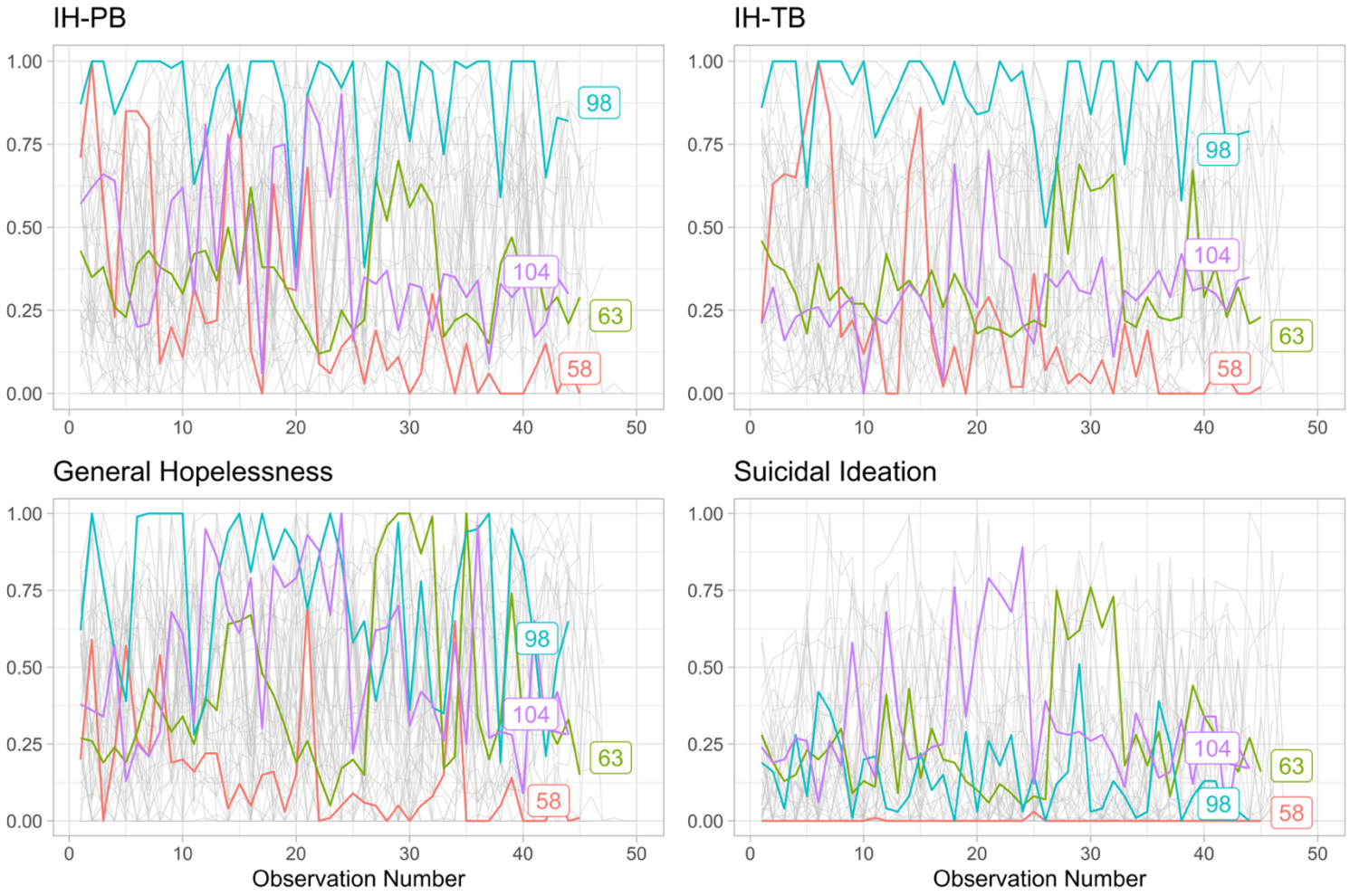
	General Hopelessness	IH-PB	IH-TB
General Hopelessness	-		
IH-PB	.42**	-	
IH-TB	.31**	.40**	-
SI	.44**	.31**	.31**

Note. IH-TB = Interpersonal Hopelessness - Thwarted Belongingness; IH-PB = Interpersonal Hopelessness - Perceived Burdensomeness; SI = Suicidal Ideation

ICCs indicated that 44.94% of the variance in SI, 36.15% of the variance in hopelessness, 53.04% in IH-PB, and 63.85% of the variance in IH-TB is between person, or explained by individual differences, as opposed to within person differences. RMSSD indicated some average variability between timepoints in all variables, with general hopelessness having the highest estimate (0.28). Higher RMSSD values indicate a stronger "saw-tooth" pattern when depicted graphically. Graphical depictions of the variables of interest can be seen in the figure below.

Aim Three: Predictive Validity of IH-TB, IH-PB, and General Hopelessness

Results from the four concurrent multilevel models can be found in Table 3. In model 1, both IH-TB and IH-PB were significant concurrent predictors of SI at baseline with small effect sizes. The deviance -2 Log Likelihood test indicated that model fit was significantly improved with the inclusion of these predictors when compared to the intercept only model ($\chi^2[\Delta df = 2] = 264.60$, $p < .001$). In model 2, IH-TB, IH-PB, and general hopelessness remained significant concurrent predictors of SI with small to medium effect sizes. The deviance -2 Log Likelihood test indicated that model fit was significantly improved with the inclusion of general hopelessness when compared to model 1 ($\chi^2[\Delta df = 1] = 221.29$, $p < .001$). In model 3, IH-TB, IH-PB, and IH-TBxIH-PB were all significant concurrent predictors of SI at baseline with small to medium effect sizes. The deviance -2 Log Likelihood test indicated that model fit was significantly improved with the inclusion IH-TBxIH-PB when compared to model 1 ($\chi^2[\Delta df = 1] = 5.50$, $p = .019$). In model 4, IH-TB, IH-PB, IH-TBxIH-PB, and general hopelessness remained significant concurrent predictors of SI with small to medium effect sizes. The deviance -2 Log Likelihood tests indicated that model fit was significantly improved with the inclusion of all predictors (IH-TB, IH-PB, IH-TBxIH-PB, and general hopelessness) when compared to model 2 ($\chi^2[\Delta df = 1] = 11.33$, $p < .001$) and model 3 ($\chi^2[\Delta df = 1] = 227.12$, $p < .001$).



Time series plot of raw individual data. Highlighted subjects were randomly selected; IH-TB = Interpersonal Hopelessness - Thwarted Belongingness; IH-PB = Interpersonal Hopelessness - Perceived Burdensomeness

Table 3. Concurrent prediction models using multilevel regression analyses to test the relation between IH-TB, IH-PB, General Hopelessness, and SI at T

	Model 1				Model 2				Model 3				Model 4			
Fixed Effects	β	*SE*	*CI*	*t*	β	*SE*	*CI*	*t*	β	*SE*	*CI*	*t*	β	*SE*	*CI*	*t*
Intercept	.19	.02	.14, .23	7.81***	.19	.02	.14, .23	7.81***	.18	.02	.14, .23	7.66***	.18	.02	.14, .23	7.62***
IH-TB	.20	.02	.16, .24	9.28***	.15	.02	.11, .19	7.10***	.18	.02	.13, .22	7.80***	.12	.02	.08, .17	5.41***
IH-PB	.18	.02	.14, .21	9.19***	.08	.02	.04, .12	4.04***	.17	.02	.13, .21	8.86***	.07	.02	.03, .11	3.58***
General Hopelessness	--	--	--	--	.25	.02	.22, .28	15.33***	--	--	--	--	.25	.02	.22, .29	3.93***
IH-TBxIH-PB	--	--	--	--	--	--	--	--	.17	.07	.03, .31	2.34*	.23	.07	.10, .36	15.58***
Random Effects																
σ^2	.03				.02				.03				.02			
Intercept (τ_{oo})	.02				.02				.02				.02			
Marginal/ Conditional R^2	.08/ .52				.13/ .58				.08/ .52				.13/ .58			

Note. T = Time; CI = Confidence Interval; IH-TB = Interpersonal Hopelessness - Thwarted Belongingness; IH-PB = Interpersonal Hopelessness - Perceived Burdensomeness; IH-TBxIH-PB = centered Interaction term of IH-TB and IH-PB; SI = Suicidal Ideation; ICC = Intraclass Correlation; *$p < .05$; ** $p < .01$; *** $p < .001$.

The results of the four time-lagged models are shown in Table 4. In model 5, IH-TB and IH-PB were significant predictors of SI at time T+1, with small effect sizes, while controlling for autocorrelation of SI. The deviance -2 Log Likelihood test indicated that model fit was significantly improved with the inclusion of these predictors when compared to the intercept only model ($\chi^2[\Delta df = 3] = 127.30$, $p < .001$). In model 6, IH-TB and general hopelessness, but not IH-PB, were significant predictors of SI at T+1 with small effect sizes. The deviance -2 Log Likelihood test indicated that model fit was significantly improved with the inclusion of these general hopelessness when compared to model 5 ($\chi^2[\Delta df = 1] = 8.06$, $p = .005$). In model 7, IH-TB and IH-PB, but not IH-TBxIH-PB, were significant predictors of SI at T+1 with small effect sizes. The deviance -2 Log Likelihood test indicated that model fit was not significantly improved with the inclusion of IH-TBxIH-PB when compared to model 5 ($\chi^2[\Delta df = 1] = 3.34$, $p = .068$). In model 8, IH-TB and general hopelessness were significant predictors of SI at time T+1 with small effect sizes, while IH-PB and IH-TBxIH-PB were not significant predictors. The deviance -2 Log Likelihood tests indicated that model fit was not significantly improved with the inclusion of all predictors (IH-TB, IH-PB, IH-TBxIH-PB, and general hopelessness) when compared to model 6 ($\chi^2[\Delta df = 1] = 2.59$, $p = .12$). However, the inclusion of all predictors (IH-TB, IH-PB, IH-TBxIH-PB, and general hopelessness) significantly improved model fit compared to model 7 ($\chi^2[\Delta df = 1] = 7.32$, $p = .007$).

Table 4. Prospective prediction models using multilevel regression analyses to test the relationship between IH-TB, IH-PB, General Hopelessness, and SI at T

	Model 5				Model 6				Model 7				Model 8			
Fixed Effects	β	*SE*	*CI*	*t*	β	*SE*	*CI*	*t*	β	*SE*	*CI*	*t*	β	*SE*	*CI*	*t*
Intercept	.15	.02	.11, .18	7.61***	.15	.02	.11, .19	7.60***	.15	.02	.11, .19	7.71***	.15	.02	.11, .19	7.69***
IH-TB	.06	.02	.02, .11	2.78**	.06	.02	.01, .10	2.48*	.08	.02	.03, .13	3.19**	.07	.02	.02, .12	2.85**
IH-PB	.04	.02	.00, .08	2.04*	.03	.02	-.02, .07	1.18	.04	.02	.00, .08	2.14*	.03	.02	-.01, .07	1.30
SI	.21	.02	.16, .26	8.59***	.18	.03	.13, .23	7.05***	.21	.02	.16, .26	8.70***	.19	.03	.13, .24	7.17***
General Hopelessness	--	--	--	--	.06	.02	.02, .09	2.86**	--	--	--	--	.05	.02	.01, .09	2.72**
IH-TBxIH-PB	--	--	--	--	--	--	--	--	-.14	.08	-.29-.01	-1.82	-.12	.08	-.27, .03	-1.61
Random Effects																
σ^2	.03				.03				.03				.03			
Intercept (τ_{oo})	.01				.02				.01				.02			
Marginal/ Conditional R^2	.07/ .39				.07 /.40				.07/ .39				.07/ .40			

Note. T = Time; CI = Confidence Interval; IH-TB = Interpersonal Hopelessness - Thwarted Belongingness; IH-PB = Interpersonal Hopelessness - Perceived Burdensomeness; IH-TBxIH-PB = centered Interaction term of IH-TB and IH-PB; SI = Suicidal Ideation; ICC = Intraclass Correlation; *$p < .05$; ** $p < .01$; *** $p < .001$.

Post- Hoc Analyses

Given significant prospective relationships between predictor variables and SI, post-hoc analyses were conducted to further test the temporal associations between IH-TB, IH-PB, IH-TBxIH-PB and SI. As seen in Table 4, IH-TB and IH-PB, but not IH-TBxIH-PB, at T are predictive of SI at T+1. To further elucidate potential directionality of these results, reverse direction models are needed to determine whether SI causes changes to IH-TB, IH-PB, and general hopelessness. To this end, three additional multi-level models were explored: Model A examines if SI at T predicts IH-TB at T1 while controlling for IH-TB at T, Model B examines if SI at T predicts IH-PB at T1 while controlling for IH-PB at T, and Model C examines if and SI at T predicts IH-TBxIH-PB at T1 while controlling for IH-TBxIH-PB at T.

Results of the post-hoc analyses can be seen in Table 5. For each model, SI at T was not a significant predictor of IH-TB, IH-PB, or IH-TBxIH-PB at T+1. These findings align with the hypotheses outlined in the ITS, suggesting that the simultaneous presence of hopelessness regarding PB and TB is a proximal cause of suicidal desire. These findings, in combination with the significant prospective models presented earlier, suggest a linear relationship amongst the variables; when IH-TB and IH-PB increase, future risk for SI increases.

Table 5. Post-hoc prediction models using multilevel regression analyses to test the relation between SI, IH-TB, IH-PB, and IH-TBxIH-PB at T + 1

	Model A IH-TB at T1				Model B IH-PB at T1				Model C IH-TBxIH-PB at T1			
Fixed Effects	β	*SE*	*CI*	*t*	β	*SE*	*CI*	*t*	β	*SE*	*CI*	*t*
Intercept	0	.01	-.01, .01	-.46	0	.01	-.01, .01	-.08	.01	0	.01, .02	5.15***
IH-TB	.30	.02	.26, .35	13.02***	--	--	--	--	--	--	--	--
IH-PB	--	--	--	--	.27	.02	.23, .32	11.66***	--	--	--	--
SI	.02	.02	-.02, .05	.85	0	.02	-.04, .04	.10	0	.01	-.01, .02	.37
IH-TBxIH-PB	--	--	--	--	--	--	--	--	.21	.02	.17-.26	9.04***
Random Effects												
σ^2	.03				.04							
Intercept (τ_{oo})	0				0							
Marginal/ Conditional R^2	.09/ .09				.08 /.8							

Note. T1 = Time 1; CI = Confidence Interval; IH-TB = Interpersonal Hopelessness - Thwarted Belongingness; IH-PB = Interpersonal Hopelessness - Perceived Burdensomeness; IH-TBxIH-PB = centered Interaction term of IH-TB and IH-PB; SI = Suicidal Ideation; ICC = Intraclass Correlation; *$p < .05$; ** $p < .01$; *** $p < .001$.

Discussion

The ITS theorizes that for passive SI (e.g., "I want to die") to transition to suicidal desire (e.g., "I want to kill myself"), there is a simultaneous presence of TB and PB, *as well as* hopelessness about the tractability of these states (Van Orden et al., 2010). The IHS measures hopelessness specific to the interpersonal constructs of TB and PB (Tucker et al., 2018), and recent findings support a two-factor solution (IH-TB and IH-PB; Mitchell et al., 2023). The current study is the first to explore the daily experiences of these constructs amongst individuals prescreened for past-two-week SI using EMA.

Consistent with the first hypothesis, findings indicate that IH-TB, IH-PB, and general hopelessness all dynamically varied over the course of the day as evidenced by the RMSSD values (IH-TB= 0.20, IH-PB = 0.24, General Hopelessness = 0.28) and graphical depictions of the raw data. These findings are consistent with previous research that has found considerable short-term variability in SI and SI risk factors (Kleiman et al., 2017; Hallensleben et al., 2019). Regarding the second hypothesis, IH-TB and IH-PB exhibited visually greater between-person variation than general hopelessness when examining the ICCs (IH-TB = 0.64, IH-PB = 0.53, general hopelessness = 0.36). The RMSSD values suggest that general hopelessness was more variable between timepoints than IH-TB, IH-PB, and SI (IH-TB= 0.20, IH-PB = 0.24, SI = 0.19, Hopelessness = 0.28). Phenomenologically, this could point to the relative stability of interpersonal variants of hopelessness when compared to broad, general conceptions of hopelessness. These analyses suggest that general hopelessness may be more variable from one timepoint to the next than hopeless perceptions of burdensomeness or hopelessness regarding one's belonging.

Connecting the temporal dynamics of these constructs to what is seen in the existing literature is obscured by differences in study design and sample characteristics. When compared to Kleiman et al.'s (2017) investigations of adults recently treated for suicidal thoughts and behaviors (STBs), general hopelessness and SI in the current investigation exhibited more within person variance (SI ICC = 0.45, general hopelessness ICC = 0.36). For reference, in the study by Kleiman et al. (2017), SI had ICCs ranging from 0.53 to 0.67, while general hopelessness had ICCs ranging from 0.57 to 0.66. These differences could be the result of the inclusion of more clinically severe samples by Kleiman et al. (2017). Those who participated in the Kleiman et al. (2017) study were individuals who had previously attempted suicide and psychiatric inpatients experiencing SI, while the current study utilized college students prescreened for past-two-week SI. Additionally, the study by Kleiman et al. (2017) had longer time periods between assessments (4 to 8 hours versus 3 to 6 hours in the current study). Given evidence that changes in SI occur rapidly (Coppersmith et al., 2022a), it could be that the additional assessments in the current investigation allowed for the identification of important fluctuations in these constructs.

While no investigations to date have explored the temporal dynamics of IH-TB or IH-PB, the study by Kleiman et al. (2017) measured TB and PB using one word affect labels ("loneliness" and "burdensomeness"). If we compare these constructs to those measured in the current study, IH-TB ("loneliness"; ICC = 0.64) had less within-person variation than "loneliness" (ICC's range from 0.41-0.61), while IH-PB ("burdensomeness"; ICC = 0.53) had more within person variability than "burdensomeness" (ICC = 0.58). While not directly comparable, there are similar patterns exhibited between the constructs across studies.

Beyond the temporal dynamics of these aspects of hopelessness, the current study investigated their cross-sectional and prospective relationships with SI. When examined

concurrently and prospectively, the main effects of IH-TB and IH-PB predicted SI at T and T +1 (with SI at the previous time point considered) when not adjusting for general hopelessness. These findings are in line with the hypothesis outlined in the ITS, that the simultaneous presence of PB and TB is a potentially proximal cause of active SI (Van Orden et al., 2010). Within the current study, the SI item used is specific to suicidal desire ("How intense is your desire to kill yourself right now?"), which further supports the theory outlined by Van Orden et al. (2010) that IH is related to suicidal desire, not simply passive thoughts of death. Additionally, whether adjusting for general hopelessness or not, the interaction of IH-TBxIH-PB predicted SI concurrently, but not prospectively while considering SI at the previous timepoint. This could be explained by the relatively short duration of suicidal crises (Deisenhammer et al., 2009) in addition to the dynamic fluctuation seen in risk factors for suicide (e.g., Kleiman et al., 2017). However, it may be that when considering SI at the next time point, the interaction of IH-TBxIH-PB is not prospectively related to SI above and beyond main effects. Additionally, as noted by Mitchell et al. (2020), the hypothesis outlined by Van Orden et al. (2010) may be more accurately tested by examining the additive effects of TB and PB, instead of the interactions. Specifically, the wording of the hypothesis outlined by Van Orden et al., (2010) does not point to an interaction between the constructs, instead stating, "The simultaneous presence of thwarted belongingness and perceived burdensomeness, when perceived as stable and unchanging (i.e., hopelessness regarding these states), is a proximal and sufficient cause of active suicidal desire" (p. 589). In the current study, it could be that IH-TB and IH-PB are not synergistically related, but instead additive when adjusting for SI at previous time points.

Inconsistent with our hypothesis that IH-TB and IH-PB would better predict SI both concurrently and prospectively than general hopelessness, IH-TB and IH-PB were not stronger

unique predictors of SI than general hopelessness. In the concurrent model (Table 3, model 2), general hopelessness (β = .25) has a higher estimate and non-overlapping confidence intervals with IH-TB (β = .15) and IH-PB (β = .08). Although IH-TB and IH-PB were both concurrently and prospectively related to SI when excluding general hopelessness from the model (models 1 and 5), only IH-TB was prospectively related to SI at T + 1 when general hopelessness and SI at T were considered (model 6).

The fact that the main effect of IH-PB was no longer significant in model 6 appears related to the addition of general hopelessness. It is possible that IH-PB is no longer significant due to the stronger correlation between general hopelessness and IH-PB (r = .42) when compared to the correlation between general hopelessness and IH-TB (r = .31), reducing the unique association between IH-PB and SI when also adjusting for previous SI. The fact that IH-PB was no longer a significant predictor of prospective SI appears contrary to existing literature. In a systematic review of the literature on the ITS, Ma et al. (2016) found that the effect of PB on SI was the most empirically supported relationship within the literature when compared to TB and other variables of the ITS. Over three-quarters of the studies examined in the literature review yielded significant main effects of PB on SI across various settings, while TB was tested less frequently and yielded insignificant results in over half of the studies examined (Ma et al., 2016). One possible explanation for the findings in the current study could be that the studies included in the Ma et al. (2016) review did not focus on hopelessness or IH, thus providing only partial tests of the ITS hypotheses. An additional explanation for our findings is a possible effect of gender. Donker et al. (2014) found that while PB was associated with increased SI in both men and women, TB was associated with increases in SI in women only. The sample in the current study identified as mostly cisgender women (N = 30, 69.77%), which could explain why

IH-TB remained significant in the model, while IH-PB did not. However, we would be under powered to test gender effects given our sample size, leaving this postulation to be tested in future studies. Finally, it is possible that hopelessness regarding PB may not be as strong of a predictor of SI as PB on its own.

Our hypothesis that the interaction of IH-TBxIH-PB would concurrently and prospectively predict SI above and beyond the main effect of general hopelessness was also not supported. While the estimate of IH-TBxIH-PB ($\beta = .23$) is similar to that of general hopelessness ($\beta = .25$) in the concurrent models, general hopelessness has a narrower confidence interval, suggesting more stability than the interaction of IH-TBxIH-PB. Additionally, model fit improved in all models in which general hopelessness was added, whereas IH-TBxIH-PB was not significant in any of the prospective models and therefore model fit was not improved with the addition of IH-TBxIH-PB. As mentioned previously, it is possible that the interaction of IH-TBxIH-PB is not associated with SI above and beyond main effects. Additionally, as pointed out by Mitchell et al. (2020), the hypothesis outlined by Van Orden et al. (2010) indicates that these constructs may be additive in nature and therefore are not accurately tested through an interaction term. Overall, SI at T was the strongest predictor of SI at T +1, consistent with past research (e.g., Kleiman et al., 2017).

Finally, post-hoc analyses were conducted to determine whether the findings exist in the opposite direction to further speculate on temporal relationships between study variables. Specifically, three models were created to examine whether SI at T predicts changes in IH-TB, IH-PB, or IH-TBxIH-PB at T +1 while controlling for these constructs at T. These reverse-direction models (Table 5) were not significant, meaning that SI at T did not predict IH-TB, IH-PB, or IH-TBxIH-PB at T+1. This aligns with the hypothesis outlined in the ITS that states

"thwarted belongingness and perceived burdensomeness ... [are] a proximal and sufficient cause of active suicidal desire" (Van Orden et al., 2010, p. 589). Thus, the ITS does not posit that the experience of SI subsequently increases IH-TB and/or IH-PB, and current results appear to support not adapting the model to do so. These findings suggest that the relationship between the constructs is linear in nature; when IH-TB and IH-PB increase, risk for active suicidal desire increases at future timepoints.

Limitations & Future Directions

The results of the current study should be interpreted considering the methodological limitations. First, while the study sample was rather diverse regarding race/ethnicity and sexual orientation, this was a relatively small undergraduate sample that primarily consisted of cisgender young adult women. Future studies should replicate these results in more diverse samples to determine the broader generalizability of these findings. Similarly, the current study did not collect information on participants' cultures and geographic backgrounds or measures of socioeconomic status, which limits the generalizability of the findings to individuals of more diverse backgrounds. The sample was comprised exclusively of undergraduate students with a recent history of SI. Therefore, results may not generalize to clinical populations (e.g., psychiatric inpatients, treatment-seeking versus non-treatment-seeking adults, etc.). Additionally, it is unclear how the constructs of general hopelessness, IH-TB, and IH-PB function in individuals without SI as all participants at baseline indicated past-two-week SI. Future research could benefit from measuring these constructs in individuals without a recent history of SI as many psychological theories of suicide, including ITS, delineate how SI develops and how it intensifies (Van Orden et al., 2010; Klonsky & May, 2015).

While EMA allows for the examination of temporal fluctuations in these constructs, it is possible that a more nuanced investigation is required to fully capture the fluctuations of these constructs. It could be that the time delay between surveys (about 3 hours) missed important fluctuations in the constructs of interest. For example, a study by Coppersmith et al. (2022a) showed substantial variation in participant's suicidal desire in timescales as short as 45 minutes. Additionally, it is worth noting that the IH-TB and IH-PB items lacked a temporal descriptor (e.g. "I believe I will always fail the people in my life" and "I expect that people will never care about me"), while the general hopelessness and SI items included the descriptor "right now" (e.g. "How hopeless do you feel right now?" and, "How intense is your desire to kill yourself right now?"). It is possible that the lack of temporal description in the item itself caused participants to rate their general levels of IH-TB and IH-PB instead of their in-the-moment levels. Finally, a bi-polar visual-analogue slider scale was used in the current study, meaning that any responses provided between the two anchors is somewhat ill-defined and can only be interpreted in reference to their general relation to the poles. Future research could benefit from utilizing Likert-style responses.

Lastly, a final limitation of this study is the use of single-items to measure constructs. While single items are used in EMA to save time and eliminate participant burden, they may not adequately assess the construct at hand. In a study exploring responses to multiple single-item questions of suicidal ideation, Ammerman et al. (2022) found inconsistencies in responses across various items attempting to assess the same construct. Four items were used to assess active suicidal ideation, but items using the word 'serious' to describe thoughts of suicide were less likely to be endorsed by participants (Ammerman et al., 2022). On the other hand, other studies on the use of single-item constructs in EMA research have shown that single items are able to

demonstrate adequate concurrent and predictive validity when compared to their multi-item counterparts (Song et al., 2022). Future studies should consider comparing single-items to multi-item measures of suicide-related constructs.

Implications

The findings of the current study have several implications for both theory and clinical practice. The results support the construct of IH being distinctly different from general hopelessness and noticeably different in its relationship to SI. IH-TB and IH-PB are more stable over time than general hopelessness and may more directly relate to the suicidal desire outlined in the ITS (Van Orden et al., 2010). These results support important hypotheses regarding the content of hopeless cognitions outlined by the ITS and support temporal hypotheses proposed in the Fluid Vulnerability Theory (FVT; Rudd et al., 2006). FVT hypothesizes that suicide risk has stable and highly variable elements. Although the theory proposes few specific factors within each aspect of risk, the theory denotes the need to understand both acute and stable processes regardless of what risk factor is being considered. In relationship to the current set of results, FVT is supported as even general versus interpersonal-specific conceptions of hopelessness demonstrate differential stability in and of themselves and how they relate to SI.

Additionally, these results support the cognitive model of suicidal behavior proposed by Wenzel and Beck (2008). The cognitive model suggests three main constructs underlying suicidal behavior: dispositional vulnerability factors, cognitive processes associated with psychiatric disturbance, and cognitive processes associated with suicidal acts. The model denotes at least two different types of schemas that activate a suicide crisis—trait (or chronic) hopelessness and perceptions of unbearability. Once a suicide schema is activated, it is possible for state hopelessness (i.e. the degree of hopelessness that one experiences in any given moment)

to emerge. They propose that suicidal ideation arises from the combination of state hopelessness and biased processing of suicide-related cues (Wenzel & Beck, 2008). The current study supports another possible suicide schema—interpersonal hopelessness. While trait hopelessness refers to the degree to which an individual has expectancies about the future that are negative and stable over time, IH represents the degree to which an individual feels they do not belong or are a burden on others. In turn, this could lead to state hopelessness and the potential for suicidal thoughts and behaviors to emerge.

The current findings have implications for clinical practice as well. While general hopelessness is an important and beneficial target in many therapies for individuals experiencing SI (e.g., CAMS; Jobes, 2016, BCBT; Bryan & Rudd 2018), the results of the current study show that interventions aimed at decreasing one's hopelessness specific to TB and PB may be beneficial for decreasing subsequent risk for SI. No research to date has investigated whether targeting broad conceptualizations of hopelessness is sufficient in reducing IH-TB and IH-PB. It could be that even though interpersonal hopelessness appears to be particularly important in the maintenance of SI, the construct may not be sufficiently targeted using conventional methods.

Existing interventions targeting interpersonal problems may be one way of decreasing IH. For example, Interpersonal Psychotherapy is a structured therapy for depression in which the therapist spends time examining the patient's interpersonal relationships and determining a course of treatment based upon one of four identified problem areas: complicated bereavement, role dispute, role transition, or interpersonal deficits (Klerman & Weissman, 1994; Markowitz & Weissman, 2004). The therapist uses specific strategies depending on which of the four problem areas is identified as the focus of treatment. The therapist assists the patient in setting goals for their interpersonal relationships, helps them identify and target problematic interpersonal

interactions, and reinforces healthy interpersonal skills (Markowitz & Weissman, 2004). By addressing interpersonal issues, it is possible that hopelessness related to TB and PB may resolve, thus decreasing risk for SI.

Another possible treatment to target IH could be an adaptation of the LEAP intervention, a web-delivered intervention targeting perceptions of burdensomeness (Hill & Pettit, 2019). The intervention includes two modules spaced one week apart and operates in four phases: learn, explore, assess your options, and plan. Drawing on cognitive behavioral therapy practices, the intervention teaches individuals about the processes behind thoughts and emotions and how to modify them. The modules encourage individuals to identify a specific person they feel they have burdened, has them challenge unhelpful cognitions, and asks them to identify activities they can perform to help reduce their burden on the previously identified individual (Hill & Pettit, 2019). While the intervention is geared towards adolescent populations, modifications could be made to help alleviate perceptions of burdensomeness in adult populations, further reducing the likelihood of developing SI.

Finally, one final implication of the current research is combining the measurement of IH constructs with Just-In-Time Adaptive Interventions (JITAIs). It is possible that fluctuations in IH-TB and IH-PB could be monitored and paired with JITAIs to decrease SI. JITAIs are interventions designed to adapt and provide support based on an individual's specific needs in the moment (Coppersmith et al., 2022b). When paired with real-time monitoring data, JITAIs are designed to deploy an intervention during the precise moment it is needed (Coppersmith et al., 2022b). Given the dynamic nature of risk factors for suicide, JITAIs may be a useful way of increasing access to care and providing interventions when people are experiencing heightened hopelessness specific to TB and PB.

Conclusions

The interpersonal constructs of IH-TB and IH-PB represent important risk factors within the ITS, as well as potential targets for intervention. It is important to understand individuals' day-to-day experiences with SI and SI risk factors to better inform theory and improve interventions and treatments (Kleiman et al., 2017). Results were consistent with previous research regarding other suicide risk factor variability (e.g., loneliness) in that IH-TB, IH-PB, general hopelessness, and SI were highly variable over the course of the day. These results suggest that while the fluctuations in IH-TB and IH-PB are similar to general hopelessness, they may be slightly more stable over time. Additionally, results suggest that the main effects of IH-TB, IH-PB, and the interaction of IH-TBxIH-PB are significant predictors of SI concurrently (regardless of whether adjusting for general hopelessness), although not as predictive as general hopelessness. When examined prospectively, the main effects IH-TB and IH-PB, though not the interaction of IH-TBxIH-PB, are predictive of SI. However, when including general hopelessness in the model the main effect of IH-PB is no longer significant. Future research would benefit by replicating these results in larger and more diverse samples and should consider the use of shorter ambulatory assessment intervals (Coppersmith et al., 2022a).

Appendix. Institutional Review Board Approval

LSU | Office of Research & Economic Development

TO:	Raymond Tucker LSUAM | Col of HSS | Psychology
FROM:	Alex Cohen Chairman, Institutional Review Board
DATE:	19-Jan-2022
RE:	4331
TITLE:	Dynamic associations of state mindfulness and suicide desire using Ecological Momentary Assessment
New Protocol/Modification/Continuation:	Continuation
Review Type:	Expedited Review
Risk Factor:	Minimal
Review Date:	19-Jan-2022
Status:	Approved
Approval Date:	19-Jan-2022
Approval Expiration Date:	18-Jan-2023
Re-review frequency:	(annual unless otherwise stated)
Number of subjects approved:	35
LSU Proposal Number:	AM210238
By:	Alex Cohen, Chairman

Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.

7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc.**

** All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/research*

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Vita

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