Response Inhibition in Suicide Ideators and Attempters

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Abstract

The ideation to action framework, when approaching suicide, has sparked a new movement of research to understand the transition from suicide ideation to suicide attempt. Impulsivity is one of the main risk factors in the progression from suicide ideation to suicide attempt; however, less is known about cognitive risk factors, including response, which is related to impulsivity. In the present preliminary analysis, response inhibition on two attention tests — Connors Continuous Performance Test (CPT) and Delis-Kaplan Executive Function System's Colour Word Interference Test (CWIT) —was compared between suicide ideators (*n*=3) and attempters (*n*=6). Consistent with my hypothesis, interference scores were suggestive of worse performance among attempters than ideators on the CWIT, and contrary to expectations, commission errors on the CPT were somewhat more frequent in ideators than attempters. However, both results were not statistically significant due to the very limited sample size. Considering this limitation, the findings suggest potential response inhibition differences between suicide ideators and attempters, which require further study in larger samples.

Keywords: suicide, suicide research, suicide attempt, suicide ideation, impulsivity, response inhibition, ideation to action framework, Connors Continuous Performance Task, Delis-Kaplan Executive Function System Colour Word Interference Test

Differences in Impulsivity Between Suicide Ideators and Suicide Attempters

Thanks to medical advancements, cures to various life-threatening disease and disorders have been found, ultimately decreasing the number of deaths per year. Contrasting with this trend, the number of deaths attributed to suicide, one of the leading causes of death, has risen over the years, seeing an increase of 35.2% in age adjusted suicide rates within the United States ("Suicide is a major health concern", 2022). Being among the top three causes of death for people between the ages 15 and 34, suicide has become a multifactorial psychiatric emergency, a pressing matter affecting families and communities worldwide (Bertolote and Fleischmann, 2002).

Evolution of Suicide Research

There are various theories attempting to explain why people attempt suicide. Edwin Shneidman's theory revolves around psychache (extreme psychological pain), whereas Roy Baumeister presents an escape theory that looks at the need to reduce aversive self-awareness as the motivator for suicide attempt. Other theories include themes of impulsivity, hopelessness, problem solving, and interpersonal communication as influencers for suicide attempt (Klonsky et al., 2016). These theories about suicide all approach the topic by looking at suicide ideation and the evolution of suicide ideation into attempts as separate processes. This perspective hinders our understanding of suicide, as it fails to differentiate and examine suicide thoughts and suicidal behaviour as separate actions. Joiner (2005) proposed an ideation to action framework, which sought out to examine suicide ideation and suicidal behaviour as different entities, requiring two different explanations (Klonsky and May, 2015). He stipulates that suicide ideation originates from the combination of social isolation, burdensomeness, and hopelessness and the progression into suicide attempt requires one to surpass one's fears of pain and death. From this sparked a

new approach towards suicide research and paves the way for new theories to emerge, one being Rory O'Conner's integrated motivational-volitional theory (IMV; Klonsky et al., 2016). This theory represents a second ideation to action framework and attributes defeat and entrapment as the main causes for suicide ideation, with a heightened degree of fearlessness, insensitivity to pain, planning, access to lethal means, and impulsivity being the bridge from suicide ideation to attempt (Klonsky et al., 2016). Understanding the ideation to action framework is essential towards progressing the current theories on suicide and research on suicide prevention.

A potential risk factor for suicide attempt is response inhibition (Moniz et al., 2017) a person's ability to suppress inappropriate responses to a given stimulus or actions interfering with a specific goal. Low response inhibition is considered a sign of impulsivity, amplifying the risk of suicide attempts from suicide ideators. Suicide ideators are a classification of people who have thought about suicide but have not attempted suicide. Further research into response inhibition has potential to provide greater insight into cognitive risk factors related to impulsivity that may facilitate the transition from suicide ideation to attempts.

The Conners Continuous Performance Test (CPT) is a task requiring participants to respond when any letter appears on a screen, except for the letter 'X' (Connors 2014). The Delis-Kaplan Executive Function System includes the Colour-Word Interference Test (CWIT), also known as the Stroop Test, which examines the individuals's ability to inhibit overlearned verbal responses to create a contradicting response through ink colours and colour words (Delis et al., 2001). These tasks are both intended to measure response inhibition (among other cognitive processes) but using different approaches. These two cognitive tests have historically been used to identify potential deficits in response inhibition in patients with neurological disorders.

A meta-analysis was conducted on articles between 1970 and 2010 on suicide, neuropsychology tests, and neuropsychology (Richard-Devantoy et al., 2012). An impairment in inhibition was detected in depressed subjects who exhibited suicidal behaviour in comparison to those without suicidal behaviour. This concluded a positive association between suicide attempt and the suicide inhibition deficits in patients with affective disorders. From this, research has focused on measuring impulsiveness through a variety of cognitive tests including Continuous Performance Tasks – Go NoGo, Stop Signal Reaction Time task, Monetary Delay Questionnaire, Information Sampling Task, and Barratt Impulsiveness Scale-11 (Milner et al., 2020). Although suicide attempters and suicide ideators showed differences in impulsiveness when compare to the control group, suicide attempters did not show any signs of more impulsiveness than suicide ideators off the scores collected from each task. Another study looked at the response inhibition differences between suicide ideators and suicide attempters by comparing their scores on the Delis-Kaplan Executive Function System Colour Word Interference Test (CWIT) (Richard-Devantoy et al., 2012). Suicide ideators performed better and demonstrated greater attentional control than suicide attempters. Suicide attempters were also found to have longer response times during the interference condition.

Purpose of Study

The purpose of the present study is to conduct a preliminary analysis of data being collected as a part of a larger study examining cognitive and neuroimaging risk factors for suicide attempt using the ideation-to-action framework comparing suicide ideators and attempters. Acknowledging that the sample size is too small to generate statistically significant results but only potential indications of the directions of the effects, I hypothesize that attempter

will show poorer performance on response inhibition measures from the CPT (commissions) and CWIT (slower response speed during the interference condition).

Methods

Inclusion and Exclusion Criteria

The aim of this study was to determine the response inhibition differences between suicide attempters and suicide ideators. Participants between the ages 18 and 65, right-handed, English speaking, and stable internet connection who scored >8 on a modified 8-item Patient Health Questionnaire depression scale and met the requirements for lifetime major depressive disorder determined by the Structural Clinical Interview for DSM-5. Participants diagnosed with schizophrenia, schizoaffective disorder, alcohol or substance abuse disorder, neurodevelopmental disorder, bipolar I or II disorder, serious medical illness, neurological illness, intellectual disability, clinical instability, visual or hearing disorders, major motor limitations, or severe head trauma were excluded from the analysis.

Participant Characteristics

Participants ranged from ages 18 to 65 (M = 30, SD = 11.39). The group "attempters" consisted of four male and two female participants whereas the group "ideators" consisted of two males and one female.

Measures

To ensure standardization for each task, a Standardize Operation Procedure was developed to administer the tasks the same way to each participant. Participants completed a battery consisting of the DKEFS Colour Word Interference Test and Connors Continuous Performance Task.

Delis-Kaplan Executive Function System Colour Word Interference Test

DKEFS CWIT was designed to quantify the person's ability to inhibit a response to generate a conflicting response. This test was administered through screensharing on Zoom using PowerPoint slides. The four conditions to this task (naming, reading, inhibition, and switching) each measure a different component skill. Naming consists of dictating the names of the patches of colour on the screen. This condition focuses on evaluating the speed of the participant, providing a baseline measure to compare other conditions to and assessing the linguistic skill and naming speed. Reading comprised of reading the colour words displayed on the screen. Similarly, to the first condition, this condition evaluates the participants linguistic skill, speed of reading, and serves as a baseline for the other conditions. Inhibition displays a screen with colour words printed in different colour ink. This section requires the participant to identify the patches of colour whilst inhibiting reading the words. This condition quantifies the participant's ability to inhibit the more automatic response (reading the word) to name the colour of the ink. Switching displays a screen like inhibition but with some words outlined in a black box. This task requires the participant to switch between naming the colour and reading the word (when the word is in a box). This condition measures both cognitive flexibility and inhibition through the comparison of performance on this condition to the previous three conditions.

Connors Continuous Performance Task

CPT tests the response inhibition of the participants by testing how well one inhibits the prepotent response. This task consists of 50 practice trials and 500 experimental trials. Each trial is grouped into 5-trial clusters with 4 trials consisting non-X letters of the alphabet and 1 trail consisting of an X with the order of presentation randomized. The task allows a window of 750ms for the participants to respond to the stimulus and provides a 250ms intertrial interval. Participants are asked to click spacebar every time they see a letter that is non-X and are asked

not to click the space bar when they see the letter X. Since most of the letters are non-X, this establishes a prepotency to click spacebar during the practice. Once this is established, we test the participants response inhibition by looking at how well they inhibit the prepotent response when viewing a stimulus, they are not supposed to respond to (i.e. X). The results gathered from this task looks at the omission errors (failure to press the spacebar when a non-X appears) and commission errors (incorrect response to non-targets such as pressing the spacebar when a X appears) of those conducting the task. High amounts of omission errors serve as an indicator for inattentiveness. High amounts of commission errors serve as an indicator for the participant rushing, failing to inhibit the response to non-targets, reflecting impulsivity. Calculating the d-prime of the results from this task provides insight on the participants ability to discriminate between signal and noise, often a strong indicator impulsivity.

Results

Table 1.0

Means and Standard Deviation Analysis of Attempters and Ideators' Performance on Connors Continuous Performance Task.

Group Descriptives

	Group	N	Mean	SD	SE	Coefficient of variation
Omission Error	Ideators	3	3.667	4.619	2.667	1.260
	Attempters	6	26.000	46.596	19.023	1.792
Comission Error	Ideators	3	41.667	23.116	13.346	0.555
	Attempters	6	33.833	18.181	7.423	0.537
D prime	Ideators	3	2.776	0.351	0.203	0.127
	Attempters	6	2.338	1.005	0.410	0.430

Note: This table presents the data from the results of the Connors Continuous Performance Task. Here it portrays important information required to complete the t-test such as the number of participants per group, the mean value, and the standard deviation.

Table 1.1

Descriptive Independent Samples T-Test for the Results from Connors Continuous Performance Task Scores Between Attempters and Ideators.

Independent Samples T-Test ▼

						95% CI for Mean Difference		
	t	df	p	Mean Difference	SE Difference	Lower	Upper	Cohen's d
Omission Error	−1.163	5.193	0.296	−22.333	19.209	−71.163	26.496	−0.675
Comission Error	0.513	3.302	0.640	7.833	15.271	−38.344	54.010	0.377
D prime	0.957	6.736	0.371	0.438	0.458	−0.653	1.529	0.582

Note. Welch's t-test.

Note: This table presents the data from the independent T-Test. The Cohen's d value for omission error is a negative value (-0.675). This is because the amount omission errors caused by Ideators was less than the amount of omission errors caused by Attempters. This is also shown by the negative t value and the negative mean difference. Cohen's d value for commission error is 0.337 and Cohen's d value for D-prime is 0.583.

Table 2.0

Means and Standard Deviation Analysis of Attempters and Ideators' Performance on Delis-Kaplan Executive Function System Colour Word Interference Test.

Group Descriptives

	Group	N	Mean	SD	SE	Coefficient of variation
Naming	Ideators	3	36.333	13.650	7.881	0.376
	Attempters	6	34.833	7.808	3.188	0.224
Reading	Ideators	3	19.333	3.215	1.856	0.166
	Attempters	6	22.333	3.830	1.563	0.171
Inhibition	Ideators	3	43.667	9.866	5.696	0.226
	Attempters	6	48.833	10.323	4.214	0.211
Switching	Ideators	3	50.000	9.000	5.196	0.180
	Attempters	6	56.667	10.838	4.425	0.191

Note: This table presents the data from the results of the Delis-Kaplan Executive Function System Colour Word Interference Test. Here it portrays important information to complete the t-test such as the number of participants, the mean, and the standard deviation.

Table 2.1

Descriptive Independent Samples T-Test for the Results from Delis-Kaplan Executive Function System Colour Word Interference Test Scores Between Attempters and Ideators.

Independent Samples T-Test ▼

						95% CI for Mean Difference		
	t	df	p	Mean Difference	SE Difference	Lower	Upper	Cohen's d
Naming	0.176	2.679	0.872	1.500	8.501	−27.483	30.483	0.135
Reading	−1.236	4.866	0.273	−3.000	2.427	−9.290	3.290	−0.849
Inhibition	−0.729	4.276	0.504	−5.167	7.086	−24.348	14.015	−0.512
Switching	−0.977	4.918	0.374	−6.667	6.825	−24.299	10.966	−0.669

Note. Welch's t-test.

Note: This table presents the data from the independent samples t-test. The Cohen's d value for Reading (-0.849), Inhibition (-0.512), and Switching (-0.669) are negative values, which indicate that the Ideators took a shorter time completing these conditions in comparison to the Attempters. This is also shown by the negative t-value and the negative mean difference. Cohen's d for Naming is 0.135.

Discussion

On the CPT, attempters seemed to have stronger response inhibition than ideators. This can be seen by comparing the commission errors committed by both groups. Commission errors committed while doing the Continuous Performance Task may be considered a potential indicator of impulsivity, as these errors are from one's failure to control their impulse to respond to the non-target. However, it is also important to consider that commission errors could be from the inattentive ness of the participant. In addition, looking at Cohen's d for commission errors, a small to medium effect size is observed. This contradicts my hypothesis that attempters would

have lower response inhibtion than ideators on this task. DKEFS CWIT reported ideators having a stronger response inhibition than attempters. Response inhibition can be measured by the inhibition and reading conditions, as these require the inhibtion of a more automatic response to name the colour of the ink. These scores can be influenced by one's linguistic and verbal skill, which are measured in the Naming and Reading conditions. Cohen's d for inhibition and reading reported a medium to large effect size. This supports my hypothesis that attempters would have lower response inhibition than inhibitors on this task.

These findings differ from the results of previous studies looking at suicide ideators and attempters' performances on neuropsychological tests. Suicide attempters' performance on Connors Continuous Performance Tasks compared to the performance of suicide ideators presented small or no differences in impulsiveness between the two groups, hypothesizing that impulsiveness may be indirectly related to suicide attempt (Milner, 2020). Here we found that suicide attempters had better response inhibitory control over suicide ideators, completely different from previous studies. This difference can be accounted for by the very small sample size in our study, causing our results to be easily thrown off by anomalies. In addition, the difference in set up and deliverance of the continuous performance task could have affected the results, with this research using city and mountain scenes and our research using letters.

Another study used the Delis-Kaplan Executive Function System Colour Word Interference Test (CWIT) to measure the cognitive control of suicide attempters and suicide ideators. Here they found that suicide attempters exhibited poorer attentional control compared to suicide ideators (Richard-Devantoy et al., 2012). Suicide attempters had longer response times in the interference condition, thus an indicator for defects in cognitive control. Our study concluded the same thing, with ideators scoring higher in the interference condition than

attempters, an indicator for higher response inhibtion in ideators. Although, a factor to consider is the exclusion of the naming and reading conditions in the interpretation of the interference condition scores. Linguistic and verbal skills of each subject could affect their performance on the interference condition, thus resulting in slight variation in scores and results.

Limitations and Conclusion

The low sample size is the primary limitation of the present study because there was insufficient statistical power to detect any potential differences between ideators and attempters. Nevertheless, this preliminary analysis provided information about the possible magnitude and directions of the differences between ideators and attempters in response inhibition performance on two related but different cognitive tasks. Future studies should look to increase the sample size to increase statistical power to generate conclusive results. Examining emotional response inhibition could be the next step for future research. With emotion having a robust and persistent influence on behaviour and actions, looking at the effect it has on suicide attempt could reveal ways to deal with these risk factors, thus preventing suicide attempts.

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