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Describing and Measuring the Pathway to Suicide Attempts: A Preliminary Study

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To die by suicide, one must think about suicide, make a plan, and then carry it out. Prior research has examined the presence and predictors of these outcomes; however, virtually no studies have characterized how these steps unfold along the pathway to suicide. A novel instrument was administered to 30 recent suicide attempters. Results revealed that although the median onset for suicidal ideation occurs 1 to 5 years prior to attempting, the median for 6 of the 10 steps measured was within 6 hours of attempting. Overall, 86.5% of proximal planning steps took place within 1 week of attempting and 66.6% occurred within 12 hours.

Suicide is a leading cause of death around the world (Lozano et al., 2012); however, some of the most basic characteristics of the pathway to suicidal behavior have not been well examined. Prior research has focused primarily on whether people have thought about suicide, whether they have made a suicide plan, and whether they have made a suicide attempt (Nock, Borges, Bromet, Cha, et al., 2008). Although there have been qualitative accounts of the lead up to suicide attempts and deaths (Kidd, 2004; Robins, 1981), there have been no detailed, descriptive, quantitative data characterizing the pathway to suicide. For example, researchers have not delineated or described what specific steps people take as they transition from suicidal ideation to a suicide attempt or how people move down this pathway to suicide.

There are several important reasons to describe the pathway to suicide. First, describing how people move through the pathway to suicide lays a foundation for future research examining factors that influence why people move from thinking to attempting suicide. For example, certain risk factors could increase the likelihood of suicide, but only when people are at specific points along the pathway. If this were the case, understanding the pathway would be critical to understanding how certain factors lead to suicide.

Second, clarifying this pathway could inform suicide risk assessment and suicide prevention. For example, future research may find that certain steps along the pathway are associated with greater risk of a future attempt. In addition, knowledge of the steps and average trajectories through the pathway could inform clinical decision making.

Third, a description of the pathway could help advance the measurement of

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suicide planning, an important area of research. Prior research has focused on two elements of the pathway to suicide: general measurement of suicide planning (e.g., the presence of a suicide plan) and whether an attempt was impulsive or not by, for example, measuring the amount of time from decision to attempt or the extent of planning prior to an attempt. Clearly, there is overlap between the presence of a plan and whether an attempt was impulsive—having a suicide plan indicates that an attempt was slower and more premeditated—and measures used to assess planning are also used to determine whether an attempt was impulsive or not (Nock et al., 2009). However, a significant issue in this research area is the lack of a definition for a suicide plan and how to determine whether an attempt was impulsive. When has a person crossed the line from not having a suicide plan to having one? Similarly, what are the specific aspects of a suicide attempt required to characterize it as "impulsive?" Currently, the field has not addressed these questions. Outlining and describing how people move from thinking to attempting suicide might provide a basis for consensus operationalization and consistent measurement that is necessary for reliable and valid research.

The most common way prior studies have assessed the existence of a plan is to simply ask whether one has ever made a "suicide plan," without providing a definition of what exactly constitutes a plan (Nock, Borges, Bromet, Alonso, et al., 2008). Prior studies have utilized a wide range of measurement approaches to assess the extent of suicide planning prior to an attempt or whether an attempt should be characterized as impulsive or not (see Anestis, Soberay, Gutierrez, Hernández, & Joiner, 2014, for a meta-analysis, and see Chalker, Comtois, & Kerbrat, 2015, for a review). Several studies use the Beck Suicide Intent Scale–Planning subscale (SIS-Plan; Beck, Weissman, Lester, & Trexler, 1976; Beck, Schuyler, & Herman, 1974), which assesses the degree of premeditation and preparation prior to an attempt, but approaches have varied. Prior studies have included a different number of items to quantify "planning" (e.g., 2, 3, 7, or 8 items; Baca–Garcia et al., 2005; Conner et al., 2005; Weyrauch, Roy-Byrne, Katon, & Wilson, 2001). Studies have also used myriad approaches to distinguish between *planned* and *impulsive* attempts. For example, studies using the SIS-Plan have had different cutoff rules (i.e., median split; Dombrovski et al., 2011), 75% quartile (Baca–Garcia et al., 2005), three equal-sized groups (Conner et al., 2005), or a particular score (Chen et al., 2007). Other studies have operationalized an impulsive attempt as: (1) a decision to attempt suicide within 5 minutes of actually attempting (Simon et al., 2002; Williams, Davidson, & Montgomery, 1980), (2) 30 minutes of "planning," (Wojnar et al., 2008), (3) 3 hours of contemplation (Spokas, Wenzel, Brown, & Beck, 2012), (4) 7 days of suicide ideation (Conner et al., 2006), (5) denial of a lifetime suicidal plan with endorsement of a lifetime suicide attempt (Borges et al., 2006; Kessler, Borges, & Walters, 1999; Nock, Borges, Bromet, Alonso, et al., 2008; Nock, Borges, Bromet, Cha, et al., 2008; Nock et al., 2009), and (6) a lack of plans, fluctuating ideation, and participants endorsing an "impulsive" suicide attempt (Wyder & De Leo, 2007). In short, most prior studies use methods that are crude, somewhat arbitrary (i.e., single-item time cutoffs), lack consensus, and fail to illustrate clearly how people transition down the pathway to suicide from thinking to acting (see Bagge, Littlefield, & Lee, 2013, for a recent study that collected nonarbitrary timing data along the pathway to suicide and argued for a 3-hour cutoff between impulsive and nonimpulsive attempts).

There are several problems with current measurement approaches for suicide planning. First, the most critical problem is the lack of conceptual operationalization of what constitutes an "impulsive" or "planned" attempt, revealed by the varied methodologies. For example, the myriad ways of measuring attempt planning with the SIS-Plan share little conceptual overlap with asking whether the decision to attempt was within

5 minutes of attempting. A recent study found modest correlations between different suicide planning assessments, leading the authors to conclude that the approaches were conceptually distinct (Chalker et al., 2015). The absence of a conceptual operationalization raises similar questions to those posed earlier, such as: At what point can it be said that a person has a plan rather than just tentative suicidal thoughts? If a person comes up with a "plan" 5 minutes prior to attempting, is that then a "planned suicide attempt" or not? If not, how long prior to attempting is necessary for an attempt to be considered "planned?" These questions remain unanswered and are essential to address.

Second, the lack of conceptualization can lead to unreliable responses from participants. Given that there is no consensus definition of a "suicide plan" among researchers, participants are unlikely to have reliable responses to questions such as, "Have you ever made a suicide plan?" Indeed, a recent study found who a substantial proportion of people who denied a "suicide plan" reported many of the same planning behaviors as those who endorsed a plan (Millner, Lee, & Nock, 2015). Similarly, in a prior study, more than a quarter of attempters paradoxically described their suicide attempt as (1) "impulsive" but "planned" or (2) "not impulsive" but with no "planning" (Wyder & De Leo, 2007). Along the same lines, a recent study found that the amount of preparation prior to an attempt was unrelated to the degree to which participants described their suicide attempt as motivated by impulsiveness (May & Klonsky, 2016). Without a consensus approach to measuring suicide planning, researchers will continue to obtain unreliable responses from participants.

Third, the lack of conceptualization produces assessments that cannot be used across studies. For example, conducting a median split on SIS-Plan data establishes a cutoff point dividing planned from unplanned that is unique to that particular study. In one case, researchers used different items from the SIS-Plan to calculate two planning scores. Although the two scores were highly correlated, only one resulted in a significant relationship with a dependent variable of interest (Baca-Garcia et al., 2005). The lack of consistent measurement across studies undermines efforts to discover reliable differences between risk factors of more unplanned versus more planned attempts.

Fourth, there is no agreement regarding whether suicide planning should be measured on a continuous scale or attempts should be dichotomized into "planned" versus "unplanned." When researchers choose to measure the construct dichotomously, it assumes that "planned" and "unplanned" attempters come from separate populations on, for example, a particular risk factor. If this is the case, then discovering the appropriate line to distinguish impulsive and planned attempts is paramount to uncovering true differences between these populations.

Fifth, even though researchers have sought to uncover differences between those who make planned versus unplanned attempts, no prior research has provided a descriptive account of the timing of planning steps and the amount of preparation prior to attempts. This is similar to critiques of psychological research in which critics have argued that psychological scientists jump straight to making inferences and testing theories, while bypassing a process most natural sciences start with to uncover a basic description of the phenomena of interest (Kagan, 2007; Tinbergen, 1963). A descriptive account could provide data to help resolve several of the aforementioned issues. For example, if suicide planning appears to fall on a bimodal distribution, then dichotomization is suitable and it identifies the appropriate dividing line. If not, then a continuous scale is more appropriate. Gaining a comprehensive description of the pathway to suicide is an essential first step toward developing a common definition and measure to study suicide planning.

The goals of this study were to describe how people move through this pathway by collecting data on the amount of time attempters spent between different

planning steps prior to a suicide attempt. We developed a novel interview that assessed the degree of preparation and the chronology of planning steps that were taken prior to attempting suicide. Planning steps were as follows: (1) thinking of attempting suicide, (2) thinking of the method, and (3) thinking of the place to attempt suicide. The interview distinguished between the lifetime onset of a planning step, onset for the current attempt, and time taken to decide upon a step. We also inquired about whether the person (4) had engaged in several preparatory actions (e.g., obtaining a method, traveling to a place) prior to attempting. The main goal of the study was to provide a description of how people move through the pathway to suicide and collect data on the timing of specific behaviors in an effort to overcome the limitations of prior studies, such as the use of relatively arbitrary measurement approaches. However, collecting retrospective data regarding the timing of particular events over weeks, months, or years has its own limitations. Particularly, we anticipated that participants would estimate time using rounded, prototypic values (e.g., 30 minutes, 1 hour, 1 day), and the increment between these rounded values would increase the longer that time had passed from the attempt (e.g., 5 minutes to 15 minutes to 30 minutes to 1 hour; Huttenlocher, Hedges, & Bradburn, 1990). Therefore, a secondary goal of this study was to closely examine and describe the manner in which people estimate the timing of planning steps to ensure appropriate analyses and interpretation.

METHOD

Participants

Participants were 30 patients in a psychiatric inpatient unit. All participants reported having made a suicide attempt in the prior 2 weeks. Additional inclusion criteria were as follows: being over 18 years of age, no current or past psychotic disorder or cognitive impairment, ability to read English, and correctly answer three questions regarding the informed consent form to ensure comprehension of the nature of the study (100% of participants answered these questions correctly). The Harvard University and Partners Healthcare System institutional review boards approved the study, and we obtained informed consent from all participants. Participant demographic information is presented in Table 1.

Procedure

Inpatient medical staff identified participants who had engaged in a suicide attempt within the past 2 weeks and met the additional study inclusion/exclusion criteria. At the beginning of the study, participants granted informed consent and completed a prestudy risk assessment. Then, the

TABLE 1
Demographic Data

	Participants (N = 30)
Age *M* (*SD*)	26.76 (8.93)
Sex *n* (%)	
Female	18 (60.00)
Male	12 (40.00)
Race *n* (%)	
Caucasian	25 (83.33)
Mixed race	1 (3.33)
Asian	3 (10.00)
African American	1 (3.33)
SES *M* (*SD*)	3.40 (0.63)
Number of participants with past suicidal behaviors *n* (%)	
Aborted attempts (1 or more)	18 (60.00)
Interrupted attempts (1 or more)	7 (23.33)
Mean number of past suicidal behaviors *M* (*SD*)	
Age of onset ideation	17.38 (9.01)
Aborted attempts	1.98 (3.83)
Interrupted attempts	2.21 (2.38)
Attempts[a]	1.93 (1.33)

[a]One participant who reported 25–50 suicide attempts was an outlier and removed from the mean number of attempts.

experimenter (AJM) administered the Pathway to Suicidal Action Interview, which took approximately 1 hour. Participants completed several other behavioral tasks and self-report questionnaires followed by a post-study risk assessment and, finally, were debriefed and compensated. This study was part of a larger study including additional behavioral tasks and self-report questionnaires not reported here.

Measures

Pathway to Suicidal Action Interview (PSAI). The PSAI was developed to assess several different steps people take as they move from thinking about suicide to acting on their thoughts. The PSAI consists of an introduction interview and follow-up interviews. The purpose of the introduction interview was to collect a history of suicidal ideation, nonsuicidal self-injury, and suicidal actions and to determine which follow-up interview would be used (see below for more information on follow-up interviews). Specifically, the ideation section includes six thoughts ranging from low-risk passive ideation (wishing to disappear or not exist or one was never born) to higher risk passive ideation (thinking life is not worth living or wanting to be dead) to active ideation (thinking that one should *maybe* kill themselves or thinking that one *should* kill themselves). The suicidal actions section assesses nonsuicidal self-injury, suicide gestures, aborted suicide attempts, interrupted suicide attempts, and suicide attempts. The interview used instructional diagrams and specific language to help participants categorize their behavior. For an action to be considered a suicide attempt, the person had to have engaged in a potentially lethal or harmful action with some intention of dying. This definition is consistent with prior work in this area (O'Carroll et al., 1996; Posner et al., 2011; Silverman, Berman, Sanddal, O'Carroll, & Joiner, 2007). Although the question assessing prior suicide attempts included the phase "intent to die," participants that endorsed a suicide attempt were asked an additional question to ensure intent for the most recent attempt. The interviewer (AJM), a senior graduate student at the time, designed the PSAI and was trained by a senior suicide researcher (MKN) to assess suicidal behaviors.

Following the introduction interview, the interviewer administered a follow-up interview. The goal of the follow-up interview was to assess the amount of time between planning steps and the suicidal action. The follow-up interview began by asking the participant to narrate the events prior to the suicide attempt for the interviewer to understand the general timing of events. This was followed by more specific questions including four pathway components: (1) thinking about suicide (i.e., *ideation*), (2) thinking of the suicide *method*, (3) thinking of the *place* to attempt suicide, and (4) carrying out *preparatory actions*. For ideation, method, and place we measured the amount of time elapsed between the suicide attempt and the (1) lifetime onset, (2) onset for the current attempt, and (3) settling on/being sure of the selected option (e.g., for method, selecting which method to use; for ideation, the decision to attempt suicide). See Table 2 for all planning steps.

For suicidal ideation, lifetime onset was determined by calculating the difference in time between participants' first lifetime thought "I should kill myself" or "Maybe I should kill myself" and the most recent attempt. Ideation for the current attempt was the amount of continuous suicidal ideation prior to the attempt. Ideation was considered continuous if the participant experienced ideation once within a week. Thus, to measure this step, we asked participants about their most recent 7-day period *without* thoughts of suicide (i.e., when there was a break in ideation) and then calculated the amount of time from following this point to the attempt.

We probed an additional phase of ideation not asked for in method or place: "mulling over" the decision to attempt suicide. *Mulling* was defined as "strongly considering attempting suicide, perhaps going

TABLE 2
Planning Steps Measured in PSAI

Pathway Component	Steps
Suicidal ideation	(1) Lifetime onset, (2) onset for current attempt, (3) mulling over decision, and (4) decision to attempt
Method (used in most recent attempt)	(1) Lifetime onset, (2) onset for current attempt, and (3) being sure of/settling on method
Place (where most recent attempt took place)	(1) Lifetime onset, (2) onset for current attempt, and (3) being sure of/settling on place
Preparatory actions	Counted based on purpose of action

back and forth in one's mind about whether to do it or not." Participants that endorsed mulling were asked how long they mulled over the decision to attempt suicide. Finally, participants were asked how long prior to the attempt they had made the decision to attempt. To better operationalize the decision, participants were asked if, at the decision point they specified, they were (1) leaning toward attempting suicide, (2) pretty sure they were going to attempt suicide, or (3) sure they would attempt. If participants reported being less than sure, they were asked to specify when they were sure they were going to attempt. Any difference between the original decision point and the point at which they were sure was added to time spent mulling. In sum, we assessed lifetime onset, onset for the current attempt, mulling over the decision, and the decision to attempt for the suicidal ideation component.

For method and place, the experimenter queried lifetime onset, onset for the current attempt, and when the person "settled on" or was sure of the method and place to attempt suicide. Settling on a method and place were assessed to distinguish between tenuous planning, where a person might be considering several options, and more concrete plans, where the person has selected how and where to attempt suicide. In some instances, a person could be sure of a method or place even when undecided about whether to attempt suicide or not (e.g., at a certain point, a person might have said, "I don't know if I'll ever attempt suicide, but if I do I know I'll take pills"). We operationalized a suicide plan as the point at which a person had thought of and settled on both the method and the place to attempt suicide.

Finally, we inquired about whether the person had engaged in several preparatory actions prior to attempting, either to help carry out the suicide attempt (e.g., obtain the method), because they would be dead soon (e.g., make a will), or other preparatory actions related to the attempt.

Analyses

Examining Participants' Time Estimates of Planning Steps. Other than the preparatory actions, all of the responses to the PSAI were free response estimates of the time between various planning steps and a suicide attempt (we refer to these as estimates of relative or elapsed time). We anticipated that as the elapsed time increased, people would use rounded estimates (e.g., "30 minutes" rather than "27 minutes 30 seconds") with increasingly larger units of time (i.e., weeks, months, or years which constitute hundred thousands or millions of seconds) and omit smaller time units (Huttenlocher et al., 1990). If true, this pattern of increasingly larger units of time suggests that elapsed time might be reported exponentially. If planning steps were accurately measured, however, elapsed time would be linear.

To better understand this potential bias, we converted all time estimates of planning steps to seconds, collapsed all

planning steps across all subjects (i.e., a single vector containing time estimates for all 288 steps across all subjects), sorted the steps in ascending order, and ranked them (i.e., the shortest time estimate was ranked 1, and the longest estimate was ranked 288). If time estimates were accurate, plotting the time estimates over the rankings should reveal a somewhat smooth, diagonal line where, moving from the shortest to longest intervals, relative time estimates increase fairly gradually. However, if time estimates were exponential, the plots should reveal "jumps" near the right side of a graph, indicating a shift to increasingly larger units of time as events move further away from the attempt. To quantify this comparison, we fit linear and exponential functions to the data where x was rankings of the sorted time estimates and y was the amount of the time between each step and the attempt. The exponential function was calculated as:

$$y = ae^{-bx} + c \quad (1)$$

where a is the y-intercept and indicates the vertical stretch of the curve, b stretches the curve horizontally, the negative sign indicates that it is a vertical reflection of the function without the negative sign, and c controls the horizontal shift. The linear function was calculated as:

$$y = a + bx \quad (2)$$

where a is the y-intercept and b is the slope of the line. We compared fits using Bayesian information criterion (BIC; Raftery, 1995), a commonly used model comparison metric which penalizes models for each additional parameter (Vrieze, 2012). To examine whether fit comparison varied depending on the time interval, we compared linear and exponential functions within 11 relative time intervals (e.g., within all planning steps that occurred within 30 minutes of the attempt and omitting all steps that occurred after 30 minutes; see Figure 1D to see all the intervals). Shorter time intervals fit functions to fewer data, with the fewest being 45 steps that all occurred in under a minute.

Results of Examining Time Estimates

Figure 1A–C shows sorted relative time estimates plotted over time with linear and exponential lines fit to the data for three of the 11 time intervals examined. As observed in each of these three plots, time estimates within 30 minutes, 1 day, and 1 week all resemble exponential functions. Indeed, compared with a linear function, BIC values revealed that an exponential function provided a superior fit at all 11 intervals (Figure 1D). In sum, regardless of where time is cut off, plotting the ordered data reveals patterns similar to those in Figure 1A–C, which are best fit by exponential functions.

PSAI Scoring

The goal of this study was to describe the pathway to suicide. To do this, we converted all elapsed time estimates for planning steps to seconds and created histograms to illustrate the pathway. However, histograms can give considerably different depictions of the data, depending on the number and width of the bins (Scott, 1979; Wand, 1997). We selected histogram bins based on two criteria: (1) approximate a log-transform to achieve linearity and (2) use prototypical values (e.g., 1 day, 1 week) for easy interpretation. First, we sought to correct for the pattern we found where participants estimated time exponentially. Log-transforming exponential data will result in linearity (i.e., the logarithmic function is the inverse of the exponential function). Indeed, log-transforming and plotting all responses over time shifted the data from an exponential to a linear trend (Figure 2A, B). Therefore, we selected bins that followed an approximately exponential pattern (Figure 2C) and placing the data in these bins approximated a log-transformation, also resulting in a linear trend (Figure 2D).

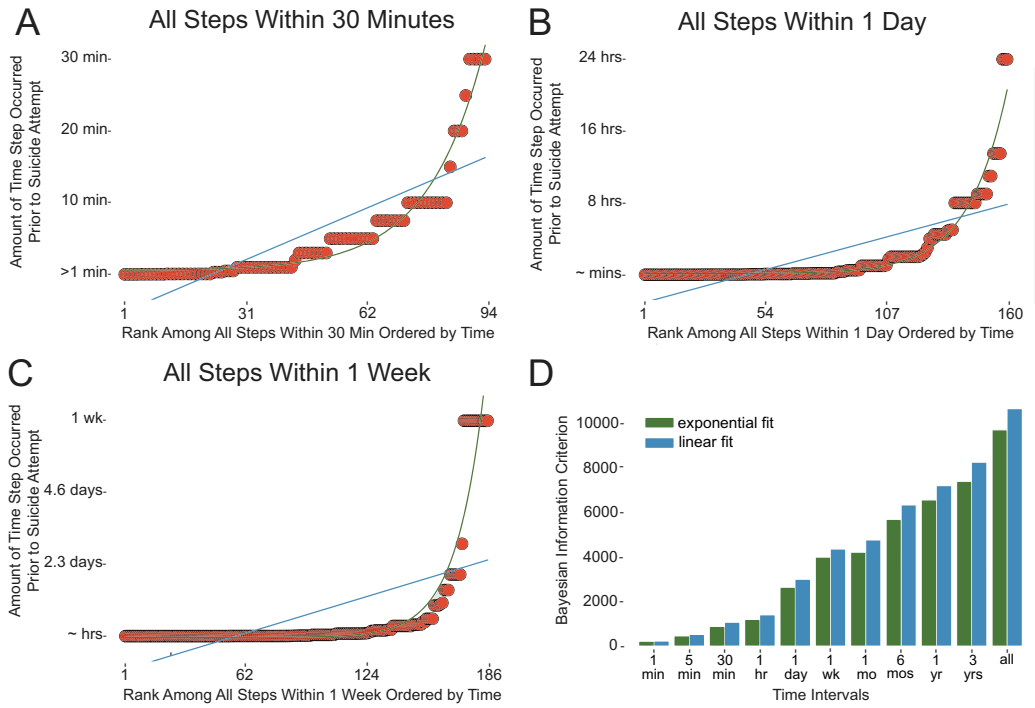

Figure 1. Raw data fit to exponential and linear functions. Data containing the amount of time between the attempt and each planning step were collapsed across all steps and all subjects, sorted in ascending order by the amount of elapsed time and assigned a rank. (A–C) Plots of estimated relative time (*y*-axis) over rank (*x*-axis) qualitatively show that, within different time intervals, an exponential function (green line) provides a superior fit for the raw data, compared with a linear function (blue line). (D) Bayesian information criterion (BIC) quantitatively confirms this qualitative impression within 11 time intervals (smaller BIC values indicate better fit).

In addition to linearity, a log-transformation also aligns with a conceptual or clinical intuition about the pathway to suicide: The further the back in time, the less relevant the distinctions of smaller time increments become. For example, once time intervals reach weeks, months, or years prior to a suicide attempt, distinctions of minutes or seconds are no longer informative or relevant.

One large difference between log-transforming the data and our selected bins was observed for time estimates under a minute. On a logarithmic scale, the difference between 5 seconds and 40 seconds is more than two units (e.g., notice how high 1 minute is on the *y*-axis on Figure 2B). However, we placed all planning steps that occurred within a minute of the suicide attempt in a single bin under the assumption that distinctions of seconds are difficult for people to remember precisely (Schacter, 1999) and of less significance than accorded by a log-transformation.

The second criterion for bin selection was interpretability. We chose prototypical time bins to increase the interpretability of the histogram and best illustrate the pathway to suicide. Providing a histogram with evenly distributed bins of log-transformed data would have resulted in nonprototypical time values (e.g., 13 days and 22 hours) and hampered interpretability.

Preparatory Actions

We used the initial narrative description of the events preceding the attempt

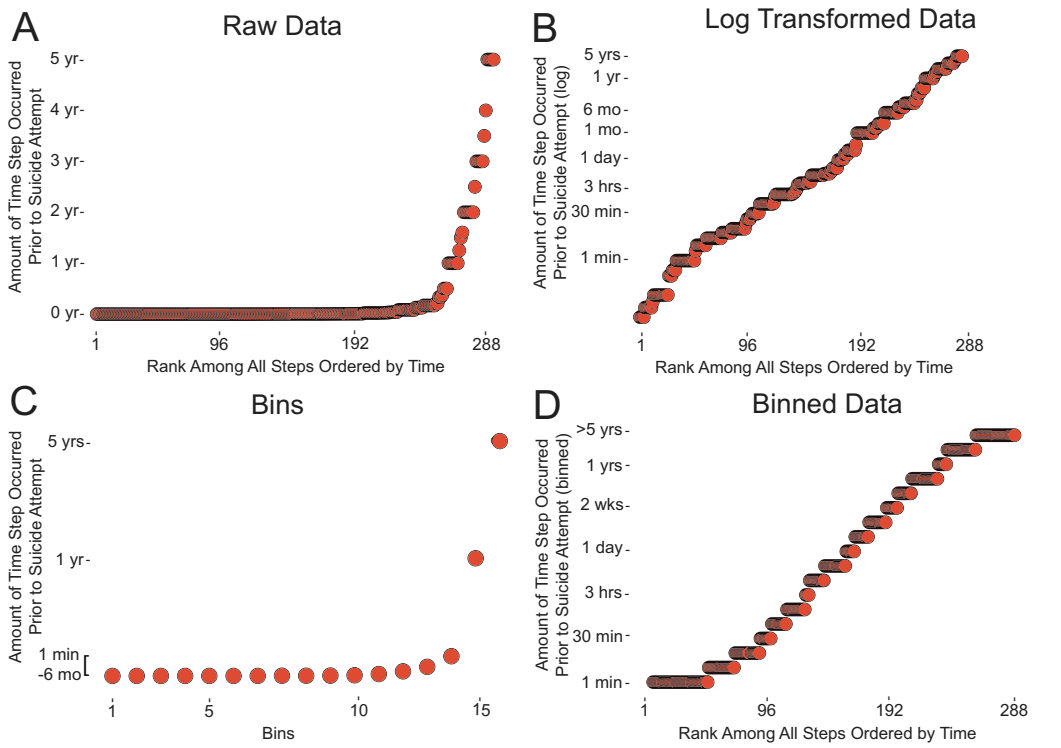

Figure 2. Log-transforming and binning raw data to achieve linearity. (A) All raw data with estimated relative time on the *y*-axis and rank on the *x*-axis show exponential pattern (see Figure 1). (B) After log-transform data are linear. (C) The histogram bins we selected to describe data approximate an exponential function. (D) Data fit to bins are also approximately linear.

and specific follow-up questions to determine whether preparatory actions were carried out for the impending suicide attempt and not ancillary or distal actions. For example, if someone wrote a note 6 months prior to the attempt and at the time had no intention of killing themselves 6 months later, it was not counted. Preparatory actions were tallied based on the number of distinct purposes of the actions, and not on the number of actions themselves. For example, writing one note or five notes were both counted as a single preparatory step. Some purposes precluded others. For example, if a person traveled to avoid discovery, other steps taken to avoid discovery would not be counted. A codebook with 27 distinct purposes, developed in previous work using an independent sample (Millner et al., 2015), was implemented by the first author to code and sum the preparation data.

Materials and Data Availability

The instrument (i.e., PSAI), data, and computer code written for analysis as well as the supplemental materials and Jupyter notebook are available under the first author's account on the Open Science Framework (https://osf.io/4wcxk/). The data were analyzed using Python 2.7 packages pandas (McKinney, 2010) for data management; Matplotlib (Hunter, 2007) and Adobe Illustrator for plotting; NumPy (van der Walt, Colbert, & Varoquaux, 2011) for math functions; and SciPy (Jones, Oliphant, & Peterson, 2001) and LMFIT (Newville, Stensitzki, Allen, & Ingargiola, 2014) for curve fitting.

RESULTS

A summary of methods used to attempt suicide and medical/physical consequences of the attempts is listed in Table 3.

What Does the Pathway to Suicide Attempt Look Like?

Plots illustrating the median time points for each step in the pathway to suicide attempt are presented in Figure 3. In the current sample, the median first onset of suicidal ideation occurred 5 years before the attempt and first thoughts about the suicide method used began 1 to 5 years prior to the attempt. A number of other steps occurred much closer in time to the index attempt. More specifically, the median onset of continuous ideation began

TABLE 3
Summary of Methods Used and Medical/Physical Consequences of the Attempt

n	Method
17	Overdose on medication/pills
4	Overdose on medication/pills and alcohol
3	Cut wrist
2	Asphyxiation
1	Asphyxiation and medication/pills
1	Suffocation (e.g., gas)
1	Cut wrists and medication/pills
1	Medication/pills and suffocation

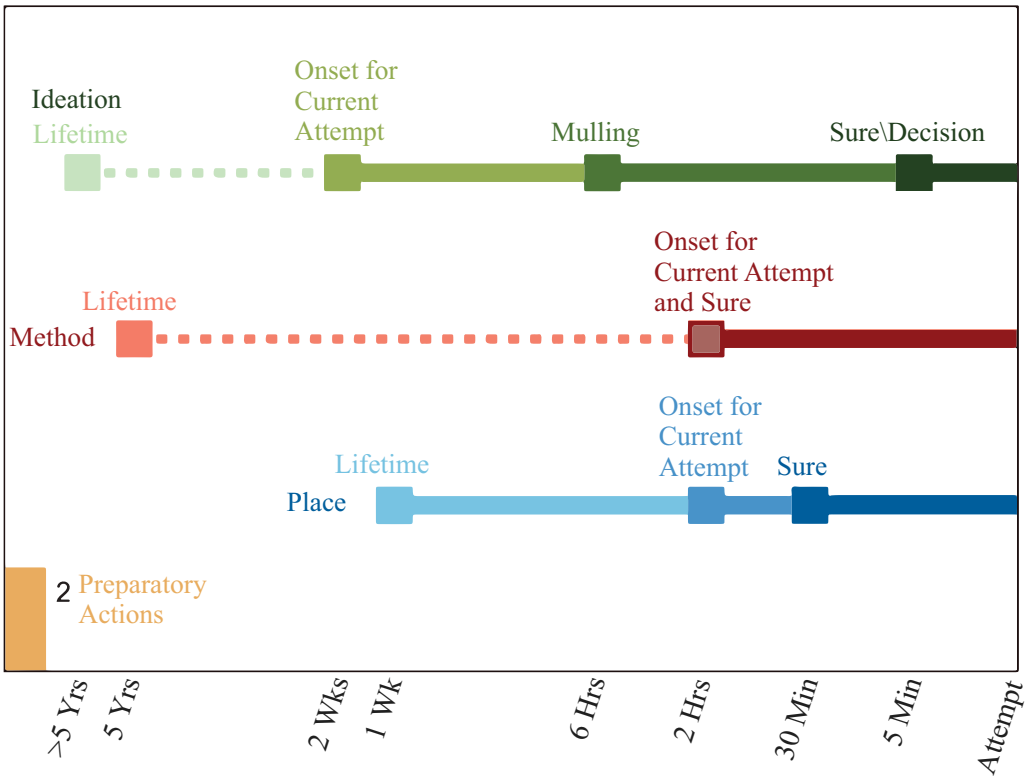

Figure 3. Median of each pathway step. The median number of preparatory actions was 2. The timing of when preparatory actions occurred was not collected, and therefore, preparatory actions bar plot does not use the same *x*-axis as the time estimates. Median lifetime ideation and lifetime thoughts about the method used both occurred years prior to attempting suicide. Median onset of ideation for the current attempt occurred 2 weeks prior to the attempt, and the lifetime thoughts about where to attempt were 1 week before attempting. Median mulling over the decision started 6 hours prior to attempting, whereas the median time for starting to think about the method, settling on the method, and thinking of the place to attempt was all 2 hours prior to attempting. Median time for settling on the place was 30 minutes prior and median time for making the decision to attempt was only 5 minutes prior to attempting.

2 weeks prior to the attempt, the onset of thoughts about *where* to attempt suicide began 1 week prior to the attempt, the onset of mulling occurred 6 hours prior to the attempt, and the onset of certainty about method occurred 2 hours prior to the attempt. The median time for certainty about the place to attempt was 30 minutes prior to the attempt, whereas the final decision to attempt occurred 5 minutes before the attempt. See Figures S1 and S2 for a plot of each participant's pathway to a suicide attempt along with a key to interpret these plots.

Variability in the Timing of Steps in the Pathway to Suicide Attempt

The median timing of each step provides a measure of central tendency for the timing of each step; however, we also wanted to examine individual differences in the timing of each of these steps. The spread of scores for each pathway step as well as a "suicide plan" is presented in Figure 4. Lifetime onset of suicidal thoughts and method frequently occur more than 1 year prior to the attempt (see Figure 4). Once ideation for the current attempt begins, the vast majority (86.5%) of the steps (across participants) is carried out within a week of the attempt and 66.6% of steps were carried out within 12 hours of the attempt. For most distributions, the modal time bin is less than 1 minute. The most skewed distribution is the decision point, in which 18 of 30 attempters (60.0%) report deciding to attempt within 5 minutes and no one deciding more than 3 days prior. For preparatory actions, most people carry out between zero and four

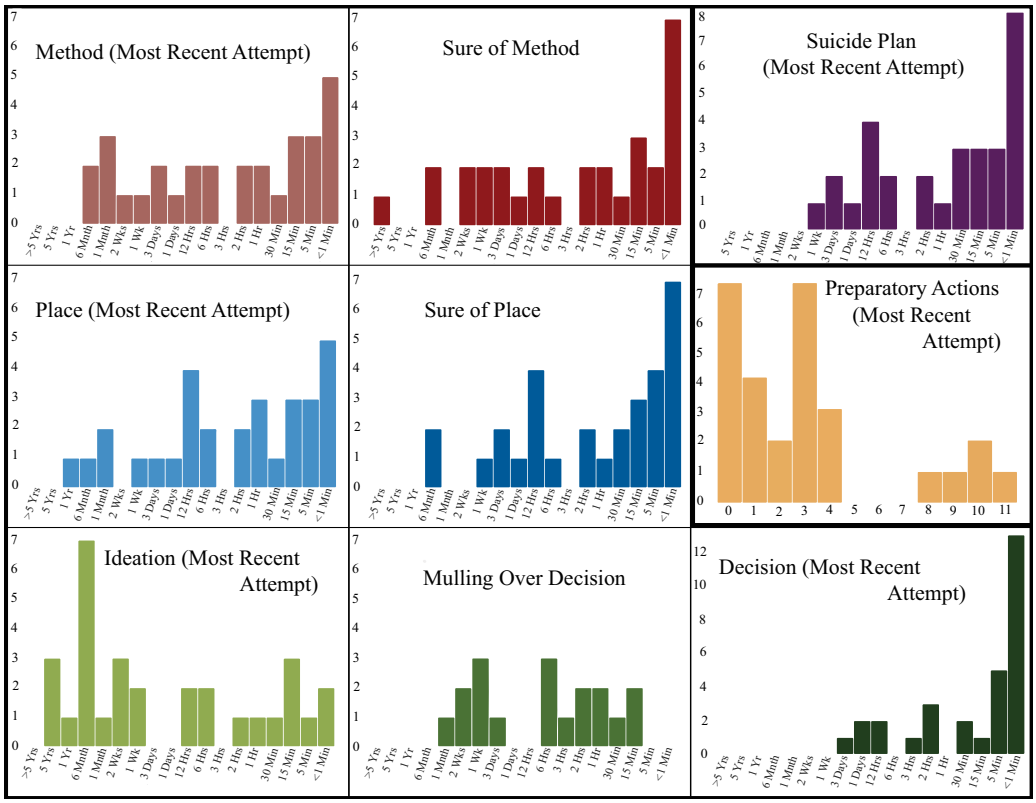

Figure 4. Histograms of the onset of pathway steps prior to the suicide attempt. Plan is defined as the point at which the person had thought of and settled on the method and place for the most recent attempt.

actions, with a small group of participants carrying several preparatory actions. For suicidal planning, although the modal response was that all four elements of a plan came together in under a minute, there was a large range with some participants reporting having a plan as far as 3 days prior, although most of the time the plan is formed within the same day as the attempt.

Order of Pathway Steps

We also determined the sequence of planning steps (i.e., which step came first and then second) regardless of the precise timing. Even when looking at only five proximal steps (timing of ideation, method, place, mulling, and decision for the current attempt), we found that the pathway to suicide is heterogeneous: There were 17 unique sequences among the 30 attempters. The most frequent sequence was to have four items occur simultaneously: onset of ideation, thinking about method, thinking about place, and making the decision to attempt suicide (16.7%). As would be expected, participants generally thought of lifetime steps prior to thinking of steps during the current attempt and generally thought of current attempt steps before settling on method, place, and the decision to attempt. About half of participants first thought about the method before thinking of the place and nearly half first thought (lifetime) about the method and place at the same time. For nearly three-quarters of participants, thinking of the method for the current attempt occurred at the same time as settling on the method. This percentage was similar for thinking of the method for the current attempt and first thinking of the place for the current attempt or settling on the place to attempt. Thinking of the place for the current attempt and settling on the place occurred simultaneously for 80% of participants. See the Supporting Informations (Tables S1 and S2) for a table containing percentages of bivariate chronology for each the planning steps.

DISCUSSION

Data on how people transition from thinking about suicide to attempting suicide are sparse, yet crucial for understanding risk factors associated with why people move down the pathway to suicide as well as building a consensus approach to measuring suicide planning. In this article we described the degree of preparation and the timing of steps people take as they move along the pathway to suicide and provided an operationalization for "suicide planning." This approach could establish a framework for an empirical operationalization of an impulsive attempt, although we were unable to accomplish this in the current study given the small sample size.

There were three main findings in this study. First, the onset of suicidal ideation and selection of a suicide method often occur years prior to an attempt; however, the vast majority of proximal steps down the pathway to suicide occur within a week and most within 12 hours of the attempt. Second, the order of steps that people take in planning a suicide attempt is quite heterogeneous. The most common pattern was that several of the steps occurred together. For instance, thinking of and settling on a method and place frequently occurred simultaneously. Third, we found that, compared with a linear function, an exponential function best fit participants, estimates of the time between planning steps and the suicide attempt looking within 11 different time intervals. As planning steps occurred further into the past from the attempt, participants used increasingly larger units of time (e.g., seconds to minutes to hours to days) and omitted smaller units, which created biased data. If time were estimated accurately, the data would be fairly linear. Several aspects of the study warrant further comment.

The first key finding was that the vast majority of proximal pathway steps occurred within a week before the attempt, and most within 12 hours. Furthermore, many steps showed a modal time of less than one minute

prior to the attempt, with two of the quickest steps being planning and making the decision to attempt. In addition, several people reported an absence of suicidal ideation until just prior to attempting. Taken together, these data suggest that, although logistically difficult, research aimed at examining psychological processes occurring during the days (or day, if possible) before a suicide attempt would provide enormous insight into why people attempt suicide because this appears to be the timescale in which the majority of planning and decisions are made (see Bagge, Glenn, & Lee, 2013; Bagge, Lee, et al., 2013; Bagge, Littlefield, Conner, Schumacher, & Lee, 2014, for a retrospective approach).

The vast majority of participants in this study experienced suicidal ideation years prior to the attempt yet the transition down the pathway to an attempt, often was precipitous, particularly the decision to attempt. Given the presence of both long- and short-term processes, we recommend that clinicians thoroughly assess lifetime suicidal ideation and help patients with a suicide history create safety plans (Stanley & Brown, 2012) to prevent or slow down the typically rapid progress down the pathway to suicide. The speed with which the participants in this study transitioned to a suicide attempt suggests that people may not have access to their own degree of risk days or perhaps even hours prior to attempting. Therefore, a crucial area of clinical research is developing methods that assist risk assessment but do not involve the patients' report (Nock et al., 2010).

The current results are consistent with a prior study that assessed the timing of suicidal behaviors leading up to an attempt. Bagge, Glenn, and Lee (2013), Bagge, Lee, et al. (2013), and Bagge, Littlefield, & Lee (2013) used a Timeline Follow-Back procedure to collect data on "contemplation," "plan," and "decision" within the 48 hours prior to a suicide attempt on a large sample ($N > 200$). The percentage of participants reporting these indexed behaviors within 3 hours is strikingly similar between the two studies: decision (current sample: 83%; Bagge et al.: 85%), plan (current sample: 67%; Bagge et al.: 67%), and ideation (current sample: 30%; Bagge et al.: 42%) (Bagge, Littlefield, et al., 2013).

The second key finding was that the most common order was for several steps to occur simultaneously and steps involving a method and place frequently occurred at the same time. Although it makes conceptual sense to characterize settling on a method and place as a "suicide plan," the fact that we found that these two steps often occur together provides additional support for this designation. Finally, for all participants, the decision point represented the last step of the pathway to an attempt and therefore represented the most proximal step prior to the attempt within this sample.

A third finding was that when recounting the amount of time between planning steps and an attempt, participants reported elapsed time exponentially. We could find no prior study that reported this pattern, although most studies focus on accuracy of veridical judgments of elapsed time (e.g., comparing reports with diary entries; Friedman, 1993). The exponential pattern represents a bias and introduces error into time estimates, which has important implications for descriptions, interpretations, and analyses of these data. Depending on the question these data are addressing, we urge caution in interpreting raw time estimates or including raw data in descriptive or inferential analyses. For example, a log-transformation or a specialized regression model (e.g., Weibull) might be more appropriate than canonical statistics (e.g., *t* test) with raw data. We specified histogram bins that approximated a log-transform to achieve linearity while using prototypical values (e.g., 1 day, 1 week) for easy interpretation. In addition to linearity, transforming the data permits time estimates ranging from less than a minute to more than 5 years to be plotted on one graph and aligns with the intuition that smaller units of time (e.g., seconds, minutes) are

relevant for steps carried out close to the attempt but are less relevant for steps carried out weeks, months, or years prior to the attempt.

The accuracy of the time estimates participants provided is unclear. There is no consensus model of how people incorporate time into autobiographical memories (Friedman, 1993), but prior research has documented several characteristics that influence the recall of the time elapsed since an event. For example, accuracy is improved when the event was more recent (Rubin & Baddeley, 1989), evoked a more extreme emotional reaction (Betz & Skowronski, 1997), or when one can utilize general knowledge from one's life (Burt, 2008; e.g., when I was in college). In the current study, most steps being estimated occurred within weeks of the interview and involved an event that likely was emotionally intense (i.e., involving suicide), and therefore, we assume estimates were fairly accurate. For more distal aspects, such as the onset of suicidal ideation, time estimates are more likely to be inaccurate. Prior research suggests that every week that passes since an event, time estimates errors increase linearly by about 1 day (Thompson, 1982) for at least 6 years (Rubin, 1982).

Appropriately measuring preparatory actions is challenging. We tallied preparatory actions based on the purpose of the action. This system prevented us from parsing the precise number of actions, which reduced reliability in pilot coding sessions (i.e., Should a "long" note be one action because it was one note or more because it was "long?"). The limitation of this approach is that scribbling a quick note and writing a 10-page note are counted equally. We considered alternative approaches, such as assessing the amount of time spent on the preparatory acts, but all had more significant limitations (e.g., for obtaining a method, when would the preparatory action start and end?). Another limitation of our approach is that we did not collect information about the amount of time that passed between preparatory actions and suicide attempt to better characterize when preparatory actions occurred along the pathway. Future studies could collect this.

Given the small sample size, we could not produce a valid, data-driven method to aggregate the data into a composite score. We hypothesize that, with the appropriate sample size, the steps along the pathway to suicide can be reduced into a single formative composite, similar to socioeconomic status. If confirmed, this composite variable could be valuable in future studies examining an array of questions regarding suicide. For example, on the one hand, future studies can examine whether this composite variable falls on a unimodal or bimodal distribution, which could be used to determine an empirical cutoff for "impulsive" versus "nonimpulsive" suicide attempt. On the other hand, large-scale studies or aggregated pathway data might reveal a continuous distribution. If this was the case, future researchers may split a sample into "impulsive" and "nonimpulsive" based on an estimate of the population distribution that can be used across studies rather than a split within a given sample. Additionally, future studies can examine whether the pathway composite interacts with certain risk factors and suicide attempts. For example, some risk factors may predict a more protracted pathway (e.g., internalizing disorder; Bagge, Littlefield, et al., 2013), while other factors may predict a rapid pathway resulting in a suicide attempt.

There are several important limitations to this study. First and foremost, the sample size is small. Studies with larger samples need to confirm several of the findings. Second, as discussed, there is likely error in people's reports of specific time estimates due to how people report time (omitting smaller time units) and their memory for the timing of events is imprecise (Schacter, 1999). Third, although we interviewed people within 2 weeks of attempting suicide, they might have difficulty remembering specific details from the event or the time leading up to it or have been motivated to withhold information because we were in an

inpatient unit. Fourth, the participants in this study were generally young (i.e., aged 18–35 years) and White, and therefore, the pathway steps should be tested across a more diverse sample. For example, in a prior study with people over aged 50 years, older age was associated with increased suicide planning (Conner et al., 2007), although a different study with a large, representative sample found no relationship between age and planning (Hjelmeland et al., 2000). Although unclear, there is a chance these data overrepresent the percentage of attempts that are less planned compared with a sample that included older adults. Fifth, although we have provided a rationale for the timing bins, the choice of bins influenced the results and interpretations. One advantage of the current approach is that other researchers can obtain the raw time interval data collected in the current study and use other bins or other analysis approaches. Despite these limitations, this preliminary study makes several advances over previous studies examining suicide planning.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Figure S1. Orientation to pathway to suicide plots (A) Components of the pathway to suicide: suicide method = red, place = blue, ideation = green, preparatory actions = orange. (B) Method, place and ideation/decision are on a timescale.

Figure S2. Individual pathway to suicide plots for every participant (n = 30).

Table S1. Percentages of subjects that thought of one planning step at the same time as another step.

Table S2. Percentages of subjects that thought of one planning step prior to or after another step.