

12-13-2019

Problem solving and suicide: A first look

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Problem solving and suicide: A first look

By

Caitlin E. Titus

A Thesis
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Master of Science
in Psychology
in the Department of Psychology

Mississippi State, Mississippi

December 2019

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2019

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Title of Study: Problem solving and suicide: A first look

Pages in Study: 60

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Suicide is the 10th leading cause of death in the United States, with rates increasing over the past several decades. This study examined whether problem-solving performance differs in those with no suicide ideation or attempts compared to those with only suicide ideation and with those with a history of attempts. Results demonstrated that when accounting for depression, problem-solving accuracy was positively predictive for the suicidal ideation group. Furthermore, the suicidal ideation group solved more problems on average than both those with no history of suicidal thoughts and behaviors and the suicide attempt group. The current study was somewhat underpowered and therefore should be interpreted with caution. Additionally, this is the first study to use the problem-solving task when investigating suicide and the first to use the task in an online manner. The findings suggest some meaningful differences that will lay the groundwork for future investigations.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the Department of Psychology at Mississippi State University, especially Drs. Andrew F. Jarosz, Michael R. Nadorff and E. Samuel Winer for their mentorship, guidance, and expertise, which helped bring this study to life.

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CHAPTER I

INTRODUCTION

Suicide was responsible for 47,173 deaths per year in 2017 equating to 129.2 deaths by suicide per day, making suicide the 10th leading cause of death in the United States (Drapeau & McIntosh, 2018). Current research suggests that for each death by suicide, 147 people are exposed, resulting in 6.6 million people annually who are at greater at risk for developing depression, anxiety, suicidal thoughts and behaviors (Cerel, McIntosh Neimeyer, Maple, & Marshall, 2014; Cerel et al., 2015). Additionally, current trends indicate that despite increased treatment, research, and intervention, the rate of suicide has not seen an appreciable decline in decades and has continued to rise over the past 11 years (Curtin, Warner, & Hedegaard, 2016; Kessler, Berglund, Borges, Nock, & Wang, 2005).

A recent meta-analysis of the last 50 years of studies examining longitudinal risk factors of suicide has demonstrated that, as a field, our ability to predict suicide has not seen marked improvements despite advances in the literature (Franklin et al., 2017). More specifically, the meta-analysis examined longitudinal risk factors as predictors of suicide and found that research over the past 50 years has been unable to predict suicidal thoughts and behaviors at a rate that is significantly greater than chance. This study also indicated that much of the research conducted adds to an already long list of nonspecific risk factors with the intent to better predict suicidal thoughts and behaviors. Moreover, 70-79% of the risk factors examined in this study fell into 5 broad risk factor categories, indicating a need to investigate novel risk factors that may help to

explain suicide risk above and beyond these five major categories (Franklin et al., 2017).

Although the nonspecific risk factors and more proximal warning signs are generally helpful, they have not led to prevention or intervention methods that have reduced suicide rates. Further, results from Franklin et al. (2017) indicate that although the number of studies and effects sizes have increased over time, the actual predictive ability across time has not. Additionally, due to the limited range of effect sizes within the literature, it appears that the poor predictive ability seen in the existing literature is likely not due to a moderating psychological or methodological factor (Franklin et al., 2017).

The results of the meta-analysis done by Franklin and colleagues (2017) combined with the current trends in suicide indicate that the status quo is not sufficient in addressing this epidemic. Novel risk factors were encouraged to be directly studied to better narrow the scope and predictability of risk factors overall (Franklin et al., 2017). Given the tragic nature and increasing rate of suicide, continued research examining intervention and prevention strategies are necessary for combating this public health crisis.

Problem-solving is an area within suicide research that has primarily been examined in interpersonal problem-solving theory and social problem solving (D'Zurilla, Nezu, & Maydeu-Olivares, 2004; Linehan, Camper, Chiles, Strosahl, & Shearin, 1987). The current study examined a novel paradigm exploring problem solving, using the Remote Associates Test to determine whether problem-solving ability (Mednick, 1962) can predict history of suicidal thoughts and behaviors.

We predicted there would be differences between the three groups of participants (comparison, suicide ideation, and suicide attempt) in the number of correct solutions generated on the RAT, with the highest number of solutions generated by individuals in the control group,

and the least number of solutions generated by those that have attempted suicide, even when statistically accounting for depressive symptoms. This hypothesis was supported by literature suggesting that the escalation from ideation to attempt is significant and those that attempt are at greatest risk for future attempts, although research is mixed regarding the mechanism behind such a distinct risk escalation (Klonsky & May, 2014; Klonsky, Saffer, & Bryan, 2018)

Definitions

Suicide

Suicide nomenclature has developed over time based on new research and active dialogues within the psychological community (Silverman, Berman, Sanddal, O'Carroll, & Joiner, 2007). Before O'Carroll and colleagues, (1996) there was not a standard nomenclature from which to clearly define suicidal thoughts and behaviors. Most difficult is the assessment of intent based on self-report, clinical judgment, or both; however, using Silverman and colleagues' (2007) revised nomenclature researchers are better able to distinguish and define suicidal thoughts and behaviors. Currently, suicide is defined as a self-initiated action intended to end one's life that results in the death of the individual (Nock et al., 2008; Silverman et al., 2007).

Suicidal ideation

Suicidal ideation is defined as any thought about engaging in behavior to end one's life that can range from brief fleeting thoughts to active planning of a suicide attempt (De Leo et al., 2006; Nock et al., 2008). Ideation is inherently more difficult to measure due to reliance on self-report; however, Nock and colleagues (2008) found that across 17 countries suicide ideation tended to peak in adolescence and young adulthood with an additional peak later in life. More importantly, the risk of transition from ideation to attempt was found to be highest within the first year of

onset and the probability of attempt among those with a plan was 56% compared to those without a plan at 15.4% (Nock et al., 2008).

Suicide attempts

Suicide attempts involve a self-initiated action that is potentially lethal with the intent to end one's life (Silverman et al., 2007). Research has demonstrated that the individual's belief that the attempt could have been fatal is more important than the actual likelihood that the attempt would be fatal in predicting future risk. In other words, if the individual believed the attempt would likely be fatal, taking two Advil is just as meaningful as an attempt using a gun when predicting future suicide risk (De Leo et al., 2006; Nock et al., 2008). That said, individuals with greater suicide intent will typically select more lethal attempt methods, which may be important for predicting the imminent risk of an additional attempt (Brown, Henriques, Sisdjan & Beck, 2004; Haw, Hawton, Houston, & Townsend, 2003). History of a prior suicide attempt is a significant risk factor as research demonstrates that those with intent to die are more likely to eventually die by suicide (Harriss, Hawton, & Zahl, 2005; Nock & Kessler, 2006). Additionally, it is important to make the distinction between suicidal ideation and attempts because research indicates that risk factors for ideation may not be risk factors for an attempt (Klonsky & May, 2014). Predicting risk based on past suicidal thoughts and behaviors is challenging based on the clinical judgment required to assess lethality and intent, though they also rely on self-report. Continued clear operational definitions that include separation of ideation and attempt will be helpful to better understand novel risk factors or algorithms (May & Klonsky 2016; O'Carroll et al., 1996).

Explanatory Models

There are a multitude of explanatory models of suicide in the literature, dating back to 1790 when Charles Moore wrote two volumes of a book titled, *A Full Inquiry Into the Subject of Suicide* and later in 1897, when French sociologist Émile Durkheim (1897) categorized suicide into four categories: egoistic, altruistic, anomic, and fatalistic suicide. Current explanatory models of suicide include, but are not limited to, emotional dysregulation (Linehan, 1993), unmet psychological needs resulting in psychache (Shneidman, 1993), impulsive-aggressive traits (Plutchik, van Praag & Conte, 1989), escape from the self theory (Baumeister, 1990), three-step theory (Klonsky & May, 2015) interpersonal problem-solving deficits (D’Zurilla, Nezu & Maydeu-Olivares, 2004), and interpersonal-psychological theory of suicide (Joiner, 2007).

Suicide rates are commonly higher among individuals with disorders such as Borderline Personality Disorder, where there is commonly emotion dysregulation. Linehan (1993) described emotional dysregulation as the inability to regulate emotions or return to a baseline after experiencing an emotional fluctuation. More specifically, suicidal thoughts and behaviors are a maladaptive coping strategy that appears in response to overwhelming or painful negative emotional experiences (Linehan, 1993). However, research examining the role of emotion dysregulation in suicide risk shows conflicting evidence regarding the mechanism through which emotion dysregulation increases suicide. Rajappa, Gallagher & Miranda (2012) found that emotion dysregulation is related to suicide risk; however, there is a stronger correlation between suicidal ideation rather than attempts, which may increase risk overall. Additionally, in a study conducted with a sample of adolescents in inpatient psychiatric care with a history of suicide ideation or attempt, Zlotnick and colleagues (1997) found that those with a history of suicide

attempts demonstrated significantly higher levels of affect dysregulation and a greater variety of self-injurious behaviors over the past year as compared to those with suicidal ideation. Linehan's approach to understanding suicide explains some portion of suicide risk, especially in those with concurrent psychopathology such as borderline personality disorder, but does not encapsulate other known variables that contribute to suicide risk such as psychological pain, which is a known contributor to suicide risk (Shneidman, 1993).

Shneidman describes suicide as behavior designed to immediately stop psychological pain as a result of unmet psychological needs (Shneidman, 1993). He coined the term "psychache" to emphasize the prominent role of the conscious mind within suicide and the choice to cease one's life as a result of unbearable anguish. In a recent study using a community sample, Campos and colleagues (2017) found that psychache (i.e., mental pain) fully mediated the relation between suicidal ideation and general distress, supporting Shneidman's theory of psychache as a risk factor for suicide. Further, a systematic literature review by Verrocchio and colleagues (2016) found that psychache and mental pain were significant predictors of suicide risk, even in the absence of diagnosed psychopathology. Both Linehan and Shneidman's theories focus on the presence of a negative emotional experience and suicide risk is centered around the inability to regulate emotion in the face of such experience or the psychache itself. Although, it is possible that suicide may be related more broadly to a more general escape from a person's internal experience (Baumeister, 1990).

In contrast to emotion dysregulation or a more conscious choice to end one's psychache, Baumeister posits that suicide is an escape from the self (Baumeister, 1990). More specifically, it emphasizes escape from aversive self-awareness as the primary motivation for suicide, rather than as a maladaptive coping mechanism. Baumeister (1990) uses evidence gathered by Henken

(1976) as direct support of this theory through the analysis of first-person pronoun use in suicide notes and death documents. This study examined suicide notes from three groups of individuals, those that attempted suicide, those facing involuntary death, and a control group. The frequency of first-person pronouns was higher in the notes by individuals that attempted suicide than both the involuntary death group and control group. Baumeister (1990) suggests that this is clear evidence of increased self-awareness and self-focus in individuals that are at risk for suicide and may also open up the idea of personal agency in this process given the increased self-awareness. Further, Baumeister explains that it is not simply negative affect or life experiences that lead to aversive self-awareness but rather the translation of these events into self-attributions. Suicide, according to this theory is associated with increased negative views of the self, perceived failures, and a sense of worthlessness. Baumeister (1990) recognizes that this theory is correlational, not necessarily causal, and does not incorporate other interpretations of suicide that include externalizing variables such as aggression or impulsivity. Moreover, Baumeister (1990) encourages further research as this theory is unable to explain the psychological shifts that might occur from suicide ideation to attempts as well as various factors that may influence lethality of an attempt.

The previous theories are related in that they acknowledge psychological pain, negative affect, and the desire to either cope or escape from those experiences, all of which are more proximal factors related to suicide risk. These theories do not include more distal factors such as biological predispositions or externalizing traits such as impulsivity or aggression (Gvion & Apter, 2011). Multiple studies have shown links between impulsive-aggressive traits and suicide risk, such as finding higher lifetime trait aggression scores in those that attempt suicide (Conner, Duberstein, Seidlitz, & Caine, 2001), impulsiveness as a correlate of suicide risk (Nock et al.,

2008), and the combination of impulsiveness and aggression as a combined factor for suicide risk (Mann & Currier, 2010). However, the challenge using this explanatory model is the use of different definitions for impulsive-aggressive traits such as hostility and violence, as well as difficulties determining whether these factors are predictive in a trait or state capacity (Gvion & Apter, 2011). Moreover, Bagge, Littlefield, Rossellini, and Coffey (2013) found that, although there is overlap between impulsivity assessments, there is little agreement between questionnaire and behavioral measures of impulsivity which therefore may be measuring different psychological processes. Anestis and colleagues (2014) conducted a meta-analysis and found that the planning subscale of Beck's Suicide Intent Scale (SIS) is commonly used when measuring impulsiveness of suicide attempts but the number and selection of items used to measure the same construct vary widely. Additionally, Anestis and colleagues point out that the items on the SIS such as level of isolation of previous attempts, help-seeking during an attempt, or leaving a suicide note are not valid constructs of impulsiveness and therefore do not accurately measure trait impulsivity. Moreover, studies appear to ignore suicide plans as evidence of forethought: in a study by Conner and colleagues (2006), 51% of attempters were considered impulsive even though 58% of the attempters had developed a suicide plan before an attempt. This further highlights the difficulty measuring impulsivity as a construct in relation to suicide risk. Overall, Anestis and colleagues (2014) found that, while there is a connection between impulsivity and suicide, it is small and can be better understood as one of the numerous distal risk factors for suicide rather than a direct relation.

So far, the evidence is clear that there are many factors involved in suicide risk, but none have conceptualized the process through which suicidal ideation becomes a suicide attempt. In the United States in 2016, 9.8 million adults had serious thoughts of committing suicide and 1.3

million adults attempted suicide (Piscopo, Lipari, Cooney, & Glasheen, 2016; SAMHSA, 2017). These numbers indicate that there is a difference between individuals that have suicidal ideation and those that actually make an attempt to die by suicide. The most widely researched and accepted model is the interpersonal-psychological theory of suicide, which posits that the desire for death is due to two factors: thwarted belongingness and perceived burdensomeness. Further, to die by suicide one must also have the ability to enact lethal self-harm, commonly called acquired capability (Joiner, 2007). Joiner's model explains thwarted belongingness as a lack of connection to a group or the loss of previously meaningful relationships. Perceived burdensomeness is defined as the experience or perception of being a burden, or a liability, to a group of people. Additionally, the acquired capability of suicide is explained as the extent to which a person is able to engage in a lethal suicide attempt. In a sample of young adults, the combination of low belongingness and perceived burdensomeness predicted suicidal ideation beyond depression measures, indicating support for these two variables with the purposeful exclusion of previous attempt history (Joiner et al., 2009). In the second study by Joiner and colleagues (2009), a three-way interaction between measures of perceived burdensomeness, thwarted belonging, and lifetime number of suicide attempts, which is considered a measure of acquired capability, predicted suicide attempts when controlling for other psychopathology (Joiner et al., 2009). Another study conducted by Van Orden et al. (2010) supports acquired capability as an independent construct that differentiates individuals with suicidal ideation and those that attempt suicide. However, a more recent study by Smith and colleagues (2012) examining the interpersonal-psychological theory of suicide using a sample of 348 adolescent male twins (116 monozygotic; 58 dizygotic twins) found that the monozygotic twin intraclass correlation between acquired capability and suicide was two times greater than the correlation in

the dizygotic twin sample. Therefore, although research has demonstrated the importance of acquired capability, it may not be acquired but rather explain how genetics may impact suicide behavior (Smith et al., 2012).

Building on Joiner's interpersonal-psychological theory of suicide, Klonsky and May (2014) argue that the progression of ideation to attempt can be conceptualized using the three-step theory within an ideation-to-action framework. More specifically, Klonsky and May (2014) agree with Joiner's theory in that the development of suicide ideation is separate from the process that occurs from ideation to attempt. According to the three-step theory, ideation occurs largely due to the combination of pain, hopelessness, and disrupted connectedness, but in order for a person to attempt suicide, they must acquire the capability, called suicide capacity (Klonsky & May, 2015). Breaking this down further, Klonsky & May (2015) propose three categories of suicide capacity that contribute to suicide risk including dispositional, acquired, and practical. Dispositional capacity refers to genetic variables or more biologically driven factors. Acquired capacity is most like Joiner's conceptualization of acquired capability and refers to habituation of pain, injury, fear, and death. Practical capacity refers to the variables that make suicide a feasible option such as knowledge and access to lethal means. According to Klonsky and May (2015), an individual will only progress from ideation to attempt if there is sufficient suicide capacity. Although early in its development, this theory moves slightly away from the use of one concept to explain all suicidal behavior and attempts to encapsulate genetic factors, learned behaviors, and access to lethal means as part of a larger suicide risk concept of suicide capacity.

These theories of suicide have added a great deal to the way we conceptualize suicide, assess risk, and target interventions designed to prevent suicide, but they have not been able to predict suicidal behavior in ways that have led to a reduction in rates of suicide (Franklin et al.,

2017). Many of the theories discussed include variables that are empirically related to suicide but most attempt to explain all suicide events with one umbrella theory. In a similar vein as Klonsky and May (2015), this study aimed to isolate novel risk factors to better understand suicide risk with the goal of increasing possible clinical and preventative utility of these theories.

Problem Solving

Problem solving is a process by which an individual is confronted with a problem and moves towards selecting a solution to that problem (Novick & Bassock, 2005). Both cognitive and clinical fields of psychology attempt to understand the problem-solving process by focusing on different portions of the process in their own way.

Clinical Approach

The clinical literature focuses on “problem solving” using social problem theory and is defined by D’Zurilla and Nezu (1982) as, “...the self-directed cognitive-behavioral process by which an individual, couple, or group attempts to identify or discover effective solutions for specific problem encountered in everyday living” (p.12). The problem is often defined as any situation or event that requires a solution that is not immediately apparent, and the solution is defined as the situation-specific response or response pattern that is applied to the problem (D’Zurilla & Nezu, 1982). This social problem theory is centered around two main components including problem orientation and problem-solving skills which are considered important aspects of coping, adjustment, and well-being (Maydeu-Olivares, D’Zurilla, 1996).

To examine the social problem-solving theory, D’Zurilla and Nezu (1990) created the social problem-solving inventory (SPSI), which attempts to assess an individual’s strengths and weaknesses in their problem-solving abilities. The original scale is based on D’Zurilla and

Nezu's work (1982) that conceptualizes problem orientation and skills as separate, but related constructs within the problem-solving process. More simply, problem orientation is the "process" measure, whereas problem-solving skills are considered an outcome or behavioral measure, see Table 1.

Problem orientation is considered a metacognitive process that is relatively stable and includes cognitive, affective, and perceptual components and is used to appraise the problem itself, past experiences, beliefs, and the person's perceived abilities to solve the problem. The original inventory measures problem orientation using the cognition subscale (e.g., generalized beliefs, attributions), emotional subscale (e.g., distress vs. calm), and behavior subscale (e.g., approach versus avoidance; D'Zurilla, Nezu, & Maydeu-Olivares, 2004).

The problem-solving skills domain emphasizes the behavioral aspects of problem solving and includes: 1. Problem definition and formulation 2. Generation of alternate solutions 3. Decision making, 4. Solution implementation and verification. These four skills are measured through examples on the inventory that a person rates on a 5-point scale as *not at all true of me* (0) to *extremely true of me* (4) (D'Zurilla & Nezu, 1990). According to Maydeu-Olivares and D'Zurilla (1996), these skills are considered necessary for selecting effective and adaptive solutions to specific real-world problems.

Upon further investigation, Maydeu-Olivares & D'Zurilla (1996) completed a factor-analytic study of the SPSI and found evidence to warrant a revision of the original SPSI based on exploratory and confirmatory factor analyses. The results indicated that the two-factor model (problem-solving orientation and problem-solving skills) was only moderately supported and found a five-factor model was more robust. The five dimensions now used in the SPSI-Revised include the following domains: positive problem orientation (PPO), negative problem orientation

(NPO), rational problem solving (RPO), impulsiveness/carelessness style (ICS), and avoidance style (AS), see Table 2 (D’Zurilla, Chang, Nottingham, & Faccini, 1998; Maydeu-Olivares & D’Zurilla, 1996). These five domains attempt to encapsulate the covert process of problem orientation (challenge vs. threat), and the overt style that individuals use to solve a problem (logical vs. impulsive vs. avoidant).

D’Zurilla and colleagues (1998) conducted three studies examining social problem-solving deficits, hopelessness, depression, and suicide risk using college students and psychiatric inpatients both with and without a history of suicidality. The first study found that in a sample of college students, negative problem orientation, impulsive/careless style, and avoidant style were positively correlated with suicide risk, and positive problem orientation was negatively correlated. In the second study using general admission psychiatric inpatients, only negative problem orientation was correlated with suicide risk. In the third experiment with psychiatric inpatients hospitalized due to serious suicidal ideation, all domains on the SPSI-R were significantly correlated with increased suicide risk. Negative problem orientation was the best predictor in this sample followed by positive problem orientation, avoidance style, and impulsivity/careless style. These results highlight the importance of the metacognitive processes measured by problem orientation as indicated by the significant correlations between negative problem solving and suicide across three different samples in relation to suicide risk; however, they do not isolate the mechanisms involved in negative problem orientation.

Chang (1998) examined cultural differences in social problem solving, perfectionism, and suicide risk between Asian and Caucasian Americans, finding that Asian Americans were significantly higher in negative problem orientation and impulsivity/carelessness style than Caucasian Americans ($p < .004$), but negative problem orientation was significantly correlated

with suicide risk in both groups. Additionally, the correlation between impulsivity/careless style was more strongly associated with negative problem orientation for Asian Americans than Caucasian Americans, suggesting that suicide risk may be related more to impulsive or careless solving behaviors versus negative self-schemas in Asian Americans. This study indicates that there are cultural differences in social problem solving and mixed evidence regarding the mechanisms by which deficits in social problem solving may be related to suicide risk (problem orientation versus solving style).

Empirical evidence suggests a link between suicide risk and problem-solving deficits. More specifically, problem orientation scales (positive and negative) appear to predict suicidal risk more so than problem-solving skills (rational, impulsive/careless, and avoidant) within the SPSI (Chang, 1998; D’Zurilla et al., 1998). The problem orientation scale, as a measure, was designed to measure a person's metacognitive process and perception of everyday problems highlighting the cognitive role of problem-solving as it relates to suicide risk. Much like the explanatory models described previously, the SPSI-R is measuring a larger construct that shows statistical correlations with suicide risk but does not highlight specific variables that can be utilized in prediction models. That is, it measures a person’s general approach to solving problems but does not capture the process or the number of solutions generated by the individual during the interaction with the problem.

The means-end problem-solving procedure (MEPS; Platt, Spivack & Bloom, 1971) is one measure that has been used in clinical research as an outcome-based measure of effective problem solving, as opposed to problem-orientation and approach as described above. The participant receives 10 situations and a stated need or desired outcome for each of the situations and must outline the steps taken to obtain the desired outcome. The steps are then evaluated by

the researchers on multiple dimensions including relevant, irrelevant, or no means, enumerations, and obstacles (Schotte & Clum, 1982; Schotte & Clum, 1987). The few studies that used the MEPS procedure found correlations between ineffective problem-solving skills and depression (Nezu & Ronan, 1988) or suicidal ideation (Schotte & Clum, 1982; Schotte & Clum, 1987) indicating a possible relationship. However, the issue with the MEPS is that it provides the desired solution for the participant rather than requiring the generation of an appropriate solution. As a result, this measure is not representative of the process by which an individual experiencing suicidal ideation may come to choose suicide as an option for the problem they are experiencing.

The theoretical approach used to measure social problem solving in clinical psychology is too broad and aims to capture general approaches used to solve problems rather than understanding the process at a mechanistic level. A more detailed understanding of this process is warranted in order to examine where in the process a person at risk of suicide may be facing difficulty.

Cognitive Approach

Cognitive psychology tends to differ from clinical psychology in that there is less emphasis on research outcomes as they relate to understanding, preventing, and treating psychopathology. As a field, cognitive psychology is also interested in understanding the mechanisms and processes that lead to cognitive outcomes. As a result, problem solving is viewed, more generally, as the process through which a person moves from the current state to the desired state (Newell & Simon, 1972). This shift in perspective allows for a mechanistic understanding of the process through which a person chooses to attempt suicide rather than a broad risk perspective as discussed previously.

Newell and Simon (1972) expanded this process further and created the problem-space theory. Driven by advances in information processing and computer science, this theory suggests that problem solving is best understood as moving through a problem space, which includes a current state, a goal state, and all possible states between (Newell & Simon, 1972; Novick & Bassock, 2005). The problem space consists of movements from one step to the next and the strategies that an individual might use to progress from the initial state to the goal state. Newell and Simon (1972) were particularly interested in discovering common strategies used by individuals moving through the step-by-step process within the problem space across various types of problems. This new focus was in contrast to Gestalt theorists, who primarily focused on problem representation and solution generation. Newell and Simon's (1972) approach to problem solving led to the development of the General Problem Solver (GPS), a computer program designed to parallel human problem solving with heuristics (Ernst & Newell, 1969). Heuristics are generally a set of rules constructed based on practical knowledge that offer guidance in problem solving but are not infallible (Newell, Shaw, & Simon, 1959). The GPS used two main heuristics including the means-ends analysis that aims to identify the differences between the current state and the goal state to generate a solution. The means-end work in the clinical literature (Nezu & Ronan, 1988; Schotte & Clum, 1982; Schotte & Clum, 1987) does get at some heuristics defined in the cognitive literature. However, this work is not capturing information about solution generation within the process (which is important for suicide) and only focuses on a single heuristic (means-end), which is not representative of problem-solving ability in a more general sense nor does it capture the problem restructuring process. The importance of these aspects in the problem-solving process will be discussed in the next paragraph.

Gestalt theorists studying problem solving emphasized the idea of problem representation

and the way that a person understood, interpreted and conceptualized a given problem (Duncker 1945; Novick & Bassock, 2005). They also separated problem solving into two distinct phases including the problem representation and the solution generation process, as opposed to the problem-space. Within the problem representation, there exists perspective; in other words, an individual is able to restructure a problem based on context and prior knowledge in a way that allows for a solution to become obvious (Duncker, 1945). Expertise research by Chi, Feltovich, and Glaser (1981) shows that one's representation of a problem changes based on domain expertise and prior learning experiences and influences the process through which an individual generates different solutions. Further, the step-by-step process through which a person solves a problem can vary by the individual as a result of problem representation, even if the final result is the same (Simon, 1975).

The influence of the Gestalt perspective resulted in a considerable body of work on creative problem solving. Creative or insight problem solving is a process through which an individual relies upon insight or problem restructuring to find a solution after normal, analytic processes (such as Newell and Simon's 1962 algorithms and heuristics) result in being "stuck" for some time (see Figure 1). Insight can be defined as a moment of clarity during which the relation between the problem and solution becomes obvious, or even an "aha!" moment, thought to be caused by a shift in the initial problem representation or the relaxation of self-imposed constraints on the problem (Ohlsson, 1984). Insight problem solving is similar to the Gestalt perspective in recognizing restructuring as an important aspect of the problem-solving process, but also acknowledges the recurring process that occurs between restructuring and solution generation. Insight can also result from activating semantic networks during solution generation, thus cueing a person to the correct answer, or from environmental information such as hints

(Seifert,1995). For example, a person may generate multiple solutions to a problem (via internal brainstorming or external cues) and continue to do so while simultaneously restructuring the problem and evaluating those solutions until a correct solution is found. Thus, the process is cyclical rather than linear, and individuals vary in their ability to successfully engage in different parts of this process, thus varying levels of problem-solving abilities between individuals.

To study creative problem solving, researchers often use insight problems, which are a specific type of problem that characteristically mislead an individual to attempt an obvious, although incorrect, solution based on prior experience (Kershaw & Ohlsson, 2004). Problems that can be solved quite simply may, in fact, end up quite difficult as a result of cognitive interference created by attempting to solve the problem based on past experiences (Kershaw & Ohlsson, 2001). Weisberg and Alba's (1981) research demonstrated that even after a hint, participants attempting the nine-dot problem, a classic insight problem, still experienced difficulty because they had not restructured the problem in a way that they personally connected with that would allow them to use the hint. This study supports the cyclical process that uses both restructuring and solution generation that is required to solve a problem because the individual must interact with the problem in their own way to generate the correct solution. Knoblich, Ohlsson, Haider, and Rhenius (1999) conceptualized insight as a process that includes constraint relaxation and chunk decomposition. They gave people math problems consisting of roman numerals constructed from matchsticks, presenting simple (but incorrect) arithmetic operations, and required the participants to move a single matchstick to make the problem solvable. Problems that required moving a single vertical matchstick (representing a 1) from one place to another were easily solved, while more difficult problems required participants to break up operators (e.g., turning a + into a -) or numerals (turning a V into an X by sliding the

matchstick over). Thus, artificial constraints brought about by the participant (such as not breaking apart an operator) had to be relaxed in order to reach a solution. They also found that difficulty was related to a chunk decomposition which involved breaking down a meaningful unit of the problem in a way that allows for a solution e.g., changing 5 into 2+3 (Knoblich, Ohlsson, Haider, & Rhenius, 1999). This research supports insight as a process that occurs in problem solving and the complexity of mechanisms required to generate solutions for novel problems.

Each cognitive approach to problem-solving attempts to better understand and isolate the mechanisms that are involved in problem solving, whether it be problem representation, solution generation, or problem space. Unlike the clinical approach to problem solving, creative problem-solving theory allows a researcher to measure an individual's ability to generate alternate solutions, restructure a problem, and find a correct solution. This is different from the clinical approach in that clinically driven studies aim to understand the functionality of solutions rather than individual ability and mechanism. Additionally, insight problems do not rely on self-report and metacognition, which allow the researcher to design tasks that better isolate variables within the problem-solving process.

Using a Cognitive Measure in Clinical Research

Both cognitive and clinical approaches to problem-solving often include the entire process between problem state and goal state as "problem-solving" (D'Zurilla & Nezu, 1982; Novick & Bassock, 2005), however, they differ in the way it is measured and interpretation of the outcomes.

The clinical approach to problem solving is aiming to understand possible problem-solving deficits and their relation to mental illness or difficulties in a person's life. The Social

Problem-Solving Inventory measures problem orientation as either positive or negative with implications that it is either constructive or dysfunctional, then problem-solving style is measured and labeled as either rational, careless/impulsive, or avoidant. A global index using the SPSI suggests that those with higher scores have better social problem-solving skills, whereas those with lower scores have problem-solving deficits. Clinical research supports a connection between poor problem-solving and suicide (Chang, 1998; D’Zurilla et al., 1998), but the methods do not support a mechanistic approach required to isolate novel risk factors for suicide.

Cognitive approaches offer methods of measuring problem solving that can better isolate variables in order to understand the underlying cognitive processes. Current literature supports that when an individual is stuck in the problem space that they often rely on restructuring or re-representation to get to the right answer (Novick & Bassock, 2005) as well as the use of insight to solve a problem (Knoblich et al., 1999). Therefore, in general, both cognitive and clinical fields seem to agree that there are approaches to problem-solving that lead to more effective and less effective solutions and that individuals vary in their problem-solving skills. This study aimed to harness the power of problem solving as a mental process using a cognitive measure to better understand creative problem solving in relation to suicide risk, a clinical problem.

Through this cognitive lens, all individuals, both those with suicidal ideation, and past attempts are generating suicide as a potential solution to a problem. Those with ideation, however, have represented the problem in such a way that alternative solution paths are available and thus suicide is not selected. Those who attempt suicide are fixated on a single solution (suicide), and cannot see the alternative paths, thus they attempt suicide. This study aimed to use creative problem solving and insight theory to conceptualize suicidal thoughts and behaviors in order to isolate the specific mechanism of solution generation to inform suicide risk predictions.

Furthermore, this study does not aim to find a causal relationship, rather a mechanistic understanding of the possible processes involved in the transition from suicidal ideation to attempt in contrast with those with no history of suicidal thoughts or behaviors based on problem-solving accuracy scores.

The Remote Associates Test (RAT; Mednick, 1962) was used as a measure of problem solving that appears to parallel the cognitive processes involved in real-life problem solving (e.g., creativity, insight, analytical thinking) and requires the generation of solutions that are not immediately available (Lee, Huggins, & Therriault, 2014; Mednick, 1962). This measure required participants to view three words and generate a fourth word that combines with each of the existing three words to create a compound word or phrase (Bowden & Jung-Beeman, 2003). We hypothesized that **H1**, individuals would differ in problem-solving accuracy based on history of suicidal behavior. Specifically, individuals who have attempted suicide in the past would have increased difficulty generating alternative solutions when completing the RAT, therefore they will generate fewer correct solutions than the comparison. Similarly, it is expected that individuals with a history of suicidal ideation will generate a number of solutions that are greater than those in the suicide attempt group, but fewer than the comparison. Additionally, **H2**, problem-solving ability should be able to differentiate which suicide group an individual belongs in (no history, suicidal ideation, suicide attempt).

CHAPTER II

METHOD

Setting and Sample

This study was conducted using an archival dataset from a convenience sample of 1,000 participants at Mississippi State University that used online data collection (Qualtrics). Based on the low prevalence rates of suicide attempts (SAMSHA, 2016), we estimated that 1,000 participants were needed to increase the likelihood that each group would be appropriately powered for analysis; however, only data from 741 participants were analyzed due to data cleaning and survey completion rates. Students taking undergraduate psychology classes received 1 research credit for their voluntary participation. This study analyzed data from 741 participants between the ages of 18-29, 66% female, 34% male, .2% gender fluid, and .2% no response. Of those individuals, 77% identified as White/Caucasian, 16% Black/African American, 4% mixed or other, 2% Hispanic, and .9% Asian/Pacific Islander (Table 3).

Sample Size and Power

Based on a study that used an undergraduate college sample of 747 participants at a large Southeastern university, we estimated group samples sizes using their reported rates, 64.8% no history of ideation or attempt, 35.2% suicidal ideation, and 4.95% suicide attempt history (Nadorff, Anestis, Nazem, Harris, & Winer, 2013). Additionally, based on research by Jarosz, Colflesh, and Wiley (2012) who used twenty participants in two groups to examine the effect of alcohol intoxication on creative problem solving using the RAT ($d = 1.08$), we estimate that

1,000 participants will allow for enough participants in each group to find a medium effect size. Using Sample Power (V.3), utilizing t-tests for independent samples sizes to account for unequal group sizes, estimating a medium effect size, an analysis comparing ideators and attempts would have .91 power. An analysis comparing attempters with the comparison group would also be appropriately powered at .92. Although we used a t-test for independent samples, this power analysis provides a slightly more conservative number and allows for a more accurate analysis as a result of unequal group size.

Measures

Demographics

The study included the collection of basic demographic information including age, sex, gender, and socio-economic status. Table 3 describes the sample above.

Suicide Behaviors Questionnaire-Revised (SBQ-R)

The Suicide Behaviors Questionnaire-Revised is a validated 4-item questionnaire that measures suicide risk based on past suicidal behavior and ideation (Linehan & Nielsen, 1981; Osman et al., 2001). This measure specifically asks about past attempts, frequency of suicidal ideation, disclosure of suicidal thoughts or behaviors, and the participant's estimate of the likelihood that they will attempt again. This study used item 1 to assign participants to groups: a comparison group (no ideation or attempts), suicidal ideation, and past suicide attempt. According to Osman et al. (2001), using item 1 was considered an accurate and reliable approach to differentiating individuals with ideation and attempt history in both clinical and non-clinical samples ($\alpha = .76$ and $.87$, respectively). Items 2-4 were not used in data analysis.

Remote Associates Test (RAT)

Bowden and Jung-Beeman (2003) developed 144 compound remote associates problems to measure insight problem solving based on the original items in the Remotes Associates Test (Mednick, 1962). Each item consisted of three words that form a two-word pair with one solution word. For example, cottage/swiss/cake/ are all associated with the solution word “cheese” and form different words or phrases when joined. These items have been normed and used to study creative thinking and problem solving (Ansburg, 2000; Bowden & Jung-Beeman, 2003) and performance is reliably correlated with the solution of classic insight problems (Dallob & Dominowski, 1993).

The RAT is considered a reliable measurement of creative problem solving but has also been used to examine the relation between psychopathology and creative performance (Fodor, 1999). Although these items are simpler than classic insight problems, they maintain the elements necessary to determine insight including misdirecting solution processes, participants having difficulty explaining their solution process, and experiencing insight or the “Aha!” moment (Ben-Zur, 1989; Bowden & Jung-Beeman, 2003). These specific compound RAT items were chosen because of the efficiency of time over classic insight problems, the ability to time responses, ease of scoring, and the ability to collect data online (Bowden & Jung-Beeman, 2003). Additionally, based on Bowden and Jung-Beeman’s work (2003), the RAT is designed to be completed as a computer-based task and traditionally employed among young adults, thus the researchers did not expect issues related to the online format of data collection (Lee, Huggins, and Therriault, 2014; Mednick, 1962).

Beck Depression Inventory-II

The Beck Depression Inventory-II (BDI-II) is a 21-item self-report questionnaire developed to assess the severity of depression symptomology (Beck, Steer & Brown, 1996). Each item on the BDI-II is rated on a scale of 0-3 with a higher score indicating more severe depressive symptoms. The revisions to the original measure aimed to update the diagnostic criteria for depression according to the DMS-IV and change the time frame in the instruction from one to two weeks to be compatible with diagnostic criteria (Beck, Steer, & Brown, 1996). The BDI-II is considered a valid and reliable measure of a sample of undergraduate students with internal consistency and convergent validity ($\alpha = 0.91$; Dozois, Dobson & Ahnberg, 1998).

Procedure

This study used data from a large dataset collected on November 6, 2017, to December 5, 2017, at a large Southeastern University. The principal investigator recruited 1,000 participants to take the online survey through Qualtrics that took approximately one hour to complete. All participants that completed the survey received one credit hour for their time as part of a requirement set forth by the university for each student enrolled in a general psychology course or extra credit in other psychology courses. Before scoring began on the RAT, the researchers did an initial cleaning of the data that removed any participants that began the survey or consented but did not complete the full survey resulting in an $n = 832$ (-52).

This study used 45 items including two practice items from a bank of 144 normed items by Bowden and Jung-Beeman (2003). The initial bank was condensed by eliminating items that included any duplicate words across either solution or stimulus words to reduce possible priming effects. The 43 scored items (excluding two practice) were then selected to create a normal distribution of difficulty level to ensure measurement across abilities (Bowden & Jung-Beeman,

2003). The two practice items administered were low in difficulty, untimed, and required the participant to select the correct solution word from a bank of three words to continue. Items were then administered based on the recommendations laid out by Bowden and Jung-Beeman (2003) with a timer displayed for each item for 15 seconds and an automatic progression should the participant not enter or submit a solution. Following administration of the practice items, participants completed the 43 scored test items.

Scoring was completed using “if [correct response], then 1” statements in Excel that scored each response that matched the solution word as a 1 and flagged non-matching items. The flagged answers were then evaluated by the researchers for spelling mistakes, alternative correct solutions, and errors. Spelling mistakes that maintained the meaning of the word or appeared to be errors in typing (e.g. “watchh” vs “watch” or, “soar” vs. “sore”) were accepted as correct answers. There were no solutions words that were deemed to be alternative solutions to the stimulus words in this sample. Additionally, some participants included the stimulus word with the correct solution word in the text box, and these were scored as correct. Answers outside of these parameters were considered incorrect, given a 0, and not included in the accuracy count (total number of correct solutions generated).

To decrease any ordering effects of the measures, the principal investigator put the Suicidal Behaviors Questionnaire-Revised (SBQ-R) at the end of the survey. The SBQ-R was used as a measure to group participants by history of suicidal ideation or attempt based on their responses to item 1 (1= never, 2= It was just a brief passing thought, 3a= I have had a plan at least once to kill myself but did not try to do it, 3b = I have had a plan at least once to kill myself and really wanted to die, 4a = I have attempted to kill myself, but did not want to die, 4b = I have attempted to kill myself, and really hoped to die). Those that endorsed 1 on item 1 were the

comparison group, 2, 3a and 3b were the suicidal ideation group, and 4a and 4b were the suicide attempt group. Additionally, the BDI was used to measure depressive symptoms (excluding suicidal ideation) to account for possible influences of mood on problem-solving ability.

Data Cleaning

Data were initially cleaned by sorting out participants that opened the survey and consented but did not complete the questionnaires and participants that did not complete the measures of interest (SBQ-R, BDI, RAT). Participants were also removed from analysis if their answers demonstrated that they did not understand the task, for example, creating a sentence using the stimulus words or rewriting the stimulus words from the prompt in the text box. Additionally, there were participants that timed out on each item of the RAT task indicating a lack of participation due to the automatic progression and these participants were also removed from analyses. Once the data were scored, the researchers ran descriptive statistics and used boxplots to identify any significant outliers. During this process, the researchers found duplicate identification numbers indicating 14 participants across the sample took the survey twice. The second attempt for these participants was eliminated from the analysis. The researchers also identified a RAT item that appeared twice in the data set and the answers from the second attempt to the item were also eliminated from the analysis. The researchers also noted a coding error in the BDI-II that did not allow the participants the opportunity to select from a full range of responses on question 12 and thus this was also eliminated from the BDI-II total. All BDI-II scores listed are out of 19 total questions with a minimum of 0 and a maximum total of 57.

Lastly, the researchers used reaction time to better isolate problem-solving as a process that involves problem restructuring rather than straight recall from memory. Cranford and Moss (2012) examined the process of insight in problem solving using remote associate problems from

the same bank of 144 normed items this study used. Results demonstrated that subjective ratings of insight differed based on reaction time and that individuals that came to a solution immediately rated it as insight but did not demonstrate the hallmarks of actual insight such as impasse, fixation, and restructuring. Further, these results indicate that reaction time can potentially differentiate two types of problem solving with immediate problem solving suggestive of recall and nonimmediate solutions indicative of insight processes (Cranford and Moss, 2012). This study conceptualized problem-solving as a process which requires insight, including impasse, restructuring, and fixation to parallel the process one might experience when contemplating suicide. The researchers used 3 seconds as the cut off for immediate solutions and eliminated items that were solved in 3 seconds or less from the analysis. Next, the researchers calculated individual accuracy scores based on the participant's correct solution attempts out of possible items with a reaction time longer than 3 seconds. The analysis was run using both the filtered reaction time (>3 seconds) and without a filtered reaction time.

CHAPTER III

RESULTS

The sample was expected to be sufficiently powered with group sample sizes consisting of 64.8% no history of ideation or attempt, 35.2% suicidal ideation, and 4.95% suicide attempt history based on previous research (Nadorff, Anestis, Nazem, Harris, & Winer, 2013). The current study of 741 participants consisted of 66.4% with no history, 30.6% with suicidal ideation, and 2.9% who had a history of suicide attempts, indicating that the following results should be interpreted with caution.

H1. hypothesized significant between-group differences (comparison, suicide ideation, and suicide attempt) on the number of correct solutions generated on the RAT with the greatest number of solutions generated from the control group and the least number of solutions generated by those that have attempted suicide. Table 4 shows the means for each measure across groups. The second hypothesis is that we will be able to significantly predict if an individual has no history of STB, history of suicidal ideation or attempts based on problem-solving accuracy. Additionally, given the relation between affect and mood on creative problem solving (Isen, 1999; Williams, Barnhofer, Crane, & Beck, 2005), the BDI-II was used to account for depressive symptomology, and we hypothesized that the relations between groups and solutions will hold when statistically adjusting for depressive symptoms.

To test these hypotheses, we used an Analysis of Covariance (ANCOVA) to determine whether problem-solving accuracy differed across groups (Table 5). Problem-solving accuracy

was normally distributed, with skewness of 0.1 ($SE = .09$), and kurtosis of .66 ($SE = .18$) using unfiltered data. Results showed that there was a significant main effect of history of suicidal thoughts and behaviors when accounting for depressive symptoms, $F(2, 737) = 3.19, p = .04$. Comparing estimated marginals means showed that those in the ideation group had the best problem-solving accuracy ($M = 15.09, SD = .46$), followed by those with a history of suicide attempt ($M = 13.98, SD = 1.48$), and last were those with no history of attempt or ideation ($M = 13.65, SD = .31$). Pairwise comparisons revealed that individuals with no history of suicidal ideation or behaviors significantly differed from those with suicidal ideation ($p = .04$), but there were no significant differences between those with suicide attempt history and the other two groups.

Multinomial Logistic Regression

To examine the second hypothesis, a multinomial logistic regression was performed, which allows predictions of categorical membership (no history, ideation, attempt) using a continuous variable (problem-solving accuracy). This statistic was selected because the aim of this study was to predict rather than assess for causality, in which case an ANOVA could be utilized (Starkweather & Moske, 2011). The analysis is discussed below using both filtered (< 3 seconds) and unfiltered reaction time.

Filtered Reaction Time

Results for this model indicate that overall model fit is significant ($X^2 = 133.5, p < .001$) and the Nagelkerke pseudo r-square accounts for 24% of the variance. However, this model does not predict any group membership using problem-solving accuracy but depressive symptoms (BDI) is a significant predictor for both groups ($p < .001$; Table 6).

Unfiltered Reaction Time

Results indicated that the overall model fit was significant ($X^2 = 158.05, p < .001$). Examining the *r*-squares also showed that the model is accounting for 24% of the variance in problem-solving accuracy using the Nagelkerke pseudo *r*-square. Although problem-solving accuracy overall predicts group membership, it only predicted membership in the suicidal ideation category ($p < .001$). This model was consistent with filtered reactions time and the BDI is still a significant predictor for both groups ($p < .001$). Overall, problem-solving accuracy positively predicted group membership for those that have a history of suicidal ideation even when accounting for depressive symptoms but no other category (Table 7). This model also indicates that for each additional RAT item an individual solves correctly, they are 3.2% more likely to be a member of the ideation group, compared to no history of suicidal ideation or attempt group.

CHAPTER IV

DISCUSSION

This study examined whether problem solving is associated with suicide risk and suicidal behavior independent of depressive symptoms. Problem solving is a complex, multi-step process that is studied very differently across subfields in psychology. This study is the first to use the Remote Associates Test, as a cognitive measure of problem-solving ability, in relation to past suicidal thoughts and behaviors measured by the SBQ-R. Results indicated that there was a main effect of problem-solving and that average problem-solving accuracy significantly differed between the no history and the suicidal ideation group. Although statistically significant, the results of this study are somewhat underpowered due to the unequal samples size, particularly between the no history ($n = 492$) and suicide attempt group ($n = 22$).

Looking at mean accuracy for each group, findings demonstrated that those in the suicidal ideation group solved the most problems followed by the suicide attempt group and the no history group which did not statistically differ from each other, contrary to the hierarchy expected. Additionally, the ANOVA revealed no statistical difference between the no history and attempt group. A possible explanation for this result is the amount of rumination, solution generation, and thought required to ponder suicide as a possible choice. Thus, these individuals may have more experienced with these processes. Previous research supports the connection between rumination and suicidal ideation (Rogers and Joiner, 2017; Teismann and Forkmann, 2017; Tucker et al., 2013); however, there is limited research on rumination and suicide attempts

(Rogers and Joiner 2017). Considering this relation between ideation and rumination, there is potential for the ideation process to be protective as a result of the generation of solutions but not selecting suicide as their implemented solution.

Research examining the connection between self-reflective rumination, mood, and creativity, which found that rumination played a significant role in explaining depressive symptomology and creativity (Verhaeghen, Joorman, & Khan, 2005). Essentially, past depressive symptomology was related to current self-reflective rumination, in turn, current rumination was related to current depressive symptomology and creative interests, fluency and originality. There was no direct link between creativity and current depressed mood, rather rumination fully explained this relationship. Expanding on Verhaegen and colleagues (2005) findings, these results support the possible role of rumination in creativity as it relates to problem-solving ability. Moreover, ideation may be a form of rumination as they both include the cyclical processing of restructuring the problem to determine a viable solution and continuing to do so until a solution is selected (Figure 1). In other words, suicide is an option to a problem but in the ideation phase, suicide is not selected as a solution because the person continues to restructure and ruminate on alternative solutions. Again, potentially, the ideation process or rumination may serve to produce alternative solutions and thus inoculate the individual at that time point from becoming an attempter. Moreover, the transition between ideation and attempting may align with difficulty generating alternative solutions at that time.

Limitations

The proposed study used a convenience sample of ungraduated college students and although the RAT and SBQ-R are validated using samples of undergraduate college students and non-clinical samples, the findings may not be representative of a clinical population (Bowden &

Jung-Beeman, 2003; Osman et al., 2001); however, it lays the groundwork for additional studies to potentially examine this dynamic in a more clinically focused setting. Additionally, the data collection was completed at the end of the semester and might be more representative of students that wait to complete academic assignments versus students that completed the credit requirement at the beginning of the semester. To offset this potential limitation, the data were carefully cleaned and those with invalid responses eliminated, and the responses analyzed are assumed to be a valid measure of those constructs among college students. Additionally, although the RAT is intended to be administered via computer, the cognitive field often administers the task using in-person laboratory protocols and not online samples. Considering this study utilized an online sample, the data cleaning was more extensive because of the number of participants that did not complete the tasks and/or progressed through the task with invalid responses without completing the tasks. This was only a limitation due to a reduction in sample size as a result of the extensive data cleaning procedures completed and a larger sample than needed should be utilized in the future to account for these procedures.

Further, the group sample sizes were not representative of the expected samples based on previous research examining suicide ideation and attempts at the institution (Nadorff, Anestis, Nazem, Harris, & Winer, 2013). Considering the lack of individuals endorsing a history of suicide attempt(s), the results may have been more robust and resilient to possible variance if the groups were more equal in size. However, given that suicidal thoughts and behaviors have low base rates, this is often a challenge within the field of suicidology (Drapeau & McIntosh, 2018). Overall, the findings are an initial step in delineating the connection between problem solving and suicide. Additionally, given the less than robust findings, this study should be used to improve and inform future research.

Future Directions

Inspired by Franklin et al. (2017), this study aimed to create a foundation from which to build a better understanding of cognitive correlates of suicide risk. Although the direction of the results differed from the hypothesized results, the findings suggest a possible protective factor involved in the problem-solving process. Problem solving could potentially reduce the risk of an individual moving from suicide ideation to attempt considering the problem restructuring process and solution generation inherent in pondering suicide as an option to a problem but not selecting it. More research is warranted given the novel findings suggesting that when compared to those with no history of suicide ideation or attempts and a history of suicide attempts, individuals that have experienced suicidal ideation were more accurate problem-solvers. Future studies could also examine the role of rumination and reappraisal as it relates to problem solving and suicide attempts to better understand the shift from ideation to attempts. Additionally, previous literature has fixated individuals prior to solving the RAT, to determine an individual's ability to overcome the fixation (Smith & Blankenship, 1991; Wiley, 1998). A future study could fixate participants on suicide to better understand if individuals that ideate or attempt struggle to problem solve when semantically primed to think of suicide. Continuing this line of research will provide a thorough understanding of the actual mechanisms underlying problem solving in the context of suicide, opening doors to both better treatments, and ideally better prevention, of this growing threat to society.

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APPENDIX A
TABLES AND FIGURES

Table A1

Social Problem-Solving Inventory

<u>Two Domains of Problem Solving</u>	
<u>Domain</u>	<u>Focus</u>
Problem Orientation Scale	Cognitive, affective, behavioral response set to problematic situations
Cognition subscale	Attentional set and generalized attributions related to problems
Emotional subscale	Immediate emotional states associated with problematic situation
Behavioral subscale	Behavioral approach-avoidance tendencies towards a problem
Problem-Solving Skills Scale	Implementation of the four goal-oriented tasks
Problem definition and formulation subscale	Obtaining relevant, factual information about the problem
Generation of alternative solutions subscale	Discover and create alternative solutions
Decisions making subscale	Judge and compare solutions
Solution implementation and verification subscale	Self-monitor and evaluate the actual outcome

Table A2

Social Problem-Solving Inventory-Revised

Five Domains of Problem Solving	
<u>Domain</u>	<u>Example</u>
Positive Problem Orientation	<i>“When my first effort to solve a problem fails, I usually think that I persist and do not give up easily, I will be able to find a good solution eventually.”</i>
Negative Problem Orientation	<i>“I usually feel threatened and afraid when I have an important problem to solve.”</i>
Rational Problem Solving	<i>“When I have a problem to solve, one of the first things I do is get as many facts about the problem as possible.”</i>
Impulsive/Careless Style	<i>“When making decisions, I do not usually evaluate and compare the different alternatives carefully enough.”</i>
Avoidant Style	<i>“When a problem occurs in my life, I usually put off trying to solve it for as long as possible.”</i>

Table A3

Demographics

Measure	<i>N</i>	Percent (%)
Age		
18	461	60
19	206	27
20	44	6
21-29	38	5
No Response	15	2
Gender		
Female	485	66
Male	252	34
Gender Fluid	2	.2
No Response	2	.2
Race/Ethnicity		
White/Caucasian	569	77
Black/African American	120	16
Other or Mixed	31	4
Hispanic	14	2

Table A4

Sample Means

Group	<i>N</i>	BDI (<i>SD</i>) ^a	RAT filtered (<i>SD</i>) ^b	RAT unfiltered (<i>SD</i>) ^b
No ideation or attempt	492	7.27 (12.33)	54.73 (19.22)	31.91(15.34)
Ideation	227	16.49 (11.24)	56.36 (19.31)	34.82 (16.25)
Attempt	22	28.18 (27.16)	59.27 (18.23)	32.80 (17.66)

Note. ^a total out of 19 questions on the BDI. ^b total percent accuracy.

Table A5

ANCOVA Results

Group	<i>df</i>	<i>F</i>	η_p^2	<i>p</i>
Suicide Category	2	3.19	.009	.042*
BDI	1	.99	.001	.320
Error	737			

Note. * $p < .05$

Table A6

Multinomial Logistic Regression, Filtered

Predictor	<i>B</i>	<i>SE β</i>	<i>p</i>	<i>Exp (B)</i>
Ideation				
Accuracy	.480	.469	.306	1.617
BDI	.104	.010	.000**	1.110
Attempt				
Accuracy	.995	1.242	.423	2.706
BDI	.120	.013	.000**	1.128

Note. $n = 741$, * $p < .05$, ** $p < .001$.

Table A7

Multinomial Logistic Regression, Unfiltered

Predictor	<i>B</i>	<i>SE β</i>	<i>p</i>	<i>Exp (B)</i>
Ideation				
Accuracy	.032	.013	.016*	1.032
BDI	.104	.010	.000**	1.110
Attempt				
Accuracy	-4.707	.557	.781	1.009
BDI	.120	.013	.000**	1.128

Note. $n = 741$, * $p < .05$, ** $p < .001$

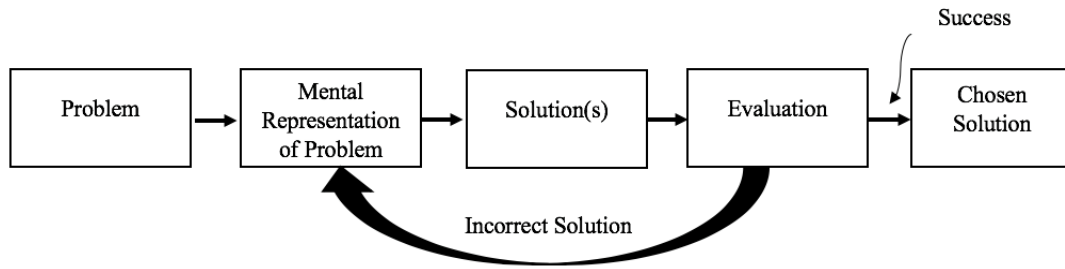


Figure A1. The creative problem-solving process.

APPENDIX B
REMOTE ASSOCIATES TEST ITEMS

Remote Associates Test Items

<u>Stimulus Word 1</u>	<u>Stimulus Word 2</u>	<u>Stimulus Word 3</u>	<u>Solution</u>
cottage	swiss	cake	cheese
cream	skate	water	ice
loser	throat	spot	sore
night	wrist	stop	watch
rocking	wheel	high	chair
dew	comb	bee	honey
fountain	baking	pop	soda
aid	rubber	wagon	band
flake	mobile	cone	snow
cracker	fly	fighter	fire
safety	cushion	point	pin
cane	daddy	plum	sugar
dream	break	light	day
fish	mine	rush	gold
measure	worm	video	tape
sense	courtesy	place	common
worm	shelf	end	book
piece	mind	dating	game
flower	friend	scout	girl
river	note	account	bank
print	berry	bird	blue
pie	luck	belly	pot
opera	hand	dish	soap
sleeping	bean	trash	bag
light	birthday	stick	candle
food	forward	break	fast
shine	beam	struck	moon
peach	arm	tar	pit
sandwich	house	golf	club
sage	paint	hair	brush
boot	summer	ground	camp
mill	tooth	dust	saw
main	sweeper	light	street
office	mail	hat	box
tank	hill	secret	top
dress	dial	flower	sun

way
pile
keg
wet
cut
grass
artist
shadow

board
market
puff
law
cream
king
hatch
chart

sleep
room
room
business
war
meat
route
drop

walk
stock
powder
suit
cold
crab
escape
eye

APPENDIX C
SUICIDAL BEHAVIORS QUESTIONNAIRE-REVISED

SBQ-R Suicide Behaviors Questionnaire-Revised

Patient Name _____ Date of Visit _____

Instructions: Please check the number beside the statement or phrase that best applies to you.

1. Have you ever thought about or attempted to kill yourself? (check one only)

- 1. Never
- 2. It was just a brief passing thought
- 3a. I have had a plan at least once to kill myself but did not try to do it
- 3b. I have had a plan at least once to kill myself and really wanted to die
- 4a. I have attempted to kill myself, but did not want to die
- 4b. I have attempted to kill myself, and really hoped to die

2. How often have you thought about killing yourself in the past year? (check one only)

- 1. Never
- 2. Rarely (1 time)
- 3. Sometimes (2 times)
- 4. Often (3-4 times)
- 5. Very Often (5 or more times)

3. Have you ever told someone that you were going to commit suicide, or that you might do it? (check one only)

- 1. No
- 2a. Yes, at one time, but did not really want to die
- 2b. Yes, at one time, and really wanted to die
- 3a. Yes, more than once, but did not want to do it
- 3b. Yes, more than once, and really wanted to do it

4. How likely is it that you will attempt suicide someday? (check one only)

- 0. Never
- 1. No chance at all
- 2. Rather unlikely
- 3. Unlikely
- 4. Likely
- 5. Rather likely
- 6. Very likely

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SBQ-R - Scoring

Item 1: taps into lifetime suicide ideation and/or suicide attempts			
Selected response 1	Non-Suicidal subgroup	1 point	
Selected response 2	Suicide Risk Ideation subgroup	2 points	
Selected response 3a or 3b	Suicide Plan subgroup	3 points	
Selected response 4a or 4b	Suicide Attempt subgroup	4 points	Total Points
Item 2: assesses the frequency of suicidal ideation over the past 12 months			
Selected Response:	Never	1 point	
	Rarely (1 time)	2 points	
	Sometimes (2 times)	3 points	
	Often (3-4 times)	4 points	
	Very Often (5 or more times)	5 points	Total Points
Item 3: taps into the threat of suicide attempt			
Selected response 1		1 point	
Selected response 2a or 2b		2 points	
Selected response 3a or 3b		3 points	Total Points
Item 4: evaluates self-reported likelihood of suicidal behavior in the future			
Selected Response:	Never	0 points	
	No chance at all	1 point	
	Rather unlikely	2 points	
	Unlikely	3 points	
	Likely	4 points	
	Rather Likely	5 points	
	Very Likely	6 points	Total Points
Sum all the scores circled/checked by the respondents.			
The total score should range from 3-18.			Total Score

AUC = Area Under the Receiver Operating Characteristic Curve; the area measures discrimination, that is, the ability of the test to correctly classify those with and without the risk. [.90-1.0 = Excellent; .80-.90 = Good; .70-.80 = Fair; .60-.70 = Poor]

	Sensitivity	Specificity	PPV	AUC
Item 1: a cutoff score of ≥ 2				
• Validation Reference: Adult Inpatient	0.80	0.97	.95	0.92
• Validation Reference: Undergraduate College	1.00	1.00	1.00	1.00
Total SBQ-R : a cutoff score of ≥ 7				
• Validation Reference: Undergraduate College	0.93	0.95	0.70	0.96
Total SBQ-R: a cutoff score of ≥ 8				
• Validation Reference: Adult Inpatient	0.80	0.91	0.87	0.89

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APPENDIX D

MISSISSIPPI STATE UNIVERSITY IRB APPROVAL LETTER



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NOTICE OF DETERMINATION FROM THE HUMAN RESEARCH PROTECTION PROGRAM

DATE: September 13, 2018
TO: Michael Nadorff, PhD, Psychology, Andrew Jarosz, Eric Winer
PROTOCOL TITLE: Investigating problem solving's role in explaining suicide ideation and attempts: an archival data analysis
PROTOCOL NUMBER: IRB-18-081
 Approval Date: September 13, 2018 Expiration Date: September 12, 2023

EXEMPTION DETERMINATION

The review of your research study referenced above has been completed. The HRPP had made an Exemption Determination as defined by 45 CFR 46.101(b)4. Based on this determination, and in accordance with Federal Regulations, your research does not require further oversight by the HRPP.

Employing best practices for Exempt studies are strongly encouraged such as adherence to the ethical principles articulated in the Belmont Report, found at www.hhs.gov/ohrp/regulations-and-policy/belmont-report/# as well as the MSU HRPP Operations Manual, found at www.orc.msstate.edu/humansubjects. Additionally, to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so.

Based on this determination, this study has been inactivated in our system. This means that recruitment, enrollment, data collection, and/or data analysis CAN continue, yet personnel and procedural amendments to this study are no longer required. **If at any point, however, the risk to participants increases, you must contact the HRPP immediately. If you are unsure if your proposed change would increase the risk, please call the HRPP office and they can guide you.**

If this research is for a thesis or dissertation, this notification is your official documentation that the HRPP has made this determination.

If you have any questions relating to the protection of human research participants, please contact the HRPP Office at irb@research.msstate.edu. We wish you success in carrying out your research project.

Review Type: EXEMPT
IRB Number: IORG0000467