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The Relationship Between Suicide Ideation and Parasuicide: An Electrophysiological Investigation Using the Loudness Dependence of Auditory Evoked Potential

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The University of Southern Mississippi

THE RELATIONSHIP BETWEEN SUICIDE IDEATION AND PARASUICIDE:
AN ELECTROPHYSIOLOGICAL INVESTIGATION USING THE
LOUDNESS DEPENDENCE OF AUDITORY EVOKED POTENTIAL

by

Angelika Marsic

Abstract of a Dissertation
Submitted to the Graduate School
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

August 2012

ABSTRACT

THE RELATIONSHIP BETWEEN SUICIDE IDEATION AND PARASUICIDE: AN ELECTROPHYSIOLOGICAL INVESTIGATION USING THE LOUDNESS DEPENDENCE OF AUDITORY EVOKED POTENTIAL

by Angelika Marsic

August 2012

The loudness dependence of the auditory evoked potential (LDAEP) has been proposed as a promising valid and a non-invasive indicator of behaviorally relevant central 5-HT functioning. There is limited research on the utility of the LDAEP in discriminating individuals who engage in various degrees of suicidal behavior. The primary purpose of the present study was to examine if the LDAEP, as a measure of central serotonergic functioning, can be useful in distinguishing groups of individuals who: (a) solely experience suicidal ideation (SI group); (b) experience suicidal ideation and have engaged in deliberate self-harm acts (SH group); and (c) individuals with no history of suicidal ideation or deliberate self-harm behavior (control group). I was also interested in observing whether the nature of individuals' suicidal behavior (i.e., cognitive versus cognitive and behavioral) would differentiate individuals' performance on Self-Aggression Paradigm (behavioral measure of self-aggression; SAP) and Suicide-Implicit Association Test (reaction-time based measure of implicit cognitive associations with death/suicide; S-IAT). Forty-eight participants consisting of college students and community members were recruited for this study. I predicted that (1) The SH group would exhibit the largest LDAEP slope, followed by the SI group, and finally the Control

group; (2) The SH group would obtain the largest mean shock score and would self-select the highest number of “20” shock, followed by the SI group, and finally the Control group; (3) SI and SH groups would obtain a more negative S-IAT index, indicating pro-suicide tendencies, than the Control group; (4) the LDAEP slope would be positively related to the SAP indexes and negatively related to S-IAT index; and (5) the LDAEP would be positively related to the self-report measures of self-harm behavior and aggression, and negatively related to self-report measure of reasons for living. Contrary to expectations, most of our predictions were not supported. Clinical implications and future research directions are discussed.

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Investigation using the Loudness Dependence of Auditory Evoked Potential

by

Angelika Marsic

A Dissertation

Submitted to the Graduate School
of The University of Southern Mississippi
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DEDICATION

To my parents Cobb and Cindy Milner and Dane and Jadranka Marsic. It is safe to say I would not be who I am and where I am, were it not for all of your love, encouragement, and support. I strive to make you proud in everything I do.

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CHAPTER I

INTRODUCTION

Although human beings are believed to possess an innate need for self-preservation, suicide, while relatively rare, is one of the leading causes of death and a significant public health concern that affects numerous individuals worldwide. Specifically, suicide is the second leading cause of death among 25-34 year olds, the third leading cause of death among 15- to 24-year olds, and 11th leading cause of death overall, in the United States. In 2006, over 33,000 suicides were completed in the United States, which corresponds to 91 suicides per day or 10.95 suicides per 100,000 people (Centers for Disease Control and Prevention; CDC, 2007). There are approximately 100-200 attempts for every completed suicide among young adults 15 to 24 years of age (Goldsmith, Pellmar, Kleinman, & Bunney, 2002). Recent national “Youth Risk Behavior Surveillance” survey results indicate that 14.5% of high school students in the U.S. had seriously considered attempting suicide during the prior 12 months and 6.9% of students had in fact attempted suicide one or more times during the same period (CDC, 2008). Both United Nations and the World Health Organization have recognized suicide as a significant worldwide crisis that requires integrated and large scale efforts toward systematic identification of individuals at risk and development of prevention programs (Jenkins & Singh, 2000).

Significance of the Study

Suicidal behavior is a complex and diagnostically heterogeneous set of behaviors (e.g., suicidal thoughts, intentions, gestures, attempts, completions) (Silverman, Berman, Sanddal, O’Carroll, & Joiner, 2007) associated with a host of psychological,

neurobiological, behavioral, and environmental/contextual risk factors. Developing techniques and identifying specific versus general risk factors which can reliably single out suicidal individuals who go on to commit suicide has been a formidable task, and one that has stood in the way of establishment of effective interventions in the prevention of suicide (Jenkins & Singh, 2000). In recent years, neurobiological studies of suicidal behavior (SB) have shed light on the specific biological factors associated with suicidal behavior. In particular, the inverse relationship between the monoamine neurotransmitter serotonin (5-HT) and suicidal behavior has been extensively studied and well-replicated (e.g., Arango et al., 1990; Asberg, 1997; Audenaert et al., 2001; Coccaro, 1989; Correa et al., 2000; Duval et al., 2001; Lester, 1995; Malone, Corbitt, Li, & Mann 1996; Mann & Malone, 1997; McCloskey, Ben-Zeev, Lee, Berman, & Coccaro, 2009). However, some of most commonly used biological indexes of central 5-HT functioning are highly invasive (e.g., lumbar punctures or pharmacochallenge) and costly and, thus, unlikely to become a part of the standard measurement of individuals who are suicidal. Therefore, there exists a need for a reliable, non-invasive marker of 5-HT functioning to elucidate the role of serotonin in suicidal behavior, aid in the identification of individuals who are at risk of committing suicide, and help in the development of efficacious treatments for SB.

The loudness dependence of the auditory evoked potential (LDAEP) has been proposed as a promising valid and a non-invasive indicator of behaviorally relevant central 5-HT functioning (Hegerl & Juckel, 1993). There is limited research on the utility of the LDAEP in discriminating individuals who engage in a range of suicidal behaviors. A recent study has indicated that the LDAEP may serve a role as a potential biological

marker of serotonin levels and could be used to identify individuals who engage in self-aggressive behaviors (i.e., deliberate behaviors intended to induce self-injury) (Marsic, Berman, & Barry, in preparation). Specifically, Marsic and colleagues found that the LDAEP slope (reflecting EEG scalp readings in response to increasing tone loudness) was positively related to the presence and frequency of self-aggressive behavior in a non-clinical population, supporting the notion that reduced central 5-HT functioning, as assessed by the LDAEP, is related to self-aggression.

There are several limitations of Marsic et al. (in preparation) study regarding their findings of the LDAEP-self aggression relation. First, the focus of the study was on the other-directed aggression instead of the SB. Therefore, participants were not selected based on their SB history which limited the number of SB individuals and the breadth of self-aggressive behaviors. Second, the study was not designed to disentangle the potential role of the LDAEP in discriminating individuals who engage in the most common forms of SB – suicide ideation (i.e., thoughts of suicide; SI) and parasuicide (i.e. potentially lethal act of deliberate self-harm [DSH] notwithstanding an intent to die; O’Carroll et al., 1996; O’Connor, Armitage, & Gray, 2006). Although suicidal ideation is a known risk factor for parasuicide (e.g., Joiner & Rudd, 2000; Lewinsohn, Rohde, & Seely, 1996) and suicide (e.g., Beck, Brown, Steer, Dahlsgaard, & Grisham, 1999), a considerable number of individuals who suffer from suicidal ideations do not go on to execute lethal or non-lethal deliberate self-harm (e.g., ten Have et al., 2009). Therefore, it would be worthwhile to examine neurological underpinnings of suicidal ideation and parasuicide to explore if certain neurological patterns could discriminate ideators (i.e., individuals only experiencing suicidal thoughts) from self-harmers (i.e., individuals who transition from

only having suicidal thoughts to action and engage in potentially lethal forms of DSH). Third, self-aggression was exclusively assessed using self-report measures which are limited in a variety of ways (e.g., hindsight and responder biases, participant's willingness and/or ability to provide an accurate report, and willful underreporting of the phenomena). Other methods derived from laboratory measures of aggression in humans and the field of cognitive psychopathology would allow for a deeper and more valuable understanding of suicidal behavior. To this end, a controlled laboratory measure of self-aggression (Self Aggression Paradigm; SAP) (Berman & Walley, 2003) and an indirect computer-administered, reaction-time based measure of cognitive associations of death/suicide with self (Suicide-Implicit Association Test; S-IAT; Nock, et al., 2010) have shown promise.

This study will address the limitations, replicate, and extend the Marsic et al. (in preparation) study to determine whether the LDAEP discriminates three groups: (a) individuals who solely experience suicidal ideation (SI group); (b) experience suicidal ideation and have engaged in deliberate self-harm acts (SH group); and (c) individuals with no history of suicidal ideation or deliberate self-harm behavior (control group). In addition, this study aims to examine differences in the above described groups in their performance on the SAP and the S-IAT. This paper will begin with a literature review of suicidal behavior encompassing the constructs of suicide ideation and parasuicide. Next, a review of the SB and 5-HT link will be provided. Subsequently, a brief description of the event-related potential (ERP) technique and a more thorough depiction of the LDAEP as a potential biological marker of 5-HT will be supplied. Description and rationale for

the SAP and the S-IAT measures will follow. Finally, a synopsis of the aims of the study, rationale, and empirical findings will be presented.

CHAPTER II

REVIEW OF RELATED LITERATURE

Suicidal Behavior

Suicidal behavior occurs on a continuum of severity, frequency, form, intensity, and intent, from entertaining the idea of ending one's life to coming up with an actual plan to follow through suicide, obtaining means to do so, and finally killing oneself (DeLeo, Bertolote, & Lester, 2002; Nock, et al., 2008; O'Carroll et al., 1996). Indeed, in effort to cover the wide spectrum of suicidal behaviors, the research on the SB has been hindered by the lack of consistency in the literature regarding operational definitions and terminology used to conceptualize and depict these behaviors (see O'Carroll et al., 1996; Prinstein, 2008; Silverman et al., 2007). For example, diverse terminology includes self-mutilation (e.g., Favazza, 1998; Ross & Heath, 2002), parasuicide (e.g., Linehan, 1993), deliberate self-harm (e.g., Gratz, 2003; Gratz & Chapman, 2007), and suicidal thoughts, intentions, ideations, and gestures (see Silverman et al., 2007). The lack of definitional clarity could also be because the SB is likely an overdetermined behavior (i.e., associated with numerous concurrent risk factors and performing numerous functions; see Garlow et al., 2008; Gratz, 2003; Prinstein, 2008). This study will examine two most frequent forms of SB using a terminology from recent "consensus papers" (see O'Carroll et al., 1996; Prinstein, 2008; Silverman et al., 2007). In particular, this study will examine individuals who have suicidal ideations (i.e., thoughts of committing suicide) as well as individuals who have suicidal ideations and have engaged in parasuicide (i.e., engaged in a deliberated self-harm behaviors that were potentially lethal) (see Nock et al., 2008).

Suicide methods differ greatly in form (e.g., jumping off the bridge, drinking

Clorox) and by gender (e.g., women choose less lethal means and are inclined to commit suicide by drug overdose or carbon monoxide poisoning, whereas men choose more lethal means and are therefore more likely to commit suicide via firearms or hanging) (Denning, Conwell, King, & Cox, 2000). Suicide, suicidal ideation, and suicide attempts are part of the diagnostic criteria set for a Major Depressive Episode. Additionally, suicide, attempted suicide, and suicidal ideation are recognized as associated feature of a number of psychiatric diagnoses (e.g., borderline personality disorder [BPD], alcohol and drug use disorders, anxiety disorders, schizophrenia) (American Psychiatric Association, 2000). In fact, it has been found that estimated 90% of individuals who have committed suicide had a diagnosable psychiatric disorder at the time of their death (see Joiner, Brown, & Wingate, 2005). Mood disorders are the most prevalent psychiatric conditions related to suicides (Beautrais, 2003; Garlow et al., 2008). A proposed neurobiological explanation of the significant suicide and depression relation is the impaired 5-HT functioning which characterizes both conditions (5-HT and suicide relation described in more detail below) (see Joiner et al., 2005). Other psychosocial factors include negative life events prior to suicide, legal problems, family history of mental illness and suicide, a history of sexual abuse, a history of a past suicide attempt, suicidal ideation, and aggression (Agerbo, Nordentoft, & Mortensen, 2002; Cooper, Appleby, & Amos, 2002; D'Eramo, Prinstein, Freeman, Grapentine, & Spirito, 2004; Garlow et al., 2008; Keilip et al., 2006).

Parasuicide (DSH). DSH is alarmingly widespread with prevalence rates ranging from 1% to 4% in nondevelopmentally disabled adults (Briere & Gil, 1998; Klonsky, Oltmanns, & Turkheimer, 2003; Prinstein, 2008) and 17% to 38% in college students,

with lifetime prevalence estimates of 35% (e.g., Gratz, 2001; Whitlock, Eckenrode, & Silverman, 2006). Furthermore, in the clinical population the estimates are still higher (21 - 61% in adolescents and young adults and 21% in adults; Briere & Gil, 1998; Darche, 1990; DiClemente, Ponton, & Hartley, 1991; Prinstein, 2008). In 2007 emergency rooms admitted 395,320 people for self-inflicted injuries with 165,997 people requiring overnight hospitalization (CDC, 2007). DSH prevalence rates do not appear to vary as a function of gender, ethnicity, or socioeconomic status (e.g., Hilt, Nock, Lloyd-Richardson, & Prinstein, 2008; Nock, 2009). Although it is estimated that DSH is approximately 10-30 times more frequent than suicide (Jenkins & Singh, 2000), previous suicide attempt is one of the best predictors of a future suicide or suicide attempt (Mann, Wateraux, Haas, & Malone, 1999).

DSH is related to an array of negative emotions including depression, anxiety, and suicidal ideation (Andover, Pepper, Ryabvhenko, Orrico, & Gibb, 2005; Hawton, Rodham, Evans, & Weatherall, 2002; Klonsky, Oltmanns, & Turkheimer, 2003). Linehan's (1993) theory of DSH provides the most comprehensive and in depth account of the emotion regulating function of DSH asserting that the interaction of emotional vulnerability and invalidating environment serve as risk factors for emotion dysregulation (i.e., invalidating environments during childhood fail to provide teaching opportunities for appropriate emotional arousal and distress regulating strategies hence contributing to emotional dysregulation). Furthermore, childhood physical, psychological, and sexual abuse and trauma, emotional neglect, and insecure attachments have all been identified as interactive risk factors for the development of DSH behavior (for a review see Gratz, 2003).

Suicidal ideation (SI). Suicidal ideations have been identified as strong predictors of ultimate suicide (Beck et al., 1999), suicidal attempts (Lewinsohn et al., 1996), and past suicide attempts (Joiner et al., 2000; Witte et al., 2005). Although, some have suggested that different psychological mechanisms underlie different aspects of suicidal behavior and ideations, and that the population engaging in those behaviors is distinct (Gil, 2005), suicidal ideations have been identified as an integral step towards eventual suicide attempt and/or completion (Conrad et al., 2009; Gunnell, Harbord, Singleton, Jenkins, & Lewis, 2004; Sokero et al., 2003; Oquendo, Lizardi, Greenwald, Weissman, & Mann, 2004; Reinherz, Tanner, Berger, Beardslee, & Fitzmaurice, 2006). tenHave and colleagues (2009) reported that individuals who made a suicide attempt did not differ from individuals who reported experiencing suicidal ideations on various socio-demographic variables and that previous suicidal ideation was one of the highest predictors of a suicide attempt. Nonetheless, it would be worthwhile to examine why some, but not all, individuals who experience suicidal ideation go on to carry out a potentially lethal deliberate self-harm. Indeed, studies have found that suicidal ideations are transient in nature and occur at much higher rates than actual attempts. For example, although it is difficult to ascertain what are the exact prevalence rates for suicidal ideations due to heterogeneous data collection and construct definitions, tenHave and colleagues (2009) reported that prevalence rates of suicidal ideations vary from 2.3 - 14.1% in comparison to 1.9-2.1 % for suicide attempts. Accordingly, examining factors underlying suicidal thoughts in individuals that do not act on suicidal thoughts versus individuals who do act on thoughts of suicide would be extremely valuable. To this end,

the present study will attempt to examine the neurological differences among these two groups and non-suicidal individuals.

Relationship among Suicide, Suicidal Ideations, and Parasuicide

As aforementioned, DSH is a significant risk factor for the ultimate suicide attempt (e.g., Comtois, 2002; McCloskey et al., 2009; Joiner, 2005; Joiner et al., 2005). Furthermore, individuals who engage in repetitive parasuicidal behavior are more likely to have recurrent suicidal ideation and higher instances of suicide attempts, independent of their DSH behaviors (Dulit et al., 1994; Langbehn & Pfohl, 1993; Lee, 1987; Soloff et al., 1991). Approximately 10% of individuals who engaged in parasuicidal behavior were found to commit suicide later on in life (Stanley et al., 2000). In clinical populations these numbers are even higher with Hillbrand (1992) reporting suicide rates in the range of 29-81% in men who were patients in a forensic psychiatric hospital and who engaged in DSH.

Joiner's (2005) interpersonal-psychological theory of suicidal behavior posits that engaging in DSH provides a pathway to an eventual suicide attempt. In particular, the central principle of Joiner's (2005) theory is that the habituation experiences to the pain (e.g., DSH, accidental injury, exposure to violence and injury through combat or work as a physician) are instrumental in the development of capacity to perform lethal self-injury and that this capacity does not equal desire. Accordingly, Joiner (2005) goes on to identify two interrelated and relevant frames of mind that amount to desire to commit suicide, subjective feeling of being a burden to others (that involves cognitive misperception that that their death may carry more worth than their life) and futile attempts at feeling a sense of belongingness (i.e., sense of alienation). Andover & Gibb

(2010) found results that are supportive of the first tenet (i.e., capacity to self-inflict pain) of Joiner's (2005) theory. Specifically, they found that individuals with a history of DSH were significantly more apt to report a past suicide attempt than individuals with no history of DSH. In agreement with Whitlock and Knox (2007) they also found that higher frequency of DSH was positively related to higher instances of suicide attempts in adult clinical and non-clinical population. The groups did not differ in depressive symptoms, hopelessness, suicidal ideation, or borderline symptoms. They concluded that their results indicated that assessment of DSH should be a significant component of a suicide risk assessment. However, the question remains as to what factors are instrumental in impelling individuals to progress from merely having suicidal thoughts to inflicting deliberate self-harm which may lead to a lethal suicidal act.

Although, as thus reported, suicide, suicidal ideations, and DSH are highly co-occurring behaviors that share common risk factors, there is some debate in the literature as to whether individuals engaging in various forms of SB represent meaningfully distinct groups or if they fall on a continuum of self-injurious behavior (e.g., tenHave et al., 2009; Conrad et al., 2009). In the literature, certain differences have been found among individuals engaging in various types of SB. For example, Conrad and colleagues (2009) conducted a study examining personality trait differences among depressed individuals who have attempted suicide (attempters), individuals who reported suicidal ideations (ideators), and controls. Authors found that depressed attempters differed in personality traits from both ideators and controls, and that ideators themselves differed from the controls. Specifically, authors found temperamental dimension (i.e., neurobiological dispositions) differences between suicide attempter and non-attempters (i.e., ideators and

controls) and character dimension (i.e., higher cognitive functions) differences between ideators and controls. Particularly, they found that depressed individuals who had a history of suicide attempt had significantly higher harm avoidance score (i.e., could be characterized as fearful, socially inhibited, shy, and pessimistic) than depressed ideators or controls. Furthermore, they found that ideators had significantly lower scores in the self-directedness (i.e., responsibility, purposefulness, resourcefulness, and self acceptance), a personality trait that is associated with Bandura's self-efficacy construct (Bandura & Cervone, 1986; Conrad et al., 2009). These findings suggested that ideators may significantly differ in higher cognitive functions of self-concept, which is an integral part of individual differences in goals and values affecting voluntary choices and life meaning. Authors concluded that suicide attempt and suicidal ideation may have different neurobiological underpinnings and may be associated with different populations. Additionally, Westheide and colleagues (2008) found that among depressed individuals with a recent suicide attempt, the ones who were experiencing current suicidal ideations exhibited a higher level of executive impairments (i.e., impaired decision-making) as compared to individuals without current suicidal ideations even after the authors controlled for depressive symptoms. The present study is designed to further examine the differences among individuals with suicidal ideations only and individuals who have engaged in potentially lethal DSH behavior by using a biological indicator of 5-HT levels.

In terms of psychiatric diagnoses, some have found that individuals who had a previous history of suicide attempts were more likely to have a psychiatric disorder than individuals with only suicidal ideations (Beautrais, 2003; Fergusson & Lynskey, 1995;

Tuisku et al, 2006), although others have found no such differences in the rates of psychiatric diagnoses (Tuisku et al., 2006; Wetzler et al., 1996). Furthermore, Brausch and Gutierrez (2010) conducted a study examining the differences in no history of self-harm (controls), non-suicidal self-injury only (NSSI), and NSSI in addition to suicide attempt (NSSI-SA) adolescent groups. As expected, they found that the control group reported lowest levels of risk factors (e.g., low depression, low negative self-evaluation, and lowest suicidal ideations) and the highest levels of protective factors (e.g., higher self-esteem, more social and parental support) whereas the results for the NSSI-SA group were reversed. Individuals from the NSSI group fell right in the middle.

In conclusion, although individuals who engage in a variety of suicidal behaviors share some common risk-factors, notable differences have also been found. Therefore, it would be worthwhile to further examine biological and behavioral characteristics that differentiate individuals engaging in a two most common forms of SB: suicide ideation and parasuicide.

Serotonin (5-HT) and Suicidal Behavior Link

Definition and Functions of 5-HT

Serotonin is primarily an inhibitory, monoamine neurotransmitter that serves a complex role in a variety of processes in both central nervous system and the periphery including regulation and control of mood, body temperature, analgesia, eating, sleep, arousal, endocrine functions, gastrointestinal functions, and vascular functions.

Neurotransmitters are chemical messengers that transmit excitatory or inhibitory signals among neuronal cells in the central and peripheral systems and that affect information flow in the human brain, associated with emotional, cognitive, and behavioral

experiences. There is a vast amount of evidence supporting the idea that irregularities in the serotonin system serve a role in a range of deleterious behaviors such as aggression, suicide, suicide attempts, non-suicidal self-injury, arson, and alcoholism (e.g. Asberg & Forslund, 2000; Berman, Jones, & McCloskey, 1997; Coccaro, 1989; Linnoila & Virkkunen, 1992; Mann et al., 1995; Mann, Brent, & Arango, 2001; Stanley et al., 2000).

5-HT Measures

The most commonly employed strategies for measuring neurotransmitter activity in humans include measurement of cerebrospinal fluid (CSF) 5-hydroxyindoleacetic acid (5-HIAA), peripheral measures, and hormonal measures following pharmacochallenge of neuroregulatory system (Mann et al., 1995). These measures provide an index of 5-HT activity that can then be statistically compared to a behavior of interest (e.g., NSSI, aggression), or used to distinguish groups of individuals (Berman, Kavoussi, & Coccaro, 1997).

Peripheral studies of 5-HT and self-aggression. Peripheral measures are acquired through urine or blood. Specifically, the neurotransmitter activity levels are thought to be reflected in (a) the concentrations of substances needed for the production of neurotransmitters in the brain; (b) enzymes responsible for neurotransmitter metabolism; or (c) metabolites created in the breakdown of neurotransmitter material in the blood or urine. Additionally, neurotransmitter receptors on blood platelet cells appear to reflect the ones in the brain, and can also be used as distal indexes of pre- or post-synaptic central neurotransmitter receptor functioning. Peripheral measures are minimally invasive, expensive, and time-consuming to collect. However, a number of factors, including genetic, epigenetic, and environmental effects have an effect on peripheral measures

which in addition to the indeterminate differences between the peripheral measures and central nervous system neurotransmitter activity, renders them the least informative index of central 5-HT activity (Berman et al., 1997; Crowell et al., 2008).

Researchers have found mixed results in the platelet studies of the relationship between suicidality and the 5-HT functioning. For example, some studies have found that suicide attempters had lower levels of serotonin in whole blood than controls (e.g., Alvarez et al., 1999; Asberg & Forslund, 2000). Brown and colleagues (1982) found an increased number of 5-HT_{2A} receptors in platelets (which may reflect decreased pre-synaptic activity) in depressed patients with suicidal ideations as compared to depressed individuals with no suicidal ideations. Additionally, lower levels of peripheral 5-HT has been found in self-injuring adolescents and individuals experiencing depression, substance use, borderline and antisocial pathology, all of which have been highly associated with self-injury (Crowell, 2008; Verkes et al., 1998). However, other studies have failed to find a difference in the number of receptor sites in suicidal individuals versus non suicidal individuals (e.g., Kamali, Oquendo, & Mann, 2001; McBride et al., 1994). Furthermore, neither Matsubara, Arora, and Meltzer (1991) nor Roy and Linnoila (1988) found any differences in peripheral indexes of serotonin levels between suicide attempters and controls (Asberg & Forslund, 2000). Finally, Chotai and colleagues (1998) found no relationship between 5-HT levels and borderline personality disorder which is highly correlated with DSH (Asberg & Forslund, 2000). It has been proposed that reasons for these conflicting results include the possibility that platelet 5-HT_{2A} receptors may be state related (Kamali et al., 2001; Pandey, 1997) or that they do not in fact reflect central nervous system 5-HT_{2A} changes (Cho, Kapur, Du, & Hrdina, 1999).

Alternatively, it is possible that serotonin functioning differentially affects various SA behaviors and these results are conflicting because majority of these studies failed to make distinctions between individuals who experience suicidal thoughts only versus individuals who experienced the suicidal thoughts and have engaged in parasuicidal behaviors.

Neurochemical studies of 5-HT and self-aggression. One of the most often used and more reliable indexes of central 5-HT functioning is the measurement of 5-hydroxyindoleacetic acid (5-HIAA), the main metabolite of serotonin, in the cerebral spinal fluid (CSF). CSF 5-HIAA is extracted from a puncture in the lumbar sack and levels of CSF 5-HIAA in the spinal column correlate with 5-HIAA levels in the frontal cortex of the brain. Animal studies revealed that CSF 5-HIAA levels remain stable across the life span and different settings (Higley et al., 1996; Higley & Linnoila, 1997; Kamali et al., 2001). However, there are several disadvantages to using 5-HIAA as an index of central 5-HT activity. For example, 5-HIAA measurements are invasive and costly procedures that lack in specificity and information in regard to the location of neuronal activity and post-synaptic neurotransmitter receptor functioning (for a review see Berman et al., 1997). Additionally, 5-HIAA levels are influenced by a variety of factors such as age, sex, height, and seasonal rhythms (Asberg, 1997; Kamali et al., 2001).

Several reviews of studies investigating CSF 5-HIAA levels in suicide attempters have mostly found an inverse relationship between various estimates of suicidality and CSF 5-HIAA levels. For example, Asberg (1997) reviewed 33 studies and found that low levels of CSF 5-HIAA were associated with suicidality in unipolar depression and personality disorders. Lester (1995) conducted a meta-analysis of 27 studies on CSF

levels of neurotransmitter metabolites, involving 1,202 psychiatric patients and controls that provided strong evidence that individuals who had attempted suicide had lower levels of CSF 5-HIAA, as compared to psychiatric controls. Several other studies have found corroborating results. Mann and Malone (1997) found diminished levels of CSF 5-HIAA in depressed patients with a high lethality suicide attempt as opposed to depressed individuals with a low lethality suicide attempt, indicating differences dependent on the form of SA behavior used. López-Ibor, Saiz-Ruiz, and Pérez de los Cobos, (1985) found decreased levels of CSF 5-HIAA in individuals engaging in non-lethal self-injurious behaviors. Samuelsson, Jokinen, Nordström, and Nordström, (2006) demonstrated that diminished levels of CSF 5-HIAA strongly predicted completed suicide in young men with a previous suicide attempt, more so than hopelessness. However, Simeon and colleagues (1992) found no difference in CSF 5-HIAA concentration between individuals with a history of self-mutilation and individuals with no history of self-mutilation (for a review see Berman et al., 1997), indicating some lack of consistency in the pattern of findings within the literature. In addition, it is difficult to determine what exact function 5-HIAA reflects as it is involved in various processes of 5-HT metabolism from synthesis, to storage, and release and it can reflect a change in the total number of 5-HT neurons (Boadle-Biber, 1993; Tyce, 1990).

Pharmacochallenge studies of 5-HT and self-aggression. Pharmacochallenge studies involve challenging functional state of serotonin neurons by administering a drug that acts on a 5-HT specific central neurotransmitter system and affects hormonal response (e.g., prolactin). Neurotransmitter activity in the brain is in part responsible for hormonal output; therefore, diminished hormonal response to an administered drug may

indicate impaired neurotransmitter functioning (Berman et al., 1997). Although the pharmacochallenge approach measures the dynamic functioning of central neurotransmitter systems in the particular areas of the brain, it is important to note that drugs generally do not affect a single neurotransmitter system (making it difficult to ascertain if the hormonal response to drug administration is due to a neurotransmitter functioning or to direct activation of the hormonal gland; e.g., Berman et al., 1997; Coccaro & Kavoussi, 1994). Additionally a variety of factors (e.g., sex, menstrual cycle, weight) may serve as confounds (Malone et al., 1996).

One of the rare studies that specifically examined 5-HT differences among individuals who attempted suicide, had suicidal ideations, or were not suicidal was conducted by Meltzer, Perline, Tricou, Lowy, and Robertson (1984). They found that serum cortisol response was highest in patients who attempted suicide following an administration of the 5-HT precursor, 5-hydroxytryptophan (5-HTP). Furthermore, Kaufman and colleagues (1998) found augmented prolactin levels post 5-HTP challenge in children with a familial history of suicide attempts versus children with no familial history of suicidal attempts. One of the most frequently used techniques has been the use of fenfluramine (both the d and d, l isomers) 5-HT challenge drug (Kamali et al., 2001). Fenfluramine is a drug which increases the bioavailability of 5-HT at the synaptic level and subsequent secretion of a host of hormones (e.g., prolactin, a hormone released from the anterior pituitary gland) (Kavoussi, Armstead, & Coccaro, 1997). Several studies confirmed a blunted prolactin response to fenfluramine challenge in individuals with a history of suicide attempts. Specifically, diminished prolactin response to fenfluramine challenge has been found in individuals with personality disorders with a history of

suicidal and self-injurious behaviors (Coccaro, 1989; New, Trestman, Mitropoulou, & Benishay, 1997); individuals with a history of suicidality in comparison to controls (Cleary, Jordan, Horsfall, Mazoudier, & Delaney, 1999; Correa et al., 2000; Herpertz, 1995); and among individuals who have made a more lethal suicide attempts (Asberg & Forslund, 2000; Malone et al., 1996). However, some studies have found no difference in prolactin response to fenfluramine challenge in depressed patients who have or have not attempted suicide (Kamali et al., 2001; Park, Williamson, & Cowen, 1996) indicating that pharmacochallenge test results should be interpreted with caution as some ambiguity of their utility as index of 5-HT functioning remains.

In conclusion, being able to measure 5-HT levels in the brain is essential in the detection, identification, and treatment of deleterious behaviors and psychiatric conditions affected by impaired central 5-HT functioning. In addition, more studies are warranted to delineate biological differences between individuals who solely experience suicidal thoughts (ideators) and individuals who act on their suicidal thoughts (self-harmers). Limitations thus far include the fact that, although several biological markers of central 5-HT functioning have been employed, they appear to be either too indirect or invasive rendering conflicting experimental findings. In addition, ideators and self-harmers are not generally examined as distinct groups. Therefore, there remains a need for a reliable, non-invasive marker of central 5-HT functioning that can be employed to further elucidate the role of serotonin in individuals engaging in various forms of suicidal behavior, and to aid in the prediction and detection of individuals who go on to engage in possibly lethal DSH behaviors.

The Loudness-Dependent Auditory Evoked Potential and 5-HT

The loudness dependence of the auditory evoked potential has been proposed as a valid and non-invasive marker of 5-HT functioning in humans (for review, see Hegerl, Gallinat, & Juckel, 2001). Event related potentials (ERPs; extracted from electroencephalogram [EEG], a non-invasive technique that reflects brain's electrical activity) are components that reflect various neurocognitive processes and are time-locked with specific physical or cognitive occurrences (e.g., the presentation of a sound or a word; Picton et al., 2000). ERPs present as the positive and negative deflections in the EEG waveforms that correspond to electrical responses in the brain to a given stimuli (e.g., a tone). Components are identified based on the direction and latency of the event relative to the presentation of the stimulus. The ERPs of interest in this study are the auditory evoked N1 (i.e., negative deflection of the ERP that occurs on average 100 milliseconds [ms] post-auditory stimulus presentation) and the P2 (i.e., positive deflection of the ERP occurring on average approximately 200 ms after the onset of an auditory stimulus) components. The number in the component name corresponds to latency in a shortened form (Luck, 2005).

The LDAEP is a measure of auditory cortex activity depicted by the auditory-evoked N1/P2 potential slopes generated in the primary and secondary auditory cortex (Hegerl et al., 2001). N1/P2 component consists of two overlapping subcomponents generated by the superior temporal plane (mainly primary auditory cortex) and the lateral temporal gyri (secondary auditory cortex; Hegerl & Juckel, 1993; Makela & Hari, 1990). The N1/P2 component, occurring about 70-200 ms post stimulus, is used as a combined ratio parameter because it was found to have a higher loudness dependence reliability

than when the loudness dependence was measured separately for N1 and P2. In addition, the relationship with clinical features and personality factors was stronger with the loudness dependence of the combined parameter than the loudness dependence of individual N1- and P2-amplitudes (Hegerl, Gallinat, & Mrowinski, 1994). The N1/P2 component, in addition to being a reliable measure, was found to have prominent and stable inter-individual differences in their loudness dependence in humans. For example, Hegerl, Prochno, Ulrich, and Muller-Oerlinghausen (1988) found test-retest reliability of .77 for the Cz site (i.e., midline position of the central lobe according to the 10/20 system - the most widely used system of describing the location of scalp electrodes) median slope, and of .74 for the amplitude/stimulus intensity function (ASF) slope in a study with 33 healthy subjects retested after three weeks. ASF reflects the N1/P2 amplitude changes as the tone intensity increase. It is calculated by fitting a straight line to the amplitude values at each tone intensity using the least square technique. Furthermore, Hegerl and Juckel (1993) reported a test-retest correlation of .90 for the intra-individual stability of the intensity dependence N1/P2 component, mainly generated by the activity of the primary auditory cortex, in 32 healthy subjects retested after three weeks. Dipole source analysis was performed on the grand mean in order to extract the subcomponents and where they were generated. Specifically, dipole source analysis is a method used to separate the overlapping subcomponents of the N1/P2 component and look at them in relation to their generating cortical structures (i.e., primary and secondary auditory cortex; Hegerl & Juckel, 1993; Hegerl et al., 1994). Hence, dipole source analysis contributes to the reliability and validity of the loudness dependence measures due to its ability to examine the intensity dependence of the radial and tangential dipoles

independently (i.e., activity in the superior temporal plane that includes primary auditory cortex and the lateral temporal cortex that includes secondary auditory area respectively). Studies using dipole source analysis have found that N1/P2 component is mainly generated in the primary auditory cortex and is more sensitive to serotonergic activity in the primary auditory cortex (Hegerl et al., 1994). Note that not all N1/P2 studies have used dipole source recordings (Nathan, Segrave, Luan Phan, O'Neill, & Croft, 2006; Segrave, Croft, Illic, Phan, & Nathan, 2006; Uhl et al., 2006). Many have used the Cz site to compute the LDAEP, and the results have been similar regardless of the technique used (Croft, Klugman, Baldeweg, & Gruzelier, 2001; Nathan et al., 2006; Tuchtenhagen et al., 2000). Therefore, the basic concept behind the LDAEP as a 5-HT index is based on the assumption that serotonergic neurotransmission modulates sensory processing in the primary auditory cortex. Hence, high serotonergic neurotransmission, presumably resulting from a high firing rate of the serotonergic neurons in the dorsal raphe nuclei, ostensibly results in a weak LDAEP (i.e., minimal augmentation in the evoked cortical response with increasing loudness of the stimuli). Accordingly, low serotonergic innervation of the auditory cortex produces a more pronounced LDAEP N1/P2 component (i.e., increased N1/P2 amplitude to increasing intensity tones) (Hegerl & Juckel, 1993).

Presently, a large number of studies offer solid support for a relationship between the LDAEP and central 5-HT functioning. The initial evidence comes from animal studies. Juckel, Molnar, Hegerl, Csepe, and Karmos (1997) studied cats with chronically implanted epidural electrodes over the auditory cortex. The cats were intravenously administer saline as control, ketanserin (a 5-HT antagonist), and 8-OH-DPAT (a 5-HT

agonist). As expected, ketanserin enhanced the LDAEP, and 8-OH-DPAT reduced the LDAEP over the primary, but not the secondary, auditory cortex. This is consistent with the findings that the primary auditory cortex is more strongly innervated with 5-HT than the secondary auditory cortex (Hegerl et al., 1994). The authors, however, did note several limitations in interpreting the results of their study. First, the sample size was small. Second, the cats showed a wide variability in baseline LDAEP. Finally, there is inherent difficulty in drawing parallels between animals and humans with respect to biobehavioral relationships (Juckel et al., 1997).

A more recent study also supported the notion that central 5-HT levels modulate the LDAEP (Wutzler et al., 2008). Wutzler and colleagues (2008) examined the relationship between the LDAEP and the extracellular 5-HT levels (i.e., serotonin released from cortical neurons) in the primary auditory cortex of 18 rats (divided into a control and experimental groups). 5-HT levels were measured by in vivo microdialysis before and after SSRI citalopram administration (for the purposes of increasing extracellular 5-HT levels). Results indicated that citalopram-induced increases in 5-HT levels were significantly related to a decrease of the LDAEP N1 component, in support of the LDAEP index as an inverse marker of 5-HT activity. The authors found no significant effect for the LDAEP P2 component. They speculated that the null finding for the P2 component could be explained by the fact that the mean amplitude of P2 component is lower in rats than in humans. Findings from human studies of the LDAEP as an index of 5-HT, although suggestive, have been somewhat mixed. A brief review of the LDAEP as an index of 5-HT in humans follows.

One approach to investigating the relationship between the LDAEP and central 5-

HT has been to acutely augment central 5-HT levels with pharmacological agents in healthy individuals as well as in individuals with conditions related to serotonergic dysfunction and then record the components needed to calculate the LDAEP slope. This approach has produced mixed results. For example, Nathan and colleagues (2006) conducted a double-blind and placebo controlled repeated measures study, in which healthy individuals were tested under placebo and citalopram (SSRI) conditions. They found that 5-HT augmentation produced a significant decrease in N1/P2 slope with increasing tone loudness. The authors concluded that their findings provided support for the validity of the LDAEP as a 5-HT index. However, follow-up studies with healthy participants have failed to replicate these findings. For example, Uhl et al. (2006) found that the administration of citalopram did not significantly alter the LDAEP as measured at Cz during and after drug administration compared to a placebo. Furthermore, Guille et al. (2008) tested healthy subjects under four conditions: placebo, escitalopram, citalopram and sertraline (the latter three intended to acutely augment 5-HT activity). They also failed to find serotonergic enhancement effects on the LDAEP. Results of these studies indicate that, at least in healthy subjects, the LDAEP may not be a good indicator of acute changes in central 5-HT activity.

However, this does not preclude the use of the LDAEP as a valid biological indicator in vulnerable individuals. Several clinical studies have found a strong LDAEP in the individuals characterized by psychiatric disorders ostensibly marked by 5-HT dysfunction. For example, Gallinat, Bottlender, and Juckel (2000) investigated whether a strong LDAEP in depressive patients (reflecting depleted 5-HT activity) would predict a better clinical outcome (as assessed by Hamilton Scale for Depression) following four

weeks of treatments with an SSRI. They found that a significantly higher number of depressive patients fell into a strong LDAEP group and that those same individuals exhibited a significant decrease in depressive symptoms following the SSRI treatment compared to the depressive patients with a flat LDAEP. The authors concluded that the LDAEP may be of clinical importance in differentiating groups with serotonergic dysfunction and predicting SSRI treatment outcomes. Another study reported that patients with borderline personality disorder (BDP), who are believed to be characterized by serotonergic dysfunction, also exhibited an enhanced LDAEP in comparison to healthy controls (Norra et al., 2003). Hegerl and colleagues (1998) have found that patients with high levels of serotonin syndrome (i.e., a state of enhanced central 5-HT activity) exhibited a weaker LDAEP than those with low serotonin syndrome as measured with the Serotonin Syndrome Scale. In addition, Chen and colleagues designed a study to examine the LDAP slope differences in depressed patients who have and have not attempted suicide (Chen et al., 2005). They found a sharper LDAEP slope in the depressive-suicide group as opposed to the depressive-nonsuicidal group. They concluded that their results confirmed the previously hypothesized relationship between a strong LDAEP and acute suicidal behaviors in that it demonstrated higher degree of 5-HT dysfunction in depressive individuals who attempted suicide, compared to depressive individuals who made no such attempt (Chen et al., 2005).

O'Neill, Croft, and Nathan (2008) reviewed the LDAEP studies to date in an attempt to investigate the utility of the LDAEP as an index of 5-HT functioning. They found that a direct relationship between the LDAEP and 5-HT is more compelling in animal studies compared to human studies. However, they proposed that, although at this

time the evidence suggests that the LDAEP is insensitive to acute changes in 5-HT functioning, the LDAEP may nonetheless have a predictive utility for antidepressant treatment response. Hence, examining the LDAEP may also have a predictive utility for individuals who transition from purely having thoughts of suicide to engaging in DSH behavior that could prove to be fatal.

Self Aggression Paradigm and Suicide-Implicit Association Test

True experimental studies used to illuminate the direction of a relationship between self-aggression and potential causal factors have been difficult to conduct due to the obvious sensitive nature of the topic at hand. However, although suicidal behavior does not, obviously, lend itself to experimental manipulation, a behavioral self-aggression marker and an indirect test of implicit associations have been used to study correlates of suicide. Use of these objective measures can also be beneficial in development of a better understanding of suicide ideation and parasuicide. To this end, a controlled laboratory measure of self-aggression (Self Aggression Paradigm; SAP) (Berman & Walley, 2003) and a time-reaction based measure of cognitive associations of death/suicide with self (Suicide-Implicit Association Test; S-IAT) (Nock et al., 2010) have shown promise.

The Self-Aggression Paradigm (SAP) (Berman & Walley, 2003). Since the mid-1960s several experimental studies examined human self-aggressive behavior under the controlled laboratory conditions with self-aggression being defined as the self-administration of noxious stimuli (see Rosenkrans, 1967; Walster, Aronson, & Brown, 1966). However, these behavioral instruments of self-aggressive behavior were not psychometrically evaluated thus lacking validity and reliability data. To address these

shortcomings and fill in the gap in the laboratory measures of self-aggression, Berman and colleagues (Berman & Walley, 2003; Berman, Jones, & McCloskey, 2005; McCloskey & Berman, 2003) have developed a behavioral analogue of self-aggression. The Self-Aggression Paradigm (SAP) is an adaptation of the Taylor Aggression Paradigm (TAP) (Taylor, 1967), which has been widely used for the experimental study of other-directed aggressive behavior. SAP mean shock setting was found to be correlated with the scores on the Suicidal Behaviors Questionnaire – Short Form (Berman & Walley, 2003; Cole, 1988) (SBQ-SF) and number of intense shock setting selections (Berman, Jones, & McCloskey, 2005; McCloskey & Berman, 2003).

The SAP requires the participants to self-administer a shock if they lose on a reaction-time task trial. Self-aggression is operationally defined as the mean shock used and the intensity of self-administered shock during the task performance. It is assumed that healthy individuals without suicidal intent and ideations or individuals not engaging in deliberate self-harm would either set no shock or low levels of shock for themselves. Several experimental studies to date have found evidence that factors generally believed to be related to self-aggression (e.g., alcohol, psychoactive drugs) do in fact promote self-aggressive responding. For example, McCloskey and Berman (2003) conducted a study that provided evidence for a significant role of ethyl alcohol in selection of higher levels of mean shock intensity and total number of intense shock selections independent of other commonly associated risk factors (e.g., depression).

Additionally, McCloskey and colleagues (2009) recently conducted one of the only studies to our knowledge observing the effects of experimentally lowered 5-HT levels (by dietary tryptophan depletion) on self-aggressive behavior using the SAP (Berman &

Walley, 2003; McCloskey & Berman, 2003). Experimental studies of 5-HT and self-aggression involve manipulation of neurotransmitter activity and a random participant assignment to treatment conditions assessing self-aggressive tendencies. Tryptophan depletion or augmentation via dietary precursors is one of the most utilized techniques used to manipulate central 5-HT levels. Tryptophan is an amino acid essential to central 5-HT synthesis that has been found to influence central CSF 5-HIAA levels in humans and animals (for a review see Berman et al., 1997). McCloskey and colleagues (2009) found that experimentally lowered 5-HT levels increased self-injurious behaviors under laboratory conditions regardless of the individuals' history of aggressive behaviors. The above addressed line of research shows promise for the future more comprehensive view of the direction of 5-HT and self-aggression relationship.

Given the 5-HT and self-aggression literature, in the current study we would expect that individuals who have acted on their suicidal thoughts (self-harmers) would score the highest on the SAP, exhibiting greatest propensity for self-harm, followed by ideators. In addition, we would expect that the control group would not show a significant pattern of self-harm behavior via shock administration.

Death/Suicide Implicit Association Test (S-IAT) (Nock et al., 2010). Recently there has been an increase in research on implicit cognitive processing that advances cognitive theory of psychopathology (Palfai & Wagner, 2004). Implicit cognitive processing is comprised of implicit cognition (i.e., unconscious influences or influences that are outside of individual's awareness that nonetheless may guide individual's actions) and automatic cognitive processes (e.g., attentional processes). Cognitive psychopathology models suggest that attentional biases (i.e., a cognitive predisposition to direct attention

toward particular aspects of stimuli), together with dysfunctional cognitive schemas (i.e., cognitive structures controlling information processing in general), heighten vulnerability for certain disorders (Beck, 1976; Cha, Najmi, Park, Finn, & Nock, 2010). In other words, cognitive models espouse the view that psychopathology is caused and maintained by unconscious cognitive processing deficits.

One of the most used measures of implicit attitudes is the Implicit Association Test (IAT) (Greenwald, McGhee, & Schwartz, 1998). The use of IAT has grown rapidly in the recent years. The IAT was developed to measure people's implicit attitudes in a covert way that is not as vulnerable to conscious deliberation (Ferguson & Bargh, 2004). The IAT is an indirect, performance-based measure of an individual's implicit thoughts on a variety of subjects. It is grounded in the idea that it should be easier and quicker for people to respond to two ideas that are already associated in one's mind than two ideas that are not already associated (Greenwald et al., 1998). Accordingly, reaction times are measured for associated or matched pairs and compared to the reaction times for the unmatched pairs. Therefore, individual's implicit attitudes are uncovered via patterns of response times in categorizing stimuli according to certain dimensions (Palfai & Wagner, 2004). The IAT was found to be resistant to 'fake good' attempts and to have good reliability, construct validity, and ability to detect meaningful changes in clinical treatment (see Nock & Banaji, 2007). Although originally developed to examine individuals' attitudes in social psychology domains, recently the use of IAT has transitioned in the assessment of clinical psychopathology.

Nock and colleagues (Nock & Banaji, 2007; Nock et al., 2010) have adapted traditional IAT into an implicit association measure of self-injury and suicide. They argue

that traditional self-report measures fail to accurately represent the degree of suicidal ideation an individual may be having due to an individual's lack of motivation to admit to such thoughts for various reasons (e.g., to avoid intervention or hospitalization) or due to an individual's lack of 'introspective awareness.' Indeed, studies have found that the suicide risk is particularly high immediately after individuals are released from the hospital, although they have ostensibly been deemed as no longer dangerous to themselves (Busch, Fawcett, & Jacobs, 2003; Nock et al., 2010). Additionally, 78% of patients who commit suicide verbally deny suicidal ideations in their last communications (Nock et al., 2010; Qin & Nordentoft, 2005).

In one study, Nock and Banaji (2007) adapted traditional IAT into an implicit association measure of self-injury, Self-Injury Implicit Association Test (SI-IAT). They found that SI-IAT was able to differentiate non-suicidal individuals, suicide ideators, and suicide attempters (Nock & Banaji, 2007). Specifically, they found that SI-IAT was able to not only predict current suicide ideation and attempt status, but that it also contributed incrementally to the prediction of suicidal outcomes above other risk factors (e.g., presence of mood disorder, prior history of suicide ideation and attempts). Additionally, the authors found that SI-IAT was able to discriminate individuals who have made a suicide attempt (attempters) and individuals who thought about suicide (ideators), with attempters showing the largest positive association between self-injury and oneself, ideators demonstrating smaller positive association between self-injury and oneself, and non-suicidal individuals exhibiting a negative association between self-injury and oneself. However, Nock and Banaji (2007) noted that the limitation of this study included the fact that both ideators and attempters had a history of some form of non-suicidal self-

injury, calling for further research to replicate these findings among suicidal individuals who have no history of self-injury and individuals who engage in potentially lethal DSH behaviors.

In the next study, Nock and colleagues (2010) developed and proposed a putative cognitive/behavioral marker of suicidality in a form of an IAT that measures implicit cognitions of death/suicide with self (S-IAT) (Nock et al., 2010). S-IAT is a short computer-based test that uses an individual's response times to suicide/death related stimuli to measure implicit attitude toward suicide. Nock and colleagues (2010) were able to distinguish suicide attempters from other psychiatrically distressed patients using an individual's implicit association scores between death/suicide and self. Furthermore, they found that S-IAT served as a cognitive marker that was able to significantly predict future (i.e., within six-months) suicide attempt above and beyond other currently used prediction techniques (e.g., clinician prediction, known risk factors), providing evidence for a potential importance of S-IAT in detection and prediction of suicidal behavior. Nock and colleagues (2010) suggest that an individual's implicit attitude may steer his or her behavior in coping with distress. However, again the limitation of this study is in the fact that Nock and colleagues did not include a sample of individuals who have suicidal thoughts but have not engaged in suicidal behavior. Therefore, it would be worthwhile to examine if S-IAT can also more specifically discriminate among ideators and self-harmers. In addition, aligning with their suggestion and the cognitive theory of psychopathology (i.e., that maladaptive cognitive schemas influence perception, judgment, and ultimately behavior) it is also possible that an individual's implicit cognitions may mediate the relationship between a biological vulnerability (e.g.,

diminished 5-HT functioning) and self-aggressive behavior. That is, it is possible that individuals who most strongly identify with suicide are more apt to engage in potentially lethal DSH and ultimately commit suicide (see Nock & Banaji, 2007; Joiner, 2005).

Accordingly, we would expect that individuals with the highest degree of dysregulated 5-HT functioning, as measured with the LDAEP, who demonstrate the strongest positive association of self with death/suicide on the S-IAT would come from the SH group.

Again, combining information from various sources would aid our understanding, prediction, and prevention of the suicidal behavior.

CHAPTER III

PROPOSED STUDY

The present study intended to provide further insight into biological differences among individuals engaging in suicidal thought, parasuicidal behaviors, and those who are non-suicidal, through cortical evoked potentials and a multi-method approach to analysis of suicidal behavior. To my knowledge, this study was the first one to use the LDAEP as a measure of central serotonergic functioning to determine an association between serotonin and suicidal behavior among individuals who engage in various degrees and forms of suicidal behaviors. Specifically, the present study builds upon a previous study (Marsic et al., in preparation) which found an association between the LDAEP as a measure of central serotonergic functioning and self-aggression as assessed by self-report only. This study aimed to address the limitations of Marsic et al.'s (in preparation) study and to replicate and extend the findings of the LDAEP and self-aggression relations by using more defined groups, the behavioral measure of self-aggression (i.e., SAP), and an implicit association measures (i.e., S-IAT) in addition to self-report measures. Three groups were composed of (a) individuals who had frequent 'suicidal ideations' but have never engaged in DSH (SI group); (b) individuals who had engaged in DSH acts and endorsed suicide ideations (SH group); and (c) individuals who had no history of suicide ideations or DSH (controls).

Primarily, I was interested in individual differences that could shed light on why some individuals transition from solely having suicide ideation to inflicting DSH. To this end, I aimed to examine if the LDAEP can provide a more nuanced picture of the neurobiological differences among the SI, SH, and control groups. The secondary

purpose was to investigate if the LDAEP would be correlated with SAP and S-IAT in addition to observing whether the three groups would exhibit differential performance on these tasks.

Hypotheses

I predicted that (1) The SH group would exhibit the largest LDAEP slope, followed by the SI group, and finally the Control group; (2) The SH group would obtain the largest mean shock score and would self-select the highest number of “20” shock, followed by the SI group, and finally the Control group; (3) SI and SH groups would obtain a more negative S-IAT index, indicating pro-suicide tendencies, than the Control group; (4) the LDAEP slope would be positively related to the SAP indexes and negatively related to S-IAT index; and (5) the LDAEP would be positively related to the self-report measures of self-injurious behavior and aggression, and negatively related to self-report measure of reasons for living.

CHAPTER IV

METHOD

Participants

A study sample consisting of college students and community members included 48 men and women (for group break down please see the results section of this document). Participants were recruited from a larger pool of students, who completed the self-report portion of the study online, and interested community members who meet the screening criteria (see Figure 1).

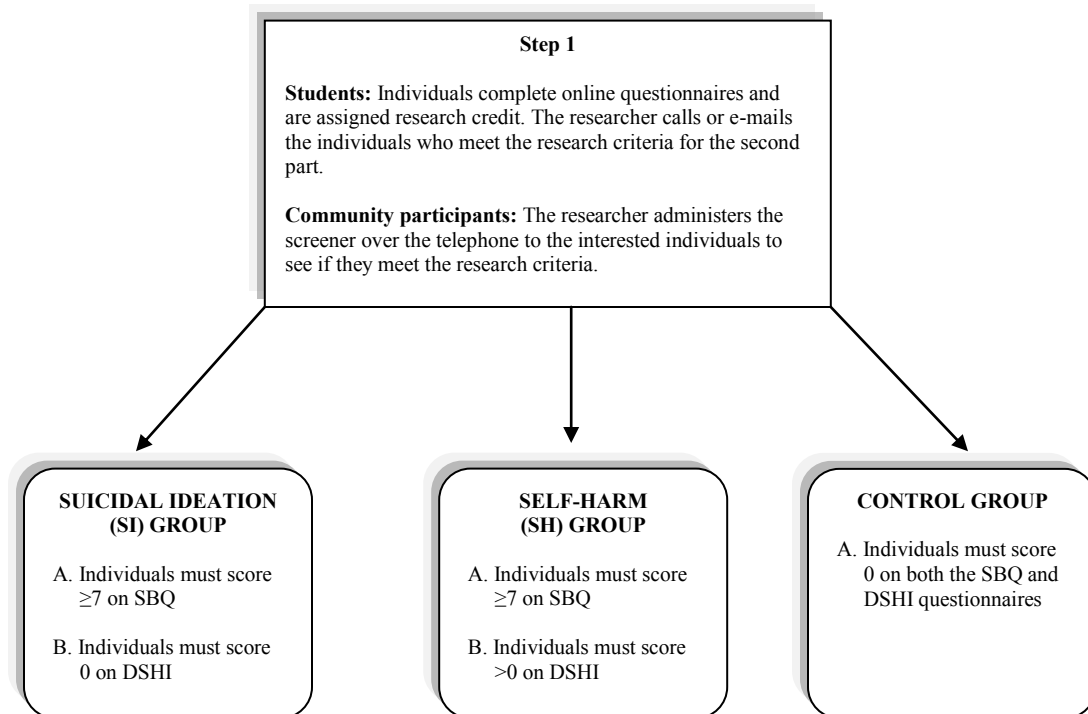


Figure 1. Group Assignment.

Groups were composed of (a) individuals who reported significant suicidal ideations but have never engaged in DSH (SI group); (b) individuals who engaged in DSH and reported significant suicidal ideation; and (c) individuals with no history of suicidal ideation or DSH (control group). Participants were assigned to groups based on

their scores on the screener measures described below (Suicidal Behaviors Questionnaire [SBQ] and Deliberate Self Harm Inventory [DSH]). Participants were screened for the history of physical, neurological, bipolar, and substance dependence disorders. They were not on any medication at the time of the study, and were told not to consume alcohol or caffeinated beverages in the 24 hours prior to the study. Hearing impaired individuals were excluded. In addition, individuals with a recent history of a major depressive episode were excluded due to recent findings that individuals experiencing an acute depressive episode may experience decreased motivation to engage in a goal-directed activity, therefore inhibiting rather than exacerbating their self-aggressive responses (McCloskey, Gollan, & Berman, 2008). Participants received either extra course credit if they were students and monetary compensation if they were from the community, for their participation in the experiment. This study was approved by the University of Southern Mississippi Institutional Review Board (Appendix A).

Measures

Demographics and Background Information Questionnaire.

A demographic questionnaire was created for the current study including items on the participant's age, gender, and race. Along with this demographic information, questions regarding hearing impairment, illicit drug and nicotine use, and questions about psychological disorder diagnoses were included (Appendix B).

Self-Report Measures of Self-Injurious Behavior

As reported above, SA behaviors occur on a continuum of severity, frequency, intensity, and form. In order to obtain a thorough and comprehensive understanding of

the type of self-injurious behavior that the research participants have engaged in the past, a slew of valid and reliable self-report and behavioral measures were administered.

Suicidal Behaviors Questionnaire (SBQ; Cole, 1988). The SBQ is a four-item self-report measure that assesses suicidal thoughts, plans, and behavior (Appendix C). The SBQ questions are as follow: (1) *Have you ever thought about or attempted to kill yourself;* (2) *How often have you thought about killing yourself in the past year;* (3) *Have you ever told someone that you were going to commit suicide, or that you might do it;* and (4) *How likely is it that you will attempt suicide one day?* Items are rated on a Likert format scale with values ranging from 0-6; 0-4; 0-2; 0-4 respectively. Scores range from 0 to 16 (with higher scores implying greater suicidality). The SBQ has adequate internal consistency ($\alpha = .80$) for a non-clinical sample, and good test-retest stability over time ($r = .95$; Cotton, Peters, & Range, 1995). Furthermore, the SBQ has good construct validity as evidenced by a significant positive correlation ($r = .69$) between the SBQ and the Scale for Suicidal Ideations (SSI; Beck, Kovacs, & Weisman, 1979) in a non-clinical sample (Cotton et al., 1995) and is positively correlated with laboratory measures of self-aggression (Berman & Walley, 2003). The SBQ was used as a screener measure of suicidal ideations. Participants completed SBQ online. Individuals who received a score of seven (a validated cutoff score in the non-clinical adult population) (Osman et al., 2001) or above on the SBQ were assigned to either SI or SH groups (determined by their score on DSHI).

Deliberate Self-Harm Inventory (DSHI; Gratz, 2001). The DSHI is a 17-question, self-report scale of self-harm behaviors (Appendix D) that has been validated in a non-clinical sample (Gratz, 2001). Questions cover a variety of non-lethal forms of self-

aggressive behaviors (e.g., self-cutting, burning, scratching, biting, and punching). For example, items include: “*Have you ever intentionally (i.e., on purpose) carved words into your skin; Have you ever intentionally (i.e., on purpose) used bleach, comet, or oven cleaner to scrub your skin.*” Individuals endorse ‘yes’ or ‘no’ for each item. Furthermore, the DSHI also inquires as to whether an individual required medical attention for any of the self-harm behaviors in which they engaged. A DSHI total score is obtained by summing the total number of endorsed self-harm behaviors.

The DSHI has been found to have adequate internal consistency ($\alpha = .82$) and test-retest stability ($r = .92$) for the number of endorsed self-harm behaviors (Gratz, 2001). Adequate, but moderate, correlations with other commonly used self-report measures of self-harm behaviors have been found (e.g., DSHI and the self-harm items on Mental Health History Form) (Boudewyn & Liem, 1995) $r = .49$ (Gratz, 2001). The DSHI was used as a screener for parasuicidal behaviors and was administered online. Specifically, individuals had to obtain a score of 0 to be considered for the SI or the control group. Conversely, individuals had to obtain a score greater than 0 on DSHI to be considered for the SH group.

The Scale for Suicide Ideation – Self-Report (SSI-SR) (Beck, Steer, & Ranieri, 1988). The SSI-SR is a 19-item self-report measure designed to assess severity of individual’s suicidal thoughts and plans (Appendix E). Items are assigned values based on a 3-point scale that ranges from 0 to 2, yielding a total score range from 0 to 36. Items include statements such as *Wish to live; Wish to die; Reason for living*.

SSI-SR has high internal consistency ($\alpha = .96$) for an outpatient sample (Beck, Steer, & Ranieri, 1988). Furthermore, the SSI-SR has good construct validity as

evidenced by a significant positive correlation ($r = .69$) between the SSI-SR and the SBQ (Beck, Kovacs, & Weisman, 1979), as well as between SSI-SR and Hopelessness Scale ($r = .62$) (Beck, Weissman, Lester, & Trexler, 1974) in a non-clinical sample. SSI-SR was used as a corroborating measure of suicidal ideations and was administered online.

The Life History of Aggression scale – Self-Aggression subscale (LHA-SA) (Coccaro, Berman, & Kavoussi, 1997). The Life History of Aggression (LHA) (Coccaro, Berman, & Kavoussi, 1997) is an 11-item self-report measure of aggressive, self-aggressive, and anti-social behavior history (Appendix F). The LHA assesses frequency and intensity of these behaviors, rather than aggressive traits or ideation, and it provides information about these behaviors across the life span (from 13 on). The LHA yields a total score and three subscale scores: Aggression (AG) subscale, Antisocial Behavior (AB) subscale, and Self-Aggression (SA) subscale.

LHA-Self Aggression is a 2-item subscale of the LHA. It measures the frequency of self-aggressive behaviors across the life span. Items are assigned values based on a six-point scale reflecting total number of occurrences of the behavior (i.e., 0 = no occurrences to 5 = more events than can be counted). Specifically, the two items query how many times the participant: *Deliberately tried to physically hurt yourself in anger or desperation*, and *Deliberately tried to end your life or kill yourself in anger or desperation*. The LHA-SA was used as a corroborating measure of self-aggressive tendencies and was administered online.

Self-Report Measures of Aggression

Aggression has been identified as a potential risk factor for suicidal behavior (Favazza, 1998; Mann et al., 1999; McCloskey et al., 2009). Particularly, a history of

aggressive behavior was found to be uniquely related to instances of suicide attempts over other frequently co-occurring personality dimensions (e.g., impulsivity) in individuals with major depression and no Axis II disorders (e.g., Keilp et al., 2006; Westheide et al., 2008). Therefore, measures of past aggressive behavior and aggressive ideations have been included to explore not only group differences among individual engaging in various degrees of SB but also to observe if the hypothesized relationship between the LDAEP and SB holds net aggression.

Life History of Aggression Scale-Aggression (LHA-AG) (Coccaro, Berman & Kavoussi, 1997; Coccaro, Berman, Kavoussi & Hauger, 1996). The five-item AG subscale of the LHA was used as a measure of other-directed aggression because of its focus on other-directed physical aggressive behaviors. Recall, items are assigned values based on a six-point scale reflecting total number of occurrences of the behavior (i.e. 0 = no occurrences to 5 = more events than can be counted). Specifically, among others, the items include the number of times the participant: *Got into physical fights with other people; Deliberately hit another person (or an animal) in anger.*

The AG subscale has adequate internal consistency ($\alpha = .87$) and test-retest stability ($r = .80$). Construct validity was established with a laboratory measure of aggressive behavior ($r = .49, p < .05$) and a measure of self-reported hostility ($r = .56, p < .05$) (Coccaro et al., 1996). This measure was administered online.

Buss-Perry Aggression Questionnaire (BPAQ) (Buss & Perry, 1992). The BPAQ is a widely used self-report measure of aggressive ideations (Appendix G). It consists of 29-items, which measure the likelihood of committing various aggressive acts on a 5-point Likert format scale (with responses ranging from *Extremely unlike me* to *Extremely*

like me) for aggressive behaviors occurring after the age of 13. Factor analyses established four subscales: physical aggression (PA), verbal aggression (VA), anger (A), and hostility (H), in addition to a total aggression scale. Higher scores indicate a greater likelihood of engaging in an aggressive behavior.

The BPAQ total and factors scores have adequate internal consistency (PA, $\alpha = .85$; VA, $\alpha = .72$; A, $\alpha = .83$; and H, $\alpha = .77$; BPAQ Total $\alpha = .89$) and stability over time (PA, $r = .80$; VA, $r = .76$; A, $r = .72$; H, $r = .72$; BPAQ Total $r = .80$) (Buss & Perry, 1992). Evidence for construct validity of BPAQ comes from the correlations with peer nominations (Buss & Perry, 1992). BPAQ was administered online.

Self-Report Measures of Negative Affect

As previously discussed, negative emotional states (e.g., depression, anxiety) have been identified as risk factors for engaging in various forms of self-injurious behavior. However, although negative emotional states such as depression and hopelessness are highly related to suicide ideation and parasuicide, many people who experience depression and hopelessness do not have thoughts of suicide, and, as discussed, many individuals who do experience suicide ideation never engage in parasuicide. Accordingly, it was important to include measures of negative emotional states, not only to explore any potential group differences in negative emotionality, but to also control for these states in order to obtain a more nuanced understanding of a relationship between the SB and the LDAEP.

Depression Anxiety Stress Scales-21 (DASS-21) (Lovibond & Lovibond, 1995). The DASS-21 is a short form of Lovibond and Lovibond's (1995) 42-item self-report measure of depression, anxiety and stress (Appendix H). The scale is comprised of three

subscales (i.e., depression, anxiety, stress) each consisting of 7-item subscales. Items are scored on a 4-point Likert scale, ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). Because the DASS-21 is a short form, each subscale score must be multiplied by two. Therefore, scores range between 0 and 42 on each subscale. On the depression subscale, scores above 20 indicate severe depression; scores above 14 on the anxiety subscale indicate severe anxiety; and scores above 25 on the stress subscale indicate severe stress.

The DASS-21 has good convergent and discriminant validity, as well as high internal consistency and reliability. Cronbach's Alpha has been reported at .88 for Depression subscale, .82 for Anxiety and .90 for Stress (Henry & Crawford, 2005). DASS-21 was administered online.

Self-Report Measure of Reasons for Living

Reasons for Living Inventory (RFL) (Linehan, Goodstein, Nielsen, and Chiles, 1983). The RFL is a 48-item scale developed to assess the cognitive component in suicide (Appendix I). Specifically, the scale consists of potential reasons for not committing suicide if one is experiencing suicidal thoughts. Items are scored on a 6-point Likert scale ranging from 1 ("*extremely unimportant*") to 6 ("*extremely important*"). The scale yields six distinct factors: survival and coping beliefs, responsibility to family, child concerns, fear of suicide, fear of social disapproval, and moral objections (Linehan et al., 1983; Range & Steede, 1988).

The RFL has good internal consistency with Chronbach Alphas ranging from .72 to .89 for each subscale (Linehan et al., 1983). RFL was included because the subscales have been found to differentiate suicide ideators from nonideators, suicide attempters

from nonattempters, and individuals with a history of suicide ideations from individuals with no history of suicidal ideations (Linehan et al., 1983; Range & Antonelli, 1990). The RFL was administered online.

Laboratory Measures

The Self-Aggression Paradigm (SAP) (Berman & Walley, 2003). The SAP task was designed to assess self-directed aggressive behavior. The SAP is a laboratory measure of self-aggressive behavior masked as a competitive reaction-time task with another (fictitious) opponent. During the SAP, the participant is presented with an opportunity to select from a range of electric shocks to self-administer from a non-self-aggressive (no shock) to an extreme self-aggressive (a severe shock) response with self-aggression operationally defined as the level of shock chosen. The SAP is a valid measure supported by positive relationship that has been found between shock intensity and self-ratings of self- and other-directed aggressive tendencies, and other variables theoretically or empirically associated with self-injurious behaviors (Berman et al., 2003; Berman & Walley, 2003). SAP behavior was found to be distinct from self-rated motivation to win and an actual reaction time performance on the reaction-time task (Berman & Walley, 2003).

Post-task questionnaire. Participants completed the Post-Task Questionnaire after completing behavioral task assessing self-aggressive behavior (Appendix J). The Post-Task Questionnaire aimed to determine participants' strategies used during the behavioral tasks, ratings of the importance of winning, importance of the perception of the experimenter and the other participant, rating of the actual or perceived painfulness of receiving a shock setting of 20, and their perception of purpose of the task. The post-task

questionnaire was designed to determine if the deception necessary for the SAP was successful. None of the participants who were included in the data analysis guessed the true purpose of the study.

Death/Suicide Implicit Association Test (S-IAT) (Nock et al., 2010). The S-IAT was designed to assess individuals' implicit associations they hold about life and death/suicide. It is a short test administered on the computer that measures people's reaction times in classification of stimuli representing the constructs of 'death' (i.e., *die, dead, deceased, lifeless, and suicide*) and 'life' (i.e., *alive, survive, live, thrive, and breathing*) and the attributes of 'me' (i.e., *I, myself, my, mine, and self*) and 'not me' (i.e., *they, them, their, theirs, and other*). Nock et al. (2010) found that individuals who have attempted suicide have a more robust implicit association between death/suicide and self than controls and that a strong implicit association exists between death/suicide and self-predicted future (i.e., within six months) suicide above and beyond other currently used prediction methods (e.g., identifiable risk factors, clinician's judgment).

Loudness-Dependence Auditory Evoked Potentials (LDAEP). The LDAEP stimulus presentation, data acquisition, and analyses were performed using equipment and software obtained from the James Long Company – 15-channel custom optically-isolated bioamp. LDAEPs were recorded with 15 electrodes arranged according to 10/20 EEG electrode system, using M1 as a reference and AFz as ground. Impedances were kept below 5 kOhm throughout the testing. Pure sinus tones (1000 Hz, with 100 ms duration with 10 ms rise and 10 ms fall time, ISI randomized between 1800 and 2200 ms) of five intensities (60, 70, 80, 90, 100 dB generated by a Stim sound generator) were presented biaurally in a pseudorandomized form by headphones. Data were collected

with a sampling rate of 500 Hz and an analogous bandpass filter (0.16 – 50 Hz). One hundred and forty sweeps of each stimulus intensity were presented (700 sweeps in all). Post-stimulus peak latencies were determined between 80-120 ms for N1 and 150-230 ms for P2 components.

Procedure

The study was conducted in two parts. First part was conducted online and the second part was conducted in the Clinical Studies Laboratory at the University of Southern Mississippi. In the first part of the study the participants completed the self-report portion of the study online using a computer of their choosing. They were given instructions to respond to the questionnaires in a quiet place and in a single setting. This portion of the study lasted approximately one hour, upon which the participants received research credit for that portion of the study.

For the second part of the study, the experimenter contacted the participants who met the research criteria or who were randomly selected as matched controls (see Figure 1) by telephone or e-mail for a chance to participate in the second part of the study for additional research credit. The researcher also contacted interested community participants via telephone. For further qualification purposes, a brief screening interview was administered via telephone to assure that participants did not have a history of physical, neurological, bipolar, and substance dependence disorders nor that they have met a criteria for Major Depressive Disorder in the past six months. Once participants met all of the inclusionary criteria and agreed to participate in the second part of the study they were scheduled and asked to abstain from alcohol or caffeinated beverages for 24 hours prior to testing.

Upon arrival, the participants completed an informed consent for the second part of the study. They were then prepared for the SAP portion of the study. Specifically, they were seated in front of the reaction-time apparatus (a computer monitor and a keyboard on which the only keys of interest are the space bar – reaction time key and the numbers – representing the shock levels). Prior to the introduction of the task, fingertip electrodes were attached to the index and middle fingers the non-dominant hand. The participant was reminded that they would be competing in a reaction-time task against another ‘fictitious’ participant in the adjoining lab. The participant’s shock-tolerance threshold was determined by administering increasingly intense shocks, at 100-mA intervals, until the participant, as instructed, requested that the threshold shock administration be stopped once the shock intensity reached a pain threshold. The same threshold determination was repeated with the ‘opponent’ to increase the credibility of the deception (in reality a pre-recorded voice was played for the participant to overhear).

After the threshold determination, the experimenter provided the instructions for the reaction time task over the intercom in order for the ‘both participants’ to hear them at the same time. Participants were instructed to select a shock from 0 through 10, or 20, by pressing one of 12 buttons on the keyboard before each reaction-time trial. They were further informed that the slower person on each trial would receive the shock level they chose for themselves before that trial. Participants was also informed that the 10 shock was equivalent to the shock level judged very unpleasant, the 9 shock was set at 95% of this maximum, 8 at 90%, 7 at 85%, and so forth and that the 20 would administer a ‘severe’ shock, twice the intensity of the 10 (in actuality, selection of a 20 delivered a shock the intensity of 10). If a participant selected a 0, no shock was administered on a

losing trials (a non-self-aggressive response option). No other information was provided about the shock function in the task. The participant completed a series of 28 reaction-time trials. The computer was preprogrammed to allow the participant to win on half of the trials. The 28 trials consisted of an initial trial followed by four blocks of six trials, with a single transition trial following each block except the last. Upon finishing the reaction time task, the participant completed the post-task computer administered questionnaire.

Next, the participant was prepped for the EEG recording. He was seated in a comfortable chair. An appropriately sized electrocap consisting of 15 electrodes (F3, F4, Fz, C3, C4, Cz, O1, O2, P3, P4, F7, F8, M1, M2, AFz) following a 10-20 International System, was fitted on participant's head. The scalp was prepared by application of a mildly abrasive gel (OmniPrep). EOG electrodes were placed on the outer canthi of each eye, and on the supraorbital and infraorbital ridge of the left eye, in order to allow for detection and removal of ocular artifacts. According to lab standards, each electrode site displayed impedance of less than 5k Ω while the impedance on the EOG sites were kept at less than 10k Ω . The left mastoid electrode site was used as a reference site during the collection phase. However, during the analysis, the right mastoid was averaged with the left mastoid to serve as the final reference. The average of both mastoids as a reference aids in avoiding the left or right hemisphere bias often found when using just one reference site (Luck, 2005). The equation used to average the left and right mastoid sites was $a' = a - (r/2)$ (with a' representing the average of both sites, a the original waveform for any site that might be referenced (e.g., Fz) with a reference to the right mastoid, and r as the original waveform for the left mastoid with the right mastoid as the reference). An

ERP waveform is never an electrical property of the specific site alone, but it is the difference between the active site and the averaged reference sites (Luck, 2005).

The participant was instructed to refrain from moving his eyes during testing to ensure that contamination of the data due to eye movement was minimized. Specifically, a fixation point was displayed on the screen for the duration of the EEG experiment and the participant was asked to softly focus on that point and refrain from any eye movement other than regular blinking as well as to keep the blinking at a minimum. In addition, the participant was asked to refrain from making any body movements, in other words to ‘sit still’ for the duration of the EEG experiment.

Finally, the participants was administered the S-IAT at the same computer. Subsequently, the participant was thanked and provided with a list of Mental Health Resources (Appendix K). The researcher assigned students research credit and provided community participants with previously agreed upon monetary compensation.

Data Analysis

EEG analysis

Prior to analyzing the N1 and P2 amplitudes, a grand mean waveform for each electrode site was created. Based on visual inspection of the grand mean waveform and findings from previous research, appropriate latency time intervals were determined (Hegerl & Juckel, 1993; Makela & Hari, 1990). N1 amplitudes were determined by computing the average amplitude between a latency of 80 and 120 ms. P2 amplitudes were determined by computing the average amplitude between a latency of 150 and 230 ms. Computing the average amplitude using in the predetermined latency is a superior measure to peak amplitudes (Luck, 2005).

The mean amplitudes were computed for each electrode site by use of the STIM analysis program ERPScore. The mean amplitudes were then entered into SPSS and organized by site (F3, F4, Fz, P3, P4, C3, C4, or Cz), tone intensity (60, 70, 80, 90, 100 dB), and amplitude (N1 or P2). Previous research demonstrated that the N1/P2 amplitude is most pronounced at the Cz site. Therefore, our analysis used the Cz site to be consistent with previous research studies. N1/P2 amplitude was then calculated as the difference between N1 and P2 (P2-N1) at the Cz site. Linear regression was conducted to calculate the N1/P2 slope with tone intensity as the independent variable, and N1/P2 amplitude as the dependent variable.

S-IAT analysis

Response latencies for all trials were analyzed using the standard IAT scoring algorithm (Greenwald, Nosek, & Banaji, 2003; Nock et al., 2010). *D* scores, representing association between death and self and life and self were calculated for each participant. *D* score was used as an implicit cognition index of self-aggressive behavior for the statistical purposes, with a more negative *D* score indicated pro-suicide tendencies, whereas a less negative or positive *D* score indicated anti-suicide tendencies.

CHAPTER V

RESULTS

Initial Data Screening

Incomplete data files were obtained for six participants due to equipment malfunction or computer failure. For these participants, the missing data consisted of the complete loss of the IAT or the SAP data. In addition, one participant provided contradictory responses on two measures of self-aggressive behavior (DSHI and LHA-SI). Thus, the remaining data from these participants were excluded from further analysis. The resulting data set consisted of forty-one participants (14 men and 27 women; $M = 25.15$ years, $SD = 9.96$).

Internal Consistency of Self-Report Measures

Self-report measures were analyzed to determine their internal consistency. The reliability results are presented in Table 1. Results show that all scales, except LHA-SA, which comprises two items, demonstrated moderate to high internal consistency. It is likely that the small number of items in LHA-SA accounts for the lower internal consistency of that subscale.

Table 1

Internal Consistency for Self-Report Measures (N = 41)

Measure	Number of Items	Chronbach's Alpha
Measures of Self-Injurious Behavior		
SBQ	4	.79
DSHI	17	.87

Table 1 (continued).

Measure	Number of Items	Chronbach's Alpha
Measures of Self-Injurious Behavior		
SSI-SR	19	.92
LHA-SA	2	.60
RFL	48	.95
Measures of Aggressive Behavior		
BPAQ	29	.91
LHA-AG	5	.91
Measures of Negative Emotionality		
DASS-D	7	.95
DASS-A	7	.80
DASS-S	7	.86

Notes. SBQ = Suicidal Behavior Questionnaire; DSHI = Deliberate Self Harm Inventory; SSI-SR = Scale of Suicide Ideations-Self-Report; LHA-SA = Life History of Aggression – Self-aggression Subscale; LHA-AG = Life History of Aggression – Aggression Subscale; BPAQ = Buss Perry Aggression Questionnaire; DASS-D = Depression Anxiety Stress Scales – Depression Subscale; DASS-A = Depression Anxiety Stress Scales – Anxiety Subscale; DASS-S = Depression Anxiety Stress Scales – Stress Subscale; RFL = Reasons for Living.

Group Differences as a Function of Age, Gender, and Ethnicity

Chi-square and one-way analysis of variance (ANOVA) tests were used to examine whether there were differences among the groups on demographic variables (e.g., gender, age, and ethnicity). Race was dichotomized into a Caucasian and Non-Caucasian group due to low numbers of Asian ($n = 2$) and Hispanic ($n = 1$) participants. Results of Chi-square tests revealed that groups did not differ in terms of gender ($\chi^2 = 0.18, p = .92$) or ethnicity ($\chi^2 = 1.45, p = .49$). In addition, no significant group differences in age were found, $F(2, 38) = 2.42, p = .10$. Results are presented in Table 2.

Table 2
Age, Race, and Gender Group Distributions

Characteristic	Total Sample (<i>N</i> = 41) <i>n</i> (%)	SI Group (<i>n</i> = 13) <i>n</i> (%)	SH Group (<i>n</i> = 15) <i>n</i> (%)	C Group (<i>n</i> = 13) <i>n</i> (%)	Statistic	<i>p</i> - value
Gender					$\chi^2 = 0.18$.92
Men	14 (34.1%)	5 (38.5%)	5 (33.3%)	4 (30.8%)		
Women	27 (65.9%)	8 (61.5%)	10 (66.7%)	9 (69.2%)		
Race					$\chi^2 = 1.45$.49
Caucasian	24 (58.5%)	6 (46.2%)	9 (60.0%)	9 (69.2%)		
Non-Caucasian	17 (41.5%)	7 (53.8%)	6 (40.0%)	4 (30.8%)		
Age					$F = 2.42$.10
<i>M</i> (<i>SD</i>)	25.15 (9.96)	29.31 (13.24)	25.13 (9.58)	21.00 (3.27)		

Notes. SI = Suicidal Ideation Group; SH = Self-Harm Group; C = Control Group.

Group Differences in SBQ and DSHI

Recall that participants were assigned to groups according to their SBQ and DSHI scores. In order to confirm that group differences reflected participants' group assignment, a 2 (gender: men, women) x 3 (group: SI, SH, control) between-subjects multivariate analysis of variance (MANOVA) was performed on SBQ and DSHI as dependent variables. No main effects for gender or interaction were found. However, anticipated significant group differences emerged, $F(4, 34) = 39.66, p < .001$, partial $\eta^2 = .70$. Specifically, univariate results indicated that differences in SBQ scores, $F(2, 35) = 38.74, p < .001$, partial $\eta^2 = .69$, and DSHI scores, $F(2, 35) = 54.07, p < .001$, partial $\eta^2 =$

= .76, among the control, SI, and SH groups were statistically significant. Furthermore, post-hoc analysis revealed that groups differed in an expected pattern. That is, Tukey's HSD tests showed that both the SI ($M = 7.62$) and the SH ($M = 8.00$) group scored significantly higher on SBQ than the control group ($M = 0$); whereas SI and SH groups did not differ. Accordingly, Tukey's HSD test revealed that the SH group ($M = 5.53$) endorsed significantly higher instances of deliberate self-harm as measured by DSHI than SI and Control groups, both of which endorsed zero instances of self-harm. These findings suggest that participants were grouped appropriately. Results are reported in Table 3.

Table 3

Group Mean Differences in SBQ and DSHI

Measures	SI Group ($n = 13$)		SH Group ($n = 15$)		C Group ($n = 15$)		Total ($N = 41$)		ANOVA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	η^2
SBQ										
Men	8.00	2.82	8.40	2.30	0.00	0.00	5.86	4.34	0.24	.01
Women	7.38	3.24	7.80	3.19	0.00	0.00	5.07	4.44		
Total	7.62 ^a	2.98	8.00 ^a	2.85	0.00 ^b	0.00	5.34	4.37	38.74*	.69
DSHI										
Men	0.00	0.00	4.60	3.13	0.00	0.00	1.64	2.87	0.90	.03
Women	0.00	0.00	6.00	2.05	0.00	0.00	2.22	3.19		
Total	0.00 ^a	0.00	5.53 ^b	2.44	0.00 ^a	0.00	2.02	3.06	54.07*	.76

Notes. SI = Suicidal Ideation Group; SH = Self-Harm Group; C = Control Group; SBQ = Suicidal Behavior Questionnaire; DSHI = Deliberate Self Harm Inventory.

^{a,b} Means with a same superscript are not significantly different from one another; means with a different superscript significantly differ from one another, per row. * $p < .001$

Self-Reported Group Differences in Suicidality and Related Constructs

Given the group differences in SBQ and DSHI, it would follow that groups would also differ on other self-report instruments measuring related constructs (i.e., suicidal ideation, self- and other directed-aggression, negative affect, and reasons for living). To examine group differences on these self-report measures a 2 (gender: men, women) x 3 (group: SI, SH, control) MANOVA was performed on following dependent variables: SSI-SR, LHA-SA, LHA-AG, BPAQ, DASS-D, DASS-A, DASS-S, and RFL. No significant effects were noted for gender or interaction. However, as expected, results indicated significant main effects for groups on all measures $F(16, 56) = 7.03, p < .001$, partial $\eta^2 = .67$. Univariate results are reported in Table 4. Post-hoc analysis revealed that SI and SH group scored higher on SSI-SR, DASS-D, and DASS-S, than the control group, but did not significantly differ from each other on these measures. Furthermore, the SH group scored significantly higher on the LHA-SA than the SI and control groups, who did not significantly differ from each other on this measure. This finding provides additional evidence that the SH group represents individuals who have a history of self-injurious behavior, as opposed to only suicidal ideations.

With respect to LHA-AG, BPAQ, DASS-A, all showed a similar pattern of findings. Specifically, post-hoc analysis revealed that the SH group scored significantly higher than the SI group. The control group scored significantly lower than both SH and SI groups.

In contrast, the RFL showed the opposite pattern of results. As would be expected the control group scored significantly higher than both SI and SH groups. In turn, the SI groups scored significantly higher than the SH group. Means and Standard Deviation are reported in Table 4.

Table 4

Group Mean Differences in Measures of Self-injurious Behavior (SIB_M), Aggression (A_M), and Negative Affect (NA_M)

Measures	SI (<i>n</i> = 13)		SH (<i>n</i> = 15)		C (<i>n</i> = 13)		Total (<i>N</i> = 41)		ANOVA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	η^2
SIB_M										
SSI-SR	8.15 ^a	5.53	8.80 ^a	7.42	0.15 ^b	0.38	5.85	6.63	8.35**	.32
LHA-SA	0.00 ^a	0.00	4.20 ^b	1.97	0.00 ^a	0.00	1.54	2.35	55.48**	.76
RFL	4.04 ^a	0.75	3.59 ^b	1.06	4.68 ^c	0.76	4.08	0.97	4.10*	.19
A_M										
LHA-AG	11.23 ^a	7.95	15.47 ^b	5.89	7.69 ^c	7.33	11.66	7.60	3.25 [†]	.16
BPAQ	70.00 ^a	23.88	85.00 ^b	15.04	55.92 ^c	13.65	71.02	21.30	10.16**	.37
NA_M										
DASS-D	9.69 ^a	6.77	8.67 ^a	6.58	1.62 ^b	2.06	6.76	6.55	257.9**	.31
DASS-A	4.77 ^a	3.53	7.40 ^b	4.76	2.00 ^c	2.45	4.85	4.31	81.37**	.24
DASS-S	8.77 ^a	5.79	9.00 ^a	4.34	3.46 ^b	3.48	7.17	5.18	133.21**	.26

Notes. SI = Suicidal Ideation Group; SH = Self-Harm Group; C = Control Group; SSI-SR = Scale of Suicide Ideations-Self-Report; LHA-SA = Life History of Aggression – Self-aggression Subscale; LHA-AG = Life History of Aggression – Aggression Subscale; BPAQ = Buss Perry Aggression Questionnaire; DASS-D = Depression Anxiety Stress Scales – Depression Subscale; DASS-A = Depression Anxiety Stress Scales – Anxiety Subscale; DASS-S = Depression Anxiety Stress Scales – Stress Subscale; RFL = Reasons for Living.

^{a, b, c} Means with a same superscript are not significantly different from one another; means with a different superscript significantly differ from one another, per row.

[†] $p = .051$, * $p < .05$, ** $p < .01$

Group Differences in the N1/P2 Slope

We predicted that individuals would exhibit differences in their N1/P2 Cz slope as a function of group assignment. Specifically, it was hypothesized that the SH group would exhibit the largest N1/P2 slope, followed by the SI group and then the Control group. Data were analyzed by conducting a 2 (gender: men, women) x 3 (group: SI, SH, control) analysis of variance (ANOVA). No significant main effects for gender were found. In addition, contrary to predictions, results indicated no significant main effect for group.

However, results revealed a significant group x gender interaction, $F(2, 35) = 3.93, p = .03$, partial $\eta^2 = .18$. Two follow up one-way ANOVAs were conducted to explore the interaction. Results indicated that men did not differ significantly as a function of their group membership, $F(2,11) = 1.47, p = 2.71$. Recall that cell sizes for men were very small, ranging from four to five participants per group. However, a non-significant trend for women emerged as a function of their group membership, $F(2, 24) = 2.56, p = .09$. Although alpha level of .05 was considered statistically significant for these analyses, given the small sample size and low statistical power, this finding is worthy of discussion. Although post-hoc analysis was not statistically significant, mean group differences in women followed the expected pattern. That is, women in the SH group exhibited the highest slope ($M = 0.86$), followed by the women in the SI group ($M = 0.67$), with women in the control group coming in last ($M = 0.55$). The results are presented in Table 5.

Table 5

Group Differences in the N1/P2 Slope

Measures	SI (<i>n</i> = 13)		SH (<i>n</i> = 15)		C (<i>n</i> = 13)		Total (<i>N</i> = 41)		ANOVA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	η^2
N1/P2										
Men	0.65	0.32	0.11	0.63	0.57	0.62	0.43	0.56	3.71	.09
Women	0.67	0.37	0.86	0.12	0.55	0.37	0.70	0.32		
Total	0.66	0.34	0.61	0.51	0.55	0.44	0.61	0.43	0.66	.03
Interaction									3.93*	.18

Notes. SI = Suicidal Ideation Group; SH = Self-Harm Group; C = Control Group; N1/P2 = N1/P2 Loudness Dependence Auditory

Evoked Potential Standardized Slope (B) at Cz site.

**p* < .05

Group Differences in the Self-Aggression Paradigm

We predicted that the control group would select lower mean shock and fewer number of 20 shock, than both SI and SH groups. We also thought that the SH group would score the highest on these SAP indexes. Overall, twelve participants (28.6%) of forty-one participants, had selected the 20 shock at some point. Thus, selection of 20 shock was not an extremely rare event. Any 20 shock selections were recoded to a numerical value of 11, to ensure that differences between groups were not enhanced by data outliers or skew.

Data were analyzed by conducting two separate 2 (gender: men, women) x 3 (group: SI, SH, control) ANOVAs, with SAP mean as a dependent variable in the first one, and the number of “20” shock as a dependent variable in the second one. Results indicated that there were no significant main effects for group in mean shock or number of “20” shock self-administered. Thus, this prediction was not supported. However, results did reveal a significant main effect for gender, $F(1, 35) = 4.38, p = .04$, partial $\eta^2 = .11$, such that men set higher shocks on average ($M = 6.07$) than women ($M = 3.75$). In addition, results indicated a significant main effect for gender in the number of “20” shock that was selected, $F(1, 35) = 7.37, p = .01$, partial $\eta^2 = .17$. Men self-administered more “20” shocks ($M = 3.21$) than women ($M = 0.41$). These results are in line with previous research that has found that men are more likely to on average self-administer higher shocks than women. No significant interaction was found. These data are presented in Table 6.

Table 6

Group Differences in the Self-Aggression Paradigm

Measures	SI (<i>n</i> = 13)		SH (<i>n</i> = 15)		C (<i>n</i> = 13)		Total (<i>N</i> = 41)		ANOVA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	η^2
SAP Avg										
Men	5.51	4.04	7.91	2.31	4.50	4.63	6.07	3.71	4.38*	.11
Women	4.31	3.79	4.14	2.52	2.82	2.47	3.75	2.89		

Table 6 (continued).

Measures	SI (<i>n</i> = 13)		SH (<i>n</i> = 15)		C (<i>n</i> = 13)		Total (<i>N</i> = 41)		ANOVA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	η^2
SAP Avg										
Total	4.71	3.77	5.39	2.99	3.33	3.17	4.54	3.34	1.65	.08
Interaction ^c									0.58	.03
SAP 20										
Men	3.80	5.21	4.20	5.71	1.25	2.50	3.21	4.64		
Women	0.87	2.47	0.20	0.42	0.22	0.44	0.41	1.36	7.37*	.17
Total	2.00	3.85	1.53	3.64	0.54	1.39	1.37	3.16	1.04	.05
Interaction									0.77	.04

Notes. SI = Suicidal Ideation Group; SH = Self-Harm Group; C = Control Group; SAP Avg = Self Aggression Paradigm – Mean Shock; SAP 20 = Self Aggression Paradigm – Number of 20s;

* $p < .05$.

Group Differences in the Suicide-Implicit Association Test

I also expected to find significant group differences in reaction times on S-IAT. Specifically, it was predicted that in comparison to control group, SI and SH groups would produce a higher negative implicit cognition index (D), indicating pro-suicide tendencies. To examine group differences on the S-IAT, a 2 (gender: men, women) x 3 (group: SI, SH, control) ANOVA was conducted. As predicted, results indicated a significant main effect for group, $F(1, 35) = 6.96$, $p < .001$, partial $\eta^2 = .28$. However, post-hoc analysis revealed that the pattern of findings only partially supported this hypothesis. Specifically, Tukey's HSD test revealed that SI group ($M = -0.54$) did receive

a significantly larger negative D score, indicating pro-suicide tendencies. However, contrary to prediction, SH ($M = -0.13$) and control ($M = -0.24$) groups did not differ. This suggests that S-IAT does tap into suicidal ideations in individuals who only have a history of suicidal ideations. However, it does not appear to tap into suicidal ideations in individuals with a history of self-harm. No significant effects were noted for gender or the interaction term. The results are presented in Table 7.

Table 7

Group Differences in the Suicide-Implicit Association Test

Measures	SI ($n = 13$)		SH ($n = 15$)		C ($n = 13$)		Total ($N = 41$)		ANOVA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	η^2
IAT-D										
Men	-0.54	0.38	0.14	0.39	-0.26	0.32	-0.21	0.45	1.45	.04
Women	-0.54	0.39	-0.27	0.22	-0.23	0.29	-0.34	0.32		
Total	-0.54 ^a	0.37	-0.13 ^b	0.34	-0.24 ^b	0.28	-0.29	0.37	6.96*	.28
Interaction ^c									1.83	.09

Notes. SI = Suicidal Ideation Group; SH = Self-Harm Group; C = Control Group; IAT-D = Implicit Cognition Index of Self-aggressive Behavior.

^{a, b} Means with a same superscript are not significantly different from one another; mean with a different superscript significantly differs from the other two, per row.

* $p < .01$

Relation among N1/P2 Slope, SAP, and S-IAT

Exploratory analysis was conducted to explore the association among N1/P2 slope, SAP, and S-IAT. A bivariate correlation matrix was generated (see Table 8).

Results indicated that N1/P2 slope was not related to the SAP Avg ($r = -.10, p = .53$) or SAP 20 ($r = -.12, p = .44$). On the other hand, the N1/P2 slope was significantly negatively related to S-IAT ($r = -.43^{**}, p = .01$). Therefore, the electrophysiological index of decreased central 5-HT functioning (N1/P2 slope) was correlated with scores on S-IAT test in the expected direction. Hence, this hypothesis was partially supported. No significant correlation was found between S-IAT and SAP.

Table 8

Correlations among N1/P2 slope, SAP, and S-IAT

Scale	1	2	3	4
1. Cz Slope	(1.00)			
2. SAP Avg	-.10	(1.00)		
3. SAP 20	-.12	.59 ^{**}	(1.00)	
4. IAT-D	-.42 ^{**}	.21	.02	(1.00)

Notes. Cz Slope = N1/P2 Loudness Dependence Auditory Evoked Potential Standardized Slope (B) at Cz site; SAP Avg = Self Aggression Paradigm – Mean Shock; SAP 20 = Self Aggression Paradigm – number of 20s; IAT-D = Implicit Cognition Index of Self-aggressive Behavior.

$p < .05$, $** p < .01$

Relation between N1/P2 Slope and Self-Report Measures

Additional exploratory analyses were conducted to examine the association among the N1/P2 slope and self-report measures of self-injurious behavior, aggression, and reasons for living. Results of the bivariate analysis revealed that the N1/P2 slope was not correlated with any of the measures. Thus, this hypothesis was not supported. The results are presented in Table 9.

Table 9

Correlations between Self-Report Measures and N1/P2 slope

Scale	1	2	3	4	5	6	7	8
1. Cz Slope	(1.00)							
2. SBQ	.07	(1.00)						
3. SSI-SR	.16	.71**	(1.00)					
4. DSHI	.15	.47**	.41**	(1.00)				
5. LHA-SA	.12	.49**	.43**	.79**	(1.00)			
6. LHA-AG	-.18	.31*	.21	.28*	.39**	(1.00)		
7. BPAQ	-.18	.44**	.37**	.45**	.49**	.55**	(1.00)	
8. RFL	-.03	-.37**	-.45**	-.45**	-.46**	-.12	-.28*	(1.00)

Notes. Cz Slope B = N1/P2 Loudness Dependence Auditory Evoked Potential Standardized Slope (B) at Cz site; SBQ = Suicidal Behavior Questionnaire; SSI-SR = Scale of Suicide Ideations-Self-Report; DSHI = Deliberate Self Harm Inventory; LHA-SA = Life History of Aggression – Self-aggression Subscale; LHA-AG = Life History of Aggression – Aggression Subscale; BPAQ = Buss Perry Aggression Questionnaire; RFL = Reasons for Living.

$p < .05$, ** $p < .01$ (1-tailed).

Aggregating participants in the SI and SH Groups

Finally, we aggregated the SI and SH groups into an overall suicide group, in order to increase statistical power to detect differences. Specifically, the SI and SH groups were collapsed into one group for the follow-up analysis exploring differences in behavioral indexes of interest (i.e., N1/P2 slope, SAP Avg, SAP 20, and IAT-D), between individuals who have engaged in any type of suicidal thought/behavior (suicide group) and individuals with no history of any suicidal thought/behavior (control group). Data were analyzed by conducting a series of one-way ANOVAs with the two groups as a

factor, and N1/P2 slope, SAP Avg, SAP 20, and IAT-D as dependent variables. Although the pattern of group differences was consistent with expectations, that is the suicide group scored higher on all four behavioral indexes, the mean differences were not statistically significant. Results can be observed in Table 10.

Table 10

One-way ANOVAs Examining Differences between Control and Suicide Groups on Behavioral Indexes

	Control (<i>n</i> = 13)	Suicide (<i>n</i> = 28)	F	<i>p</i> - value
N1/P2 Slope				
<i>M</i>	0.55	0.63	0.31	.58
<i>SD</i>	0.43	0.43		
SAP Avg				
<i>M</i>	3.33	5.10	2.57	.12
<i>SD</i>	3.17	3.32		
SAP 20				
<i>M</i>	0.54	1.75	1.30	.26
<i>SD</i>	1.39	3.67		
IAT-D				
<i>M</i>	-0.24	-0.32	0.38	.54
<i>SD</i>	0.28	0.40		

Notes. N1/P2 Slope = N1/P2 Loudness Dependence Auditory Evoked Potential Standardized Slope (B) at Cz site; SAP Avg = Self Aggression Paradigm – Mean Shock; SAP 20 = Self Aggression Paradigm – number of 20s; IAT-D = Implicit Cognition Index of Self-aggressive Behavior.

CHAPTER VI

DISCUSSION

The purpose of this study was to examine the loudness-dependent auditory evoked potential differences among individuals who have engaged in various degrees of suicidal behavior. Specifically, to our knowledge this was the first study to date to compare individuals who: (a) solely experienced suicidal ideation (SI group); (b) experienced suicidal ideation and have engaged in deliberate self-harm acts (SH group); and (c) individuals with no history of suicidal ideation or deliberate self-harm behavior (control group), with regard to cortical evoked potentials and a multi-method approach to analysis of suicidal behavior.

Discussion of the LDAEP Findings

In relation to the LDAEP, I hypothesized the following pattern of results: (1) SH group would exhibit the largest LDAEP slope, followed by the SI group, and finally the Control group; (2) the LDAEP slope would be positively related to the SAP indexes and negatively related to S-IAT index; and (3) the LDAEP would be positively related to the self-report measures of self-injurious behavior and aggression, and negatively related to self-report measure of reasons for living.

An expected pattern of results only emerged with regard to the relation between the S-IAT and the LDAEP. This implied that individuals with a more pronounced implicit pro-suicide attitudes exhibited a stronger N1/P2 slope, thought to reflect decreased central 5-HT functioning. It has been suggested that implicit death/suicide associations may be a prelude to suicidal behavior and are responsible for influencing individual's suicidal response to a severe distress (Nock, 2009). It appears that

serotonergic dysfunction, as measured by the LDAEP may underlie these implicit attitudes.

Contrary to expectations, results of this study did not find the LDAEP to be a clinically useful tool in discriminating individuals who have engaged in various degrees of suicidal behavior. These results are in line with studies that have found that the LDAEP did not discriminate healthy control individuals from individuals with major depressive disorder (Linka et al., 2009; Park et al., 1996). This may be due to the fact, as Park et al., (1996) suggested, that individuals who engage in deliberate self-harm, like the individuals with major depressive disorder, comprise heterogeneous subgroups.

These results are, however, not in line with other studies that have found, for example, that the LDAEP slope discriminates individuals who have attempted suicide from the ones that have not attempted suicide among major depressive individuals (Chen et al., 2005). The difference between the Chen study and this study, was the fact that in Chen study all of the patients met current Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria for major depression, and that their SH group actually attempted suicide, versus engaged in a deliberate self-harm behavior with an unclear intent. In our study, individuals' report of suicidal behavior was retrospective in nature, the deliberate self-harm inflicted did not necessarily qualify as a suicide attempt; and the participants did not necessarily meet the current diagnostic criteria for depression. Perhaps the LDAEP would be more useful in individuals with clearly defined psychopathology and who engage in more severe forms of suicidal behavior.

Nevertheless, it is important to note that although the LDAEP did not discriminate groups as whole, the female group differences followed the expected pattern, even if the

results were not statistically significant. This means that our findings do not absolutely repudiate the function of the LDAEP in discriminating these groups of individuals, rather it is possible that the detection of statistically significant results would require larger sample size in general, and more men in particular. Recall, men were not very well represented in the groups, with sample sizes ranging from four to five in each group.

Also unsupported was the postulated relationship between the LDAEP and the self-report measures of suicidality, aggression and negative affect, as well as the SAP indexes. Lack of relation between the LDAEP and negative affect is consistent with Chen (2005) research that found that although suicide attempters exhibited a sharper LDAEP slope, the self-report depression scale scores were not correlated with the LDAEP slope. It is possible that the LDAEP is not a good indicator of the severity of negative affect an individual may experience. Furthermore, lack of significant relationship between the LDAEP and aggression is concurrent with Marsic et al. (unpublished study) results. As it is the case in this study, Marsic and colleagues did not recruit individuals with a marked and documented history of violence, which may explain non-significant results. In addition, Marsic et al. contributed the lack of significant findings to aggression being a complicated social construct, caused by myriad of factors ranging from personality to biological factors (e.g., Berman et al., 2009), thus making it more difficult to detect neurobiological correlates of this class of behaviors.

On the other hand, surprisingly, this study failed to replicate Marsic et al. additional finding, which found an association between the LDAEP and suicidality as assessed by self-report measures, calling into question the results of the previous study. Furthermore, this study failed to extend Marsic et al. findings by not finding a significant

association between the LDAEP and the SAP. Methodological differences between the two studies exist, that could explain the contradictory nature of the results found. First, Marsic et al. results were based on an all men sample, which is in contrast to this study that used both men and women, but had notably small number of men in each group. Second, unlike this study, Marsic et al. did not recruit individuals with a marked history of self-injurious or suicidal behaviors. Considering that individuals for this study were recruited based on a cut off score on SBQ and DSHI measures, the results may have been influenced by the range restriction. It is possible that a statistically pronounced LDAEP and self-harm relation would be more easily observed in individuals who exhibit a wider range of suicidality scores.

Another explanation for the lack of significant findings may be the ostensible instability of the serotonergic activity in at risk populations. That is, it has been suggested that individuals who are at a clinical risk of self-harming experience dynamic fluctuations in 5-HT levels (Juckel and Hegerl, 1994). Specifically, Juckel and Hegerl (1994) suggested that at risk populations may have a volatile serotonin system, and that only when individuals are acutely suicidal may they exhibit a momentary decrease in serotonin levels. Future studies should systematically examine individuals at a full spectrum of severity, from outpatient individuals with a history of suicidal behaviors who are currently not engaging in any self-harm behaviors, to inpatient individuals who are acutely suicidal at the time of the study.

Finally, it is possible that the LDAEP may not tap into 5-HT functioning related to various levels of suicidal behavior, and/or may not be a reliable biological index of 5-HT functioning in these populations. However, considering contradictory findings in the

literature and the potential clinical usefulness of the LDAEP in identifying at risk individuals, this topic is worthy of further exploration. One way to do this would be to examine the LDAEP in conjunction with peripheral 5-HT markers in an at risk population.

Discussion of the SAP Findings

The Self-Aggression Paradigm has been used widely for the experimental study of aggressive behavior directed towards self. Previous studies have demonstrated that individuals who scored high on measures of suicidal behavior (e.g., SSI-SR and SBQ) were more likely to self-administer more intense shocks and a higher number of intense shock settings (Berman et al., 2005; Berman & Walley, 2003; McCloskey & Berman, 2003). Contrary to expectations, this study failed to find the same pattern of results. Specifically, the SAP was not found to differentiate individuals based on their group membership.

This contradictory finding could be explained in part by the methodological differences among the studies. Specifically, this study examined whether the SAP indexes would differentiate groups based on pre-existing characteristics, namely their history of suicidal behaviors. On the other hand, the studies mentioned above used healthy controls with a wide range of scores on the measures of suicidal behavior. In addition, they used experimental manipulations to create the SAP differences among groups. For example, the effects of alcohol (McCloskey and Berman, 2003), diazepam (Berman et al., 2005), and social modeling (Berman & Walley, 2003), on self-aggression in healthy controls, as assessed by the SAP, were examined experimentally. It is possible that these manipulations served as risk factors that propelled an individual to set more

severe shocks. Nock (2009) has suggested that, among other reasons, individuals engage in deliberate self-harm because they possess interpersonal vulnerability factors that impede the likelihood that they would respond to distressing situations in an adaptive way, but rather resort to using self-injury to manage their emotional distress. It is possible that the individuals from the SH group did not resort to self-aggressive behavior because they were not in distress at that time. It is important to remember that the laboratory paradigms limit the ecological validity, and may not be the best reflection of people's behaviors outside the lab when confronted with distressing triggers.

Despite the lack of the group differences in SAP, our results did reveal gender differences in the self-selected shock. That is, across the two shock indexes, higher levels of self-aggression were noted in men. This is in line with previous research that has found that men are more likely to self-aggress than females regardless of group membership.

Discussion of the S-IAT Findings

The Suicide-Implicit Association Test is a novel performance-based measure that has been developed in an attempt to differentiate suicide attempters from other psychiatrically distressed patients. In line with expectations, we found that the S-IAT discriminated the SI group from the SH and control groups. However, contrary to prediction the S-IAT did not discriminate the SH group from the control group. This finding is curious and difficult to explain considering that individuals in the SI and the SH groups had similar scores on the measures of suicidal ideations. One possibility is that the S-IAT only taps into suicidal ideations in individuals who engage in cognitive versus cognitive and behavioral suicidal behavior. In addition, the IAT stimuli in this study only focused on death. Future version that use more narrowly defined self-harm stimuli may

do a better job in discriminating the SH group from the control group.

Discussion of Group Differences in DASS

We found group differences on self-report instruments measuring suicidal ideation, self- and other directed-aggression, negative affect, and reasons for living. For the most part, the differences followed the expected pattern of results. However, of particular interest was the finding that although the SI and SH groups did not significantly differ on their DASS-D and DASS-S scores, they did differ in DASS-A scores, such that the SH group scored significantly higher than the SI group. It is possible that higher levels of depression and stress contribute to suicidal ideations, however higher levels of anxiety may contribute to the probability of an individual transitioning from having suicidal ideation to engaging in a self-harming behavior. It has been proposed that physiological hyperarousal, as a reaction to stressful events, is a predisposing risk factor for the use of self-injury as a maladaptive coping mechanism for emotion regulation (Nock, 2009). Considering that anxiety is theoretically linked to physiological hyperarousal, the results indicating that anxiety appears to discriminate SI and SH groups are not surprising.

Limitations

First, a central limitation of the current study was the small sample size. Several factors may have hindered recruitment efforts and individuals' willingness and motivation to sign up for this study: (a) the low base rate of the suicidal behavior; (b) private nature of suicidal behavior; (c) social unacceptability of suicidal behaviors; and (d) individual's tendency to hide suicidal thoughts and intentions. Future studies should involve a greater number of participants, and an equal number of men and women.

Second, event related potentials (ERPs), especially LDAEPs, are very small and some amount of inference is necessary when interpreting them. In addition, the current study observed the LDAEP only from the Cz electrode (as per previous research) instead of using dipole source analysis that would allow for the examination of the LDAEP generated in the primary auditory cortex. Primary auditory cortex was found to have greater serotonergic activity, and to generate the LDAEP in a way that may be more sensitive to 5-HT functioning. However, the differences between the two measurement techniques have not been found to be large (Nathan et al., 2006).

Third, we did not exclude individuals who smoke, nor did we control for menstruation cycle in women. Yet both of these parameters may have an impact on 5-HT functioning (Park et al., 1996). Future studies should control for these two factors.

Fourth, with regard to the assessment of suicidal behavior, we made no distinction between current and past self-harm behaviors and ideations. Future studies should further classify individuals as currently experiencing/engaging in severe suicidal behaviors and ones that have a history of suicidal behaviors, but are currently not suicidal or engaging in deliberate self-harm.

Conclusion

In conclusion, our results indicated that the LDAEP was not successful in differentiating individuals who solely experienced suicidal ideation, experienced suicidal ideation and have engaged in deliberate self-harm acts, and individuals with no history of suicidal ideation or deliberate self-harm behavior. These findings bring into question the value of the LDAEP, as an indicator of serotonergic activity, in identifying high risk population. However, ascertaining bio-psycho-social differences among individuals who

engage in various degrees of suicidal behavior is of paramount importance in designing detection and prevention components of programs that would be effective in reducing rates of suicide and suicidal behaviors. Therefore, this line of research should continue. Future studies should use larger and clinical samples, peripheral measures of 5-HT, and a multi-method approach to analysis of suicidal behavior, to further investigate the validity of the LDAEP as a marker of the central serotonergic system and its clinical usefulness in discriminating individuals who have engaged in various degrees of suicidal behavior.

APPENDIX A

INSTITUTIONAL REVIEW BOARD NOTICE OF COMMITTEE ACTION



THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Institutional Review Board

118 College Drive #5147
 Hattiesburg, MS 39406-0001
 Tel: 601.266.6820
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 www.usm.edu/irb

**HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
 NOTICE OF COMMITTEE ACTION**

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: **C10100403**

PROJECT TITLE: **The Relationship Between Suicide Ideation and Parasuicide: An Electrophysiological Investigation Using the Loudness Dependence of Auditory Evoked Potential**

PROPOSED PROJECT DATES: **10/01/2010 to 07/31/2011**

PROJECT TYPE: **Previously Approved Project**

PRINCIPAL INVESTIGATORS: **Angelika Marsic**

COLLEGE/DIVISION: **College of Education & Psychology**

DEPARTMENT: **Psychology**

FUNDING AGENCY: **N/A**

HSPRC COMMITTEE ACTION: **Expedited Review Approval**

PERIOD OF APPROVAL: **05/19/2011 to 05/18/2012**

Lawrence A. Hosman

 Lawrence A. Hosman, Ph.D.
 HSPRC Chair

5-23-2011

 Date

APPENDIX B

DEMOGRAPHIC AND BACKGROUND QUESTIONNAIRE

Subject Number: _____ Date: ___/___/___
 Age: _____ Date of Birth: _____

Height: _____ Weight: _____

Right or left handed: _____

Ethnic Group: _____
 Caucasian
 African-American
 Hispanic
 Other (specify) _____

Marital Status: _____
 Never Married
 Married
 Separated
 Divorced
 Divorced & Remarried
 Widowed
 Widowed & Remarried

Years of education including kindergarten? _____

Current occupation? _____

Current yearly income? _____

Please circle "Yes" or "No" for the following questions. If you answer yes, please describe in further detail in the space provided. Include dates when applicable.

Have you ever been diagnosed with a mental health disorder (e.g., depression, anxiety, bipolar)?

Yes No

If yes, please explain:

Have you ever been diagnosed with a psychotic disorder (e.g. Schizophrenia)?

Yes No

Are you currently taking any medication to treat a psychotic or mental health disorder?

Yes No

If yes, what type of medication are you currently taking?

Are you currently taking any other form of medication?

Yes No

If yes, what type of medication are you currently taking?

Have you ever had a head injury that required medical attention?

Yes No

If yes, please describe, including age at time of injury:

Have you ever had a head injury that produced a loss of consciousness?

Yes No

If yes, how long in minutes of hours were you unconscious? _____

(MINUTES/HOURS)

If yes, how old were you at the time? _____

If you ever had a head injury did anyone notice any change in your behavior or personality after the injury?

Yes No

If yes, please describe:

Do you have a history of seizures?

Yes No

If yes, please describe:

Do you require a hearing aid? Yes No

If yes, are you wearing your hearing aid today?

Yes No

Do you have a hearing problem that is not corrected by a hearing aid?

Yes No

If yes, please describe:

Do you drink caffeinated beverages?

Yes No

If yes, what is the average number of caffeinated beverages that you consume in a day:

When was the last time that you consumed a caffeinated beverage: _____
(Day/Time)

Do you smoke or use other nicotine products?

Yes No

If yes, what is the average amount of nicotine that you use in a:

day _____ or a **week** _____

When was the last time that you used nicotine: _____
(Day/Time)

Do you drink alcoholic beverages?

Yes No

If yes, what is the average number of alcoholic beverages that you consume in a day:

When was the last time that you consumed an alcoholic beverage: _____
(Day/Time)

Do you use any illicit drugs?

If yes, what is the average amount of illicit drugs that you use in a:

day _____ or a **week** _____

When was the last time that you used illicit drugs: _____
(Day/Time)

APPENDIX C

SUICIDE BEHAVIORS QUESTIONNAIRE

Instructions: Please answer the following by circling the number that most accurately reflects the number of events. Your answers to these sensitive questions will be strictly confidential.

1. Have you ever thought about or attempted to kill yourself?

No 0 1 2 3 4 5 6 I have attempted to kill myself
and I think I really hoped to die

2. How often have you thought about killing yourself in the past year?

Never 0 1 2 3 4 Very Often

3. Have you ever told someone that you were going to commit suicide, or that you might do it?

No 0 1 2 Yes, during more than one
period of time

4. How likely is it that you will commit suicide one day?

No chance at all 0 1 2 3 4 Very likely

APPENDIX D

DELIBERATE SELF-HARM INVENTORY

This questionnaire asks about a number of different things that people sometimes do to hurt themselves. Please be sure to read each question carefully and respond honestly. Often, people who do these kinds of things to themselves keep it a secret for a variety of reasons. However, honest responses to these questions will provide us with greater understanding and knowledge about these behaviors and the best way to help people. Please answer yes to a question only if you did the behavior intentionally, or on purpose, to hurt yourself. Do not respond yes if you did something accidentally (e.g. you tripped and banged your head on accident). Also, please be assured that your responses are completely confidential.

- | | | | |
|-----|--|-----|----|
| 1. | Have you ever intentionally (i.e. on purpose) cut your wrist, arms, or other area(s) of your body (without intending to kill yourself)? | Yes | No |
| 2. | Have you ever intentionally burned yourself with a cigarette? | Yes | No |
| 3. | Have you ever intentionally burned yourself with a lighter or a match? | Yes | No |
| 4. | Have you ever intentionally carved words into your skin? | Yes | No |
| 5. | Have you ever intentionally carved pictures, designs, or other marks into your skin? | Yes | No |
| 6. | Have you ever intentionally severely scratched yourself, to the extent that scarring or bleeding occurred? | Yes | No |
| 7. | Have you ever intentionally bit yourself, to the extent that you broke the skin? | Yes | No |
| 8. | Have you ever intentionally rubbed sandpaper on your body? | Yes | No |
| 9. | Have you ever intentionally dripped acid onto your skin? | Yes | No |
| 10. | Have you ever intentionally used bleach, comet, or oven cleaner to scrub your skin? | Yes | No |
| 11. | Have you ever intentionally stuck sharp objects such as needles, pins, staples, etc. into your skin, not including tattoos, ear piercing, needles used for drug use, or body piercing? | Yes | No |
| 12. | Have you ever intentionally rubbed glass into your skin? | Yes | No |

- | | | |
|---|-----|----|
| 13. Have you ever intentionally broken your own bones? | Yes | No |
| 14. Have you ever intentionally banged your head against something, to the extent that you caused a bruise to appear? | Yes | No |
| 15. Have you ever intentionally punched yourself, to the extent that you caused a bruise to appear? | Yes | No |
| 16. Have you ever intentionally prevented wounds from healing? | Yes | No |
| 17. Have you ever intentionally done anything else to hurt yourself that was not asked about in this questionnaire? If yes, what did you do to hurt yourself? | Yes | No |

If you answered yes to any of the above questions, please answer the following:

How old were you when you first did this? _____

How many times have you done this? _____

When was the last time you did this? _____

How many years have you been doing this? (If you are no longer doing this, how many years did you do this before you stopped?) _____

Has this behavior ever resulted in hospitalization or injury severe enough to require medical treatment? _____

APPENDIX E

THE SCALE FOR SUICIDE IDEATION – SELF REPORT

Instructions: Please rate each of the following statements, by circling the letter below each statement that best describes you.

1. Wish to live
 - A. Moderate to strong
 - B. Weak
 - C. None
2. Wish to die
 - A. None
 - B. Weak
 - C. Moderate to strong
3. Reasons for living, dying
 - A. For living outweigh for dying
 - B. About equal
 - C. For dying outweigh living
4. Desire to make active suicide attempt
 - A. None
 - B. Weak
 - C. Moderate to strong
5. Passive suicidal desire
 - A. Would take precautions to save life
 - B. Would leave life, death to chance
 - C. Would avoid steps necessary to save or maintain life

If you rated the all of the previous items "A", stop here. If you rated any of the previous items "B" or "C", then continue and rate the remaining items.

6. Time dimension: Duration of suicide ideation, wish
 - A. Brief, fleeting periods
 - B. Longer periods
 - C. Continuous (chronic) or almost continuous
7. Time dimension: Frequency of suicide
 - A. Rare, occasional
 - B. Intermittent
 - C. Persistent or continuous
8. Attitude toward ideation/wish
 - A. Rejecting
 - B. Ambivalent; indifferent
 - C. Accepting

9. Control over suicidal action/ acting-out wish
 - A. Has sense of control
 - B. Unsure of control
 - C. Has no sense of control
10. Deterrents to active attempt (e.g., family, religion, irreversibility)
 - A. Would not attempt because of a deterrent
 - B. Some concern about deterrents
 - C. Minimal or no concern about deterrents
11. Reason for contemplated attempt
 - A. To manipulate the environment; get attention, revenge
 - B. Combination of A and C
 - C. Escape, surcease, solve problems
12. Method: Specificity/planning of contemplated attempt
 - A. Not considered
 - B. Considered, but details not worked out
 - C. Details worked out/well formulated
13. Method: Availability/opportunity for contemplated attempt
 - A. Method not available; no opportunity
 - B. Method would take time/effort; opportunity not readily available
 - C. Method and opportunity available
 - D. Future opportunity or availability of method anticipated
14. Sense of “capability” to carry out attempt
 - A. No courage, too weak, afraid, incompetent
 - B. Unsure of courage, competence
 - C. Sure of competence, courage
15. Expectancy/anticipation of actual attempt
 - A. No
 - B. Uncertain, not sure
 - C. Yes
16. Actual preparation for contemplated attempt
 - A. None
 - B. Partial (e.g., starting to collect pills)
 - C. Complete (e.g., had pills, loaded gun)
17. Suicide note
 - A. None
 - B. Started but not completed; only thought about
 - C. Completed
18. Final acts in anticipation of death (e.g., insurance, will)
 - A. None
 - B. Thought about or made some arrangements
 - C. Made definite plans or completed arrangements
19. Deception/concealment of contemplated suicide
 - A. Revealed ideas openly
 - B. Held back on revealing
 - C. Attempted to deceive, conceal, lie

APPENDIX F

THE LIFE HISTORY OF AGGRESSION SCALE

Instructions: Rate yourself on each of the following items using the rating system below. Only rate actual behavior be it verbal and/or physical. Do not include in your ratings thoughts not followed by any action or fantasies. For these questions it is important to rate any events that have occurred over your lifetime (including your years as a teenager and a young adult).

SCALE:

0 = never happened

1 = only happened "once" (e.g., one time)

2 = happened "a couple" or "a few" (e.g., 2-3) times

3 = happened "several" (e.g., 4-9) times

4 = happened "many" (e.g., 10+) times

5 = happened "so many" times that I couldn't give a number

How Many Times Would You Say You Did the Following Things Over the Course of Your Life to DATE?

1. "Throw" a temper tantrum (for example: screaming, slamming doors, throwing things when frustrated to the "breaking point")
2. Get into physical fights with other people
3. Get into verbal fights or arguments with other people
4. Deliberately hit another person (or an animal) in anger
5. Deliberately struck or deliberately broke objects, (for example: windows, dishes, etc.) in anger
6. Deliberately tried to physically hurt yourself in anger or desperation
7. Deliberately tried to end your life or kill yourself in anger or desperation
8. Had discipline problems in school which resulted in a reprimand by the school principal, or in a suspension, or expulsion from school
9. Had difficulties with bosses or supervisors which resulted in a physical or verbal fight and led to a reprimand, a demotion, or a firing from your job
10. Had difficulties with other people due to lying, stealing, sexual promiscuity, involvement in activities that were questionably legal, disregard for the rights of others
11. Had difficulties with the law or police which resulted in a warning, arrest, or conviction for a misdemeanor or felony offense

APPENDIX G

BUSS-PERRY AGGRESSION QUESTIONNAIRE

Please rate each of the following items in terms of how characteristic they are of you. Use the following scale for answering these items.

1	2	3	4	5	6	7
Extremely						Extremely uncharacteristic
						characteristic of me
						of me

- 1) Once in a while I can't control the urge to strike another person.
- 2) Given enough provocation, I may hit another person.
- 3) If somebody hits me, I hit back.
- 4) I get into fights a little more than the average person.
- 5) If I have to resort to violence to protect my rights, I will.
- 6) There are people who pushed me so far that we came to blows.
- 7) I can think of no good reason for ever hitting a person.
- 8) I have threatened people I know.
- 9) I have become so mad that I have broken things.
- 10) I tell my friends openly when I disagree with them.
- 11) I often find myself disagreeing with people.
- 12) When people annoy me, I may tell them what I think of them.
- 13) I can't help getting into arguments when people disagree with me.
- 14) My friends say that I'm somewhat argumentative.
- 15) I flare up quickly but get over it quickly.
- 16) When frustrated, I let my irritation show.
- 17) I sometimes feel like a powder keg ready to explode.
- 18) I am an even-tempered person.
- 19) Some of my friends think I'm a hothead.
- 20) Sometimes I fly off the handle for no good reason.
- 21) I have trouble controlling my temper.
- 22) I am sometimes eaten up with jealousy.
- 23) At times I feel I have gotten a raw deal out of life.
- 24) Other people always seem to get the breaks.
- 25) I wonder why sometimes I feel so bitter about things.
- 26) I know that "friends" talk about me behind my back.
- 27) I am suspicious of overly friendly strangers.
- 28) I sometimes feel that people are laughing at me behind me back.
- 29) When people are especially nice, I wonder what they want.

APPENDIX H

DEPRESSION ANXIETY STRESS SCALES – 21

Please read each statement and click on a number 0, 1, 2, or 3 that indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

- 0 Did not apply to me at all
 - 1 Applied to me to some degree, or some of the time
 - 2 Applied to me a considerable degree, or a good part of the time
 - 3 Applied to me very much, or most of the time
1. I found myself getting upset by quite trivial things.
 2. I was aware of dryness of my mouth.
 3. I couldn't seem to experience any positive feeling at all.
 4. I experienced breathing difficulty (for example, excessively rapid breathing, or breathlessness in the absence of physical exertion).
 5. I just couldn't seem to get going.
 6. I tended to over-react to situations.
 7. I had a feeling of shakiness (for example, legs going to give way).
 8. I found it difficult to relax.
 9. I found myself in situations that made me so anxious I was most relieved when they ended.
 10. I felt that I had nothing to look forward to.
 11. I found myself getting upset rather easily.
 12. I felt that I was using a lot of nervous energy.
 13. I felt sad and depressed.
 14. I found myself getting impatient when I was delayed in any way (for example, elevators, traffic lights, or being kept waiting).
 15. I had a feeling of faintness.
 16. I felt that I had lost interest in just about everything.
 17. I felt I wasn't worth much as a person.
 18. I felt that I was rather touchy.
 19. I perspired noticeably (for example, hands sweaty) in the absence of high temperatures or physical exertion.
 20. I felt scared without any good reason.
 21. I felt that life wasn't worthwhile.
 22. I found it hard to wind down.
 23. I had difficulty in swallowing.
 24. I couldn't seem to get any enjoyment out of the things I did.
 25. I was aware of the action of my heart in the absence of physical exertion (for example, sense of heart rate increase, heart missing a beat).
 26. I felt down-hearted and blue.

27. I found that I was very irritable.
28. I felt I was close to panic.
29. I found it hard to calm down after something upset me.
30. I feared that I would be “thrown” by some trivial but unfamiliar task.
31. I was unable to become enthusiastic about anything.
32. I found it difficult to tolerate interruptions to what I was doing.
33. I was in a state of nervous tension.
34. I felt I was pretty worthless.
35. I was intolerant of anything that kept me from getting on with what I was doing.
36. I felt terrified.
37. I could see nothing in the future to be hopeful about.
38. I felt that life was meaningless.
39. I found myself getting agitated.
40. I was worried about situations in which I might panic and make a fool of myself.
41. I experienced trembling (for example, in the hands).
42. I found it difficult to work up the initiative to do things.

APPENDIX I

REASONS FOR LIVING SCALE

INSTRUCTIONS: Many people have thought of suicide at least once. Others have never considered it. Whether you have considered it or not, we are interested in the reasons you would have for **not** committing suicide if the thought were to occur to you or if someone were to suggest it to you.

On the following pages are reasons people sometimes give for **not** committing suicide. We would like to know how important each of these possible reasons would be to you at this time in your life as a reason to **not** kill yourself. Please rate this in the space at the left on each question.

Each reason can be rated from 1 (Not At All Important) to 6 (Extremely Important). If a reason does not apply to you or if you do not believe the statement is true, then it is not likely important and you should put a 1. Please use the whole range of choices so as not to rate only at the middle (2, 3, 4, 5) or only at the extremes (1, 6). In each space put a number to indicate the importance to you of each reason for **not** killing yourself.

1. Not At All Important (as a reason for **not** killing myself, **or**, does not apply to me, I don't believe this at all).
2. Quite Unimportant
3. Somewhat Unimportant
4. Somewhat Important
5. Quite Important
6. Extremely Important (as a reason for **not** killing myself, I believe this very much and it is very important).

Even if you never have or firmly believe you never would seriously consider killing yourself, it is still important that you rate each reason. In this case, rate on the basis of **why killing yourself is not or would never be an alternative for you.**

In each space put a number to indicate the importance to you of each for **not** killing yourself.

- | | |
|--------------------------------|------------------------------|
| 1. Not At All Important | 4. Somewhat Important |
| 2. Quite Unimportant | 5. Quite Important |
| 3. Somewhat Unimportant | 6. Extremely Important |
-

- _____ 1. I have a responsibility and commitment to my family.
- _____ 2. I believe I can learn to adjust or cope with my problems.
- _____ 3. I believe I have control over my life and destiny
- _____ 4. I have a desire to live.
- _____ 5. I believe only God has the right to end a life.
- _____ 6. I am afraid of death
- _____ 7. My family might believe I did not love them
- _____ 8. I do not believe that things get miserable or hopeless enough that I would rather be dead
- _____ 9. My family depends upon me and needs me
- _____ 10. I do not want to die
- _____ 11. I want to watch my children as they grow
- _____ 12. Life is all we have and is better than nothing

- _____ 13. I have future plans I am looking forward to carrying out
- _____ 14. No matter how badly I feel, I know that it will not last
- _____ 15. I am afraid of the unknown
- _____ 16. I love and enjoy my family too much and could not leave them
- _____ 17. I want to experience all that life has to offer and there are many experiences I haven't had yet which I want to have
- _____ 18. I am afraid that my method of killing myself would fail
- _____ 19. I care enough about myself to live
- _____ 20. Life is too beautiful and precious to end it
- _____ 21. It would not be fair to leave the children for others to take care of
- _____ 22. I believe I can find other solutions to my problems
- _____ 23. I am afraid of going to hell
- _____ 24. I have a love of life
- _____ 25. I am too stable to kill myself
- _____ 26. I am a coward and do not have the guts to do it
- _____ 27. My religious beliefs forbid it
- _____ 28. The effect on my children could be harmful
- _____ 29. I am curious about what will happen in the future
- _____ 30. It would hurt my family too much and I would not want them to suffer
- _____ 31. I am concerned about what others would think of me
- _____ 32. I believe everything has a way of working out for the best
- _____ 33. I could not decide where, when, and how to do it
- _____ 34. I consider it morally wrong
- _____ 35. I still have many things left to do
- _____ 36. I have the courage to face life
- _____ 37. I am happy and content with my life
- _____ 38. I am afraid of the actual "act" of killing myself (the pain, blood, violence)
- _____ 39. I believe killing myself would not really accomplish or solve anything
- _____ 40. I have hope that things will improve and the future will be happier
- _____ 41. Other people would think I am weak and selfish.
- _____ 42. I have an inner drive to survive
- _____ 43. I would not want people to think I did not have control over my life
- _____ 44. I believe I can find a purpose in life, a reason to live
- _____ 45. I see no reason to hurry death along
- _____ 46. I am so inept that my method would not work
- _____ 47. I would not want my family to feel guilty afterwards
- _____ 48. I would not want my family to think I was selfish or a coward

APPENDIX J

POST-TASK QUESTIONNAIRE

1. Were you following any system with regard to the reaction-time key (e.g., were you pulling your finger up or to the side, etc.)? Please write a brief sentence.
2. Was it important for you to win?

Not at All	1 2 3 4 5 6 7 8	Very Much
------------	-----------------	-----------
3. Compared to most participants, how high were the shocks you set for your opponent (circle one statement only).
 - a. I set much lower shocks than most people in the study
 - b. I set somewhat lower shocks than most people in the study
 - c. I set the same shocks as most people in the study
 - d. I set somewhat higher shocks than most people in the study
 - e. I set much higher shocks than most people in the study
4. Compared to most participants, how high were the shocks you set for your opponent (circle one statement only).
 - a. I set much lower shocks than most people in the study
 - b. I set somewhat lower shocks than most people in the study
 - c. I set the same shocks as most people in the study
 - d. I set somewhat higher shocks than most people in the study
 - e. I set much higher shocks than most people in the study
5. Why did you choose the shock settings you did? Please explain.
6. How much did you feel in control of the situation?

Not at All	1 2 3 4 5 6 7 8	Very Much
------------	-----------------	-----------
7. How anxious were you during the task?

Not at All	1 2 3 4 5 6 7 8	Very Much
------------	-----------------	-----------
8. How concerned were you with what the experimenter thought of you?

Not at All	1 2 3 4 5 6 7 8	Very Much
------------	-----------------	-----------
9. How concerned were you with what your opponent thought of you?

Not at All	1 2 3 4 5 6 7 8	Very Much
------------	-----------------	-----------
10. How important is it for you to know your opponent?

Not at All	1 2 3 4 5 6 7 8	Very Much
------------	-----------------	-----------
11. How painful was the highest shock you took during the threshold procedure?

Not at All	1 2 3 4 5 6 7 8	Very Much
------------	-----------------	-----------
12. How much tissue damage do you think the 20 shock causes?

None	1 2 3 4 5 6 7 8	Very Much
------	-----------------	-----------
13. If you did not receive a 20, how painful would you expect a 20 to be?

Not Painful	1 2 3 4 5 6 7 8	Extremely Painful
-------------	-----------------	-------------------
14. Did you know anything about this experiment before you participated (other than what the experimenter told you on the phone)? Please explain:
15. As best as you can recall, your opponent was: Male _____ Female _____
16. Your best guess about your opponent's age: _____ years old
17. What do you think the purpose of this study is?

APPENDIX K

MENTAL HEALTH CARE RESOURCE LIST

If you feel in need of counseling or mental health services, the following phone numbers are provided for your use. Individuals at these numbers may be able to provide other appropriate contacts. There may be fees involved for these services. You will be responsible for payment of these fees.

1. Student Counseling Services

118 College Drive #5075 Hattiesburg
MS 39406-0001

Hours of Operation and Location:

M-F 8 a.m. - 5 p.m. Kennard-Washington Hall Room 200

Walk-In Services for Students:

M-F 9:45 a.m. - 11:15 a.m. and 1:45 p.m. - 3:15 p.m.

Telephone: (601) 266-4829

FAX: (601) 266-5146

Email: counseling@usm.edu

EMERGENCY: 911. Ask for University Police. Counselors are also available after-hours in emergency situations call: 601.818.6352.

If you or someone you know is currently experiencing a suicidal crisis, call Student Counseling Services at 601.606.HELP (4357). For life threatening and/or medical emergencies: call 911.

2. Pine Belt Mental Healthcare Resources 601-544-4641

24-hour coverage
Sliding fee schedule

1-800-SUICIDE (1-800-784-2433)

1-800-273-TALK (1-800-273-8255)

Thank you for your participation in this study.

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