

**Profiling the Digital Mosaic of Uncensored Suicidal Thought and Behavior:
A Theory-Driven Network Analysis of Online Written Expression**

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Abstract

The highly stigmatizing and taboo nature of suicidal thought and behavior (STB) makes it especially prone to censorship across modern communication platforms, ultimately impacting breadth of phenomenological detection. Applying ideation-to-action models of suicide to uniquely naturalistic data sources may serve to deepen understanding of digital STB expression. STB written communication across $N=839$ posts on the pro-choice suicide forum, Sanctioned Suicide, was qualitatively coded through development of a 20-item inventory based on the Integrated Motivational-Volitional (IMV) model. Reliable items were modeled using network analysis techniques to highlight patterns in post content. Coping strain-related stressors and feelings of defeat/entrapment most frequently characterized posts. Recapitulating the IMV framework, network modeling implicated defeat/entrapment as the most central node among items. Further analysis of the estimated network structure highlighted three primary themes of STB expression: contexts of powerlessness, trauma-mediated alienation, and crowdsourced preparation. This research offered an analytical foray into the expression of unmitigated STB. Findings aligned with documented associations in the literature, establishing a baseline summary of STB content within a marginalized, at-risk community. Future work should focus on modeling detailed semantic and social engagement data within this extraordinary microcosm to further explore, describe, and develop digital profiles of STB risk.

Keywords: suicide; online forum; censorship; IMV model; qualitative coding; network analysis

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1. Introduction

Suicide is a global health threat, accounting for more than 700,000 deaths annually and attaining a rate more than double that of homicide (Ritchie et al., 2015; *WHO: Suicide*, 2022). These numbers reflect one death to suicide every 40 seconds (Ritchie et al., 2015; *WHO: Suicide*, 2022). Furthermore, data indicate that there are more than 20 suicide attempts for every successful suicide (*WHO: Suicide*, 2022). While sobering, the statistics do not faithfully reflect the full magnitude of incidence—the inherently sensitive, taboo, and in some cases, illegal, nature of this act make it especially prone to underreporting and misclassification (*WHO: Quality of Suicide Mortality Data*, 2022). Indeed, the quality of suicide information across the world is heterogeneous and generally poor, thus making suicidal thought and behavior (STB) challenging to study.

From Durkheim (Durkheim, 1897) to Joiner (Joiner, 2005) and beyond, many theoretical and empirical models over the past 125 years that have approached the problem of understanding suicide from biological, psychological, and sociological perspectives (Maris, 2019). However, a criticism of most models concerns their generalizability—the question of an ability to fully encapsulate and explain suicide and related phenomenology. Focusing on one or few aspects of suicide (e.g., personal motivations, social stressors, environmental triggers) couched in specific mechanistic terms (e.g., a means of escape (Baechler, 1975; Baumeister, 1990), a response to specific types of stressors (Zhang, 2019), a learned behavior (Lester, 1988)), individual models have traditionally offered highly valuable insight into targeted facets of STB. Nonetheless, these models have tended to operate in explanatory isolation from others, favoring depth of theory

over breadth of manifestation and thereby failing to provide a cohesive representation of STB that can exist under a single explanatory framework.

Beyond the limited scope of foundational theories, relatively recent endeavors in suicidology have introduced a more comprehensive modeling approach—the “ideation-to-action” framework—to operationalize and explain STB. Through the contextualization and combination of many known STB risk factors into a singular model, the framework parses STB into interrelated, yet distinct, components with their own inherent processes, theoretical explanations, and empirical presentations. Prominent among the ideation-to-action models are the innovative Interpersonal-Psychological Theory of Suicide (IPTS) (Van Orden et al., 2010), the Integrated Motivational-Volitional (IMV) model (O’Connor & Kirtley, 2018), and the Three-Step Theory (Klonsky & May, 2015). The culmination of over a century of research, these models represent an important paradigm shift within suicidology that has united the theoretically defensible and empirically bolstered aspects of past works into powerful explanatory tools. It therefore stands to reason that the application of these models to relevant, rich, and uniquely insightful data sources may pave the way toward a more complete understanding of STB.

In recent years, the primary modes of day-to-day communication and expression have altered significantly, rapidly transforming the landscape of social interaction. The ubiquitous adoption of computers and integration of mobile devices with daily life has fashioned an emergent digital dimension of sociality. For suicidology, this translates to an opportunity for analyses on dense and contextually rich data. Accordingly, several descriptive and predictive studies have capitalized on the affordances of this digital revolution, leveraging STB content across multiple social media platforms including, but not limited to, Facebook (Ruder et al., 2011), Twitter (Jashinsky et al., 2014; O’Dea et al., 2017), Reddit (De Choudhury & Kıcıman,

2017; Shing et al., 2018; Yates et al., 2017), and Instagram (Brown et al., 2019; Carlyle et al., 2018; Picardo et al., 2020), as well as in various blogs, discussion forums, message boards, and news sites (Biddle et al., 2016; Chen et al., 2017; Ozawa-de Silva, 2008; Song et al., 2016). Research has revealed that STB presence online is not only pervasive, but varies in presentation from formal support communities (Coulson et al., 2017; De Choudhury & Kıcıman, 2017) to fringe information sites detailing suicidal methodologies (Biddle et al., 2016). In addition to STB's mix of content presentation, its impact across individuals is complex and highly variable (Mok et al., 2016). Within social media, for example, responses to suicidal content are a mix of encouraging, discouraging, and dismissive (O'Dea et al., 2018).

Since mainstream social platforms on the Internet are characterized by a diverse confluence of individuals with varying thoughts, beliefs, and attitudes, expression of STB at the center stage of online communication engenders an overall lack of familiarity that drives impersonal public judgments of "positive" and "negative". In turn, this setting has the potential to restrict critical opportunities for honest self-expression and further contribute to a paralyzing stigma that distances suicidal individuals from the support they require. Studies have found that individuals who use social networking sites to communicate distressful thoughts and feelings look for recognition and offers of help, even if that help comes from a complete stranger (Whitehill et al., 2013); however, it is important to realize that definitions of "help" are subjective and deeply personal, especially as concerns STB. Moreover, the level of relativity required for suicidal individuals to feel supported may not be attainable within a population where the individual is the alienated minority. Taken together, public voices of concern and the associated recommendations for medical attention as measures of suicide prevention, while

exceptionally important, may not be as immediately ameliorative as desired responses of commiseration, nor even constitute remediation in the eyes of the afflicted.

From a research perspective, public reactions to STB may translate to behavioral data that is stunted through fear of social reproach, ultimately impacting the ability to capture the breadth of STB expression. STB, being especially taboo, stigmatizing, and socially unattractive, is prone to censorship (Myers West, 2018). Acting as “arbiters of permissible speech within the confines of their services” (Cobbe, 2021), activity within commercially operated social networking domains and mainstream public forums have rules that define “socially acceptable” speech and expression (Hooker, 2019; Jackson, 2014; Patty, 2019). As subjects of behavioral research, careful consideration is due regarding the degree of influence self-compliance and moderating entities have on user behavior (Lee & Scott-Baumann, 2020). Censorship, both human (Das & Kramer, 2021; Gillespie, 2018; Powers et al., 2019; Sleeper et al., 2013) and algorithmic (Cobbe, 2021), may alter the scope, detection, and understanding of a behavioral repertoire. Studies undertaken within these digital microcosms must therefore contend with the unavoidable, perhaps imperceptible, behavioral mediators of social marginality (Trevisan, 2020), competing corporate interest (Cobbe, 2021), and the hidden programmatic manipulation of information exchange (Just & Latzer, 2017). Ideally, a deeper dive of STB phenomenology online would consist of data derived from an environment where the afflicted individual is no longer the minority and the medium is free from filters, restrictions, and barriers to communication.

To overcome the limitations of censored social platforms, this study utilized data collected from the publicly facing, pro-choice, suicide forum, Sanctioned Suicide (<https://sanctioned-suicide.org>). Originally a subforum on Reddit, the community was permanently banned from the platform for controversial content and subsequently established an

independent Web presence in March 2018. While completely anonymous, users engage in raw and uninhibited conversation regarding the physical and philosophical realities of their own STB. The forum is self-described as “a safe space to discuss the topic of suicide without the censorship of other places, as well as a community that can understand you and let you be yourself without judging you or forcing you to do anything” (*Sanctioned Suicide: Rules & FAQs*, 2018).

According to the forum’s information page, the platform is intended for users to “vent, talk to like-minded individuals, share experiences, or to empathize and offer kind words to others who might need them” (*Sanctioned Suicide: Rules & FAQs*, 2018). Sanctioned Suicide thus presents as an exceptionally rare opportunity to characterize and study STB in an unfiltered, naturalistic medium of modern communication.

To this end, the current research modeled and profiled the content of STB written communication on the Sanctioned Suicide forum using the comprehensive IMV model as a theoretical basis. With constructs of the IMV model, in conjunction with literature-supported measures and definitions of these constructs, this work first developed a 20-item STB inventory to qualitatively code 840 original posts (OPs) from a cohort of more than 11,000 users. With information on the presence/absence of items in each OP, a network analysis modeling framework was then employed to discern thematic patterns in STB-related written expression. This endeavor offers the first known theory-guided characterization of online STB content from a source whose content is devoid of censorship or filtering, thereby providing unique and potentially valuable insight into the more prominent feelings, actions, and experiences of the suicidal mind.

2. Methods

2.1 Cohort and Data Source Characteristics

This study leveraged written post data of users participating within the main discussion subforum of Sanctioned Suicide. Given the nature of the medium and the highly sensitive nature of the topic, the rules and moderation efforts of the platform prohibit the disclosure of any potentially identifying information. To register for an account, individuals must acknowledge that they are at least 18 years of age and do not have intellectual disabilities. While the forum and all its content are publicly accessible for viewing, individuals must register for an account and pass screening and approval by the site moderators to post and interact with others. Sanctioned Suicide exists to provide a digitally accessible and anonymous, judgment-free space for those suffering with suicide-related thoughts, behaviors, and associated negative experiences, thus users represent a globally diverse cohort of heightened at-risk individuals. This study and all associated protocols were deemed to present no greater than minimal risk to subjects and thus “exempt” from further review by the Committee for the Protection of Human Subjects at Dartmouth College (STUDY00032141).

2.2 Data Collection

All activity within the “Suicide Discussion” subforum from March 17, 2018 to February 5, 2021 was programmatically collected and transformed into tabular format using a custom built Python (v3.8) script that primarily leveraged the *BeautifulSoup* package (Richardson, 2007) to parse the website’s html code. The resultant data consisted of more than 600,000 time-stamped posts across approximately 37,600 threads, ultimately reflecting expressions of STB for 11,583 users. Information on (i) thread title, (ii) thread author, (iii) post author, (iv) post date, (v) post text content, and (vi) direct mentions and references to other users within the post text were collected. During collection of the data, each user was automatically assigned a randomly

generated, 32-character hashed ID. This de-identifying ID was automatically replaced with all instances of the respective user's online handle in the data prior to subsequent preprocessing.

2.3 Data Preprocessing and Sampling

To achieve a sufficiently descriptive and representative sampling of content across the forum's user base, the current analysis focused on original posts (OPs)—the first post made by a user when creating a new discussion thread. OPs were filtered to only include those which met a word count threshold of 200, thereby maximizing the chance of the post containing contextually relevant information. This filtering yielded 7,610 OPs for further consideration. For reasons explained in 2.6 below, this pool of OPs was randomly sampled to arrive at a final set of 840 OPs for downstream processing and analysis.

2.4 Theoretical Foundation – The IMV Model

The IMV model served as the core theoretical foundation of this work. This model was selected because of its ability to reconcile and incorporate several models and frameworks of STB across a wide breadth of measurable constructs (O'Connor & Kirtley, 2018). The IMV framework is an ideation-to-action model that most notably integrates factors from the Interpersonal-Psychological Theory of Suicide (IPTs) (Van Orden et al., 2010), the Strain Theory of Suicide (Zhang, 2019), as well as the Cry of Pain (COP) (Williams, 1997) and the Schematic Appraisal Model of Suicide (SAMS) (Johnson et al., 2008) which adopt an evolutionary perspective to explain STB as an involuntary defeat strategy (Gunn & Lester, 2014). Divided into a pre-motivational, motivational, and volitional stage, the model mechanistically explains STB progression in a way that assigns roles to a diverse suite of

biopsychosocial factors that serve to moderate development from predisposition to ideation, intent, and action.

Borrowing from the stress-diathesis view of suicide, the pre-motivational stage emphasizes the joint biosocial interplay of state variables (stressors) and trait variables (diatheses). Accordingly, the pre-motivational stage outlines potentially relevant internal (e.g., negative evaluations of self and situation) and external (e.g., stressful life events) contexts which represent possible vulnerability to several categories of “strains” (Zhang, 2019) and may ultimately result in the predisposition of an individual to develop STB. Exposure to one or more pre-motivational factors may in turn lead to suicidal ideation through the development of feelings of defeat and entrapment—the central causal pathway of the model. Core explanatory importance for STB is thus given to sentiments that are hypothesized to have roots in an evolutionarily reconciled, psychobiological response to socially-derived powerlessness (Gunn & Lester, 2014). To explain transitions from defeat to entrapment, and from entrapment to suicidal ideation, the model incorporates two major unifying clusters of constructs: threat-to-self moderators (e.g., rumination, catastrophizing) and motivational moderators (e.g., thwarted belongingness, perceived burdensomeness), respectively. Once suicidal ideation and intent are developed, the volitional phase of the IMV model describes transitions to and from behavioral enactment. Similar to the motivational phase, this process is governed by a cluster of constructs, called volitional moderators (e.g., planning, access to means), which have roots in notions of “acquired capability” as presented in the IPTS.

For further details on the IMV model, interested readers are encouraged to consult the original work by O’Connor and Kirtley (O’Connor & Kirtley, 2018) as well as a number of works which have since applied the model in various research settings (Branley-Bell et al., 2019;

Cleare et al., 2021; Forkmann & Teismann, 2017; Ordóñez-Carrasco et al., 2021; Teismann & Brailovskaia, 2020).

2.5 Inventory Development

Using key components of the IMV model as a basis, a 20-item inventory was developed to classify the written content of OPs. Table 1 lists the constructs utilized to develop the inventory along with literature demonstrating potential significance of association with STB-related outcomes. Constructs were selected and inventory items were developed and modified over several workshop sessions. In these sessions, the research team met to discuss the content of randomly selected posts across the Sanctioned Suicide forum and determined whether it was feasible to operationalize each construct given the type and level of detailed information available and, if so, how to best capture the construct as objectively and consistently as possible. Formal definitions for each item were developed from descriptions and criteria present within previously published psychometric scales and tuned to the written nature of the medium. Three non-IMV-derived items were also included in the inventory: (i) information seeking, (ii) information sharing, and (iii) pro-suicide choice attitude. These items were created to enhance the motivational and volitional context of suicide risk given the form and content of Sanctioned Suicide. All items comprising the inventory, along with abridged definitions of each, are presented in Table 2. The inventory itself, including full operational definitions and sources used to develop the definitions, are available as Supplementary File 1.

Table 1. Foundational IMV Model Constructs and the Supporting Literature

IMV Stage	IMV Construct Group	Construct	Empirical Support in Literature
Pre-Motivational	–	Traumas	(Aitken & Munro, 2018; Joiner et al., 2007; Maniglio, 2011)
		Stressors	(Haboush-Deloye et al., 2015; Kim et al., 2009; Misono et al., 2008; O'Neill et al., 2021; Polanco-Roman & Miranda, 2013; Sokol & Eisenheim, 2016; Tsai et al., 2015)
Motivational	Core	Defeat	(Taylor et al., 2011; Panagioti et al., 2015; Höller et al., 2020; Pollak et al., 2021; Höller et al., 2022)
		Entrapment	(Cramer et al., 2019; Höller et al., 2020, 2022; Panagioti et al., 2015; Pollak et al., 2021)
	Threat-to-Self Moderators (TSMs)	Rumination	(Miranda & Nolen-Hoeksema, 2007; Surrence et al., 2009; Tang et al., 2021)
		Suicide Rumination	(Rogers et al., 2021; Rogers & Joiner, 2018; Sheri L. Johnson et al., 2022)
		Pain Catastrophizing	(Kowal et al., 2014; Racine et al., 2014; Sansone et al., 2013; Tripp et al., 2016)
	Motivational Moderators (MMs)	Perceived Burdensomeness	(Bhargav & Swords, 2022; Duffy et al., 2020; Hill et al., 2015; King et al., 2019; Roeder & Cole, 2019)
		Thwarted Belongingness	(Bhargav & Swords, 2022; Hill et al., 2015; King et al., 2019; Roeder & Cole, 2019)
		Lack of Purpose	(Din et al., 2018; Eskiyurt & Ozkan, 2017)
		Lack of Social Support	(Angelakis & Gooding, 2022; Mackin et al., 2017; Moller et al., 2021; Tseng & Yang, 2015)
		Hopelessness	(Horwitz et al., 2017; Kao et al., 2012; McMillan et al., 2007; Sueki, 2022; Tsujii et al., 2020; Wolfe et al., 2019)

Volitional	Volitional Moderators (VMs)	Planning and Preparation	(Diaz et al., 2003; Spirito et al., 1996; Stefansson et al., 2012)
		Past Suicide Attempt	(Bostwick et al., 2016; Lewinsohn et al., 1994)
		Self-Harm	(Anestis et al., 2013; Brailovskaia et al., 2019; Nock et al., 2006; Wester et al., 2016)
		Pain Tolerance	(Orbach et al., 1996; Pennings & Anestis, 2013; P. N. Smith et al., 2010)
		Fearlessness of Death	(Dhingra et al., 2015; Ferm et al., 2020; Meerwijk & Weiss, 2018)
		Vivid Death Imagery	(Crane et al., 2012)
Other	—	Information Seeking/Sharing	(Areán et al., 2021; Harris et al., 2009; Kemp & Collings, 2011)
		Pro-Suicide Choice Attitude	(Agnew, 1998)

Table 2. Inventory for Describing Online Written Expression of STB

Item Name (Abbreviation)	IMV Stage / Construct Group	General Definition
Coping Strain (ST-COPE)	Pre-Motivational	events or perceptions predisposing an individual to feel unable to deal with the consequences or changes to aspect(s) of life
Aspiration/Deprivation Strain (ST-ASDP)	Pre-Motivational	negative feelings resulting from comparison of the realized self to the idealized self or the state of self to that of others
Value Strain (ST-VALU)	Pre-Motivational	perception that personal social values or beliefs conflict with those of society or specific individuals of personal relevance
Physical or Emotional Trauma (TR-PHEM)	Pre-Motivational	history or ongoing physical or emotional abuse as a child or adult
Sexual Abuse Trauma (TR-SXAB)	Pre-Motivational	history of one or more sexual abuse incidents as a child or adult
Defeat or Entrapment (MP-CORE)	Motivational / Core	negative appraisal of self and state (defeat) which may entail feelings of hopelessness or arrested flight (entrapment)
Ruminative Behaviors (MP-RUMI)	Motivational / TSMs	tendency to solitarily and negatively reflect; may manifest as an inability to escape persistent suicidal thoughts
Pain Catastrophizing (MP-PCAT)	Motivational / TSMs	preoccupation with physical pain described as incessant, insurmountable, triggering, or a source of worry
Perceived Burdensomeness (MP-BURD)	Motivational / MMs	feeling that family, friends, or society would be better off, relieved, or happier if individual was gone
Thwarted Belongingness (MP-TWBG)	Motivational / MMs	feeling disconnected from others or feeling like an outsider; may include a perceived lack of social support
Lack of Purpose (MP-PURP)	Motivational / VMs	belief that life has no meaning and there is nothing worth living for
Suicide Planning (VP-PLAN)	Volitional / VMs	having acquired tools or having recently carried out one or more steps necessary to attempt suicide
Previous Suicide Attempt (VP-AMPT)	Volitional / VMs	history of one or more suicide attempts
Self-Harm Behaviors (VP-SHRM)	Volitional / VMs	deliberate past or current non-suicidal self-harm behaviors
Pain Tolerance (VP-PAIN)	Volitional / VMs	toleration of discomfort and pain or behaviors that deliberately seek to endure physical discomfort
Fearlessness of Death (VP-FEAR)	Volitional / VMs	absence of negative feelings or emotional disturbance surrounding the topic of death or the individual's own death
Vivid Death Imagery (VP-IMAG)	Volitional / VMs	detailed descriptions of suicide-related behaviors or one's own death that evoke positive emotional responses

Information Seeking (OT-INFO)	Other	appeal for further information regarding suicidal methods or the acquisition of necessary items for suicide
Information Sharing (OT-SHAR)	Other	dissemination of suicide-related information without appeal for further information or advice from others
Pro-Suicide Choice Attitude (OT-PROS)	Other	expressed opinion that people have a right to end their own life or that suicide is justifiable given adverse circumstances

2.6 Qualitative Coding

Each of the 840 forum posts were assessed by a team of four raters who also developed the 20-item inventory. The inventory was used to qualitatively code the presence/absence (“1”/“0”) of each item. Each post was first coded by a randomly assigned subset of two raters. Next, for each post that did not have agreement across all 20 items (as well as a random subset of posts that did have agreement), a third rater from the team was randomly assigned to code the post and serve as a tie-breaker for any discrepancies. During processing, one post was lost, resulting in a total of 46,920 ratings across 839 posts. For all posts with three raters ($n=668$), the consensus for each item was then taken to ultimately define the presence/absence of content.

2.7 Interrater Reliability

Reliability among raters for each item was assessed through percentage agreement, as well as the calculation of both Cohen’s kappa (Cohen, 1960) and Fleiss’ kappa (Fleiss, 1971) to account for chance agreement. Because many posts were rated by more than two raters, and Cohen’s kappa is used to calculate the agreement between two raters, the average Cohen’s kappa between all pairs of raters was calculated and reported for each item. Fleiss’ kappa served as a complementary metric to increase the robusticity of agreement estimation; however, Fleiss’ kappa requires a consistent and complete set of raters across all posts. To address this, the ratings for each item were imputed to arrive at ten versions of complete data (four ratings for each post). Fleiss’ kappa was then calculated for each item on each of the imputed datasets and averaged across the datasets. Details on the imputation approach, along with an illustrative example, are available as Supplementary File 2. Importantly, Krippendorff’s alpha (Krippendorff, 2011) was not utilized in the current analysis as this metric severely penalizes categorical data whose base

rates of class representation are highly skewed (Feng, 2015). Moreover, Fleiss' kappa has been reported as a suitable substitute when data are binary nominal (Feng, 2015).

The average Cohen's kappa and average Fleiss' kappa for each item were interpreted based on the standards applied within exploratory, social science-based research. Any item with at least one kappa metric below moderate agreement (≤ 0.4) was deemed unreliable and thus not considered in subsequent modeling and analysis.

2.8 Network Modeling

Using the consensus ratings of presence/absence across 13 reliably scored items (see 3.1) for 839 posts, an Ising network model was estimated using the *IsingFit* package in R (v4.2) (van Borkulo & Epskamp, 2016). Briefly, this approach uses regularization techniques alongside the Bayesian Information Criterion (BIC) to model the partial correlative associations among binary variables. For the current analysis, the gamma hyperparameter was set to "0", effectively using the ordinary BIC instead of the extended BIC, and the "and rule" was set to "FALSE", allowing for edges to be drawn between nodes (items/variables) even if only one of the regression coefficients was estimated as nonzero. Given the exploratory goals of this research, this configuration was appropriate as it maximizes sensitivity and minimizes specificity. For more information on the practical aspects of implementing an Ising model, interested readers are encouraged to consult an excellent tutorial on the *IsingFit* package (van Borkulo, 2017).

To assess significance and stability of the estimated network, the *bootnet* package in R was used (Epskamp et al., 2018). Nonparametric bootstrap resampling was performed $k=1,000$ times to generate 95% confidence intervals around the network edge estimations. Associations between nodes were considered significant if the confidence interval did not cross zero.

Additional introspection involved (i) calculating the standardized degree centrality for each node and (ii) performing community detection using the Louvain algorithm (Blondel et al., 2008).

3. Results

3.1 Qualitative Coding and Item Reliability

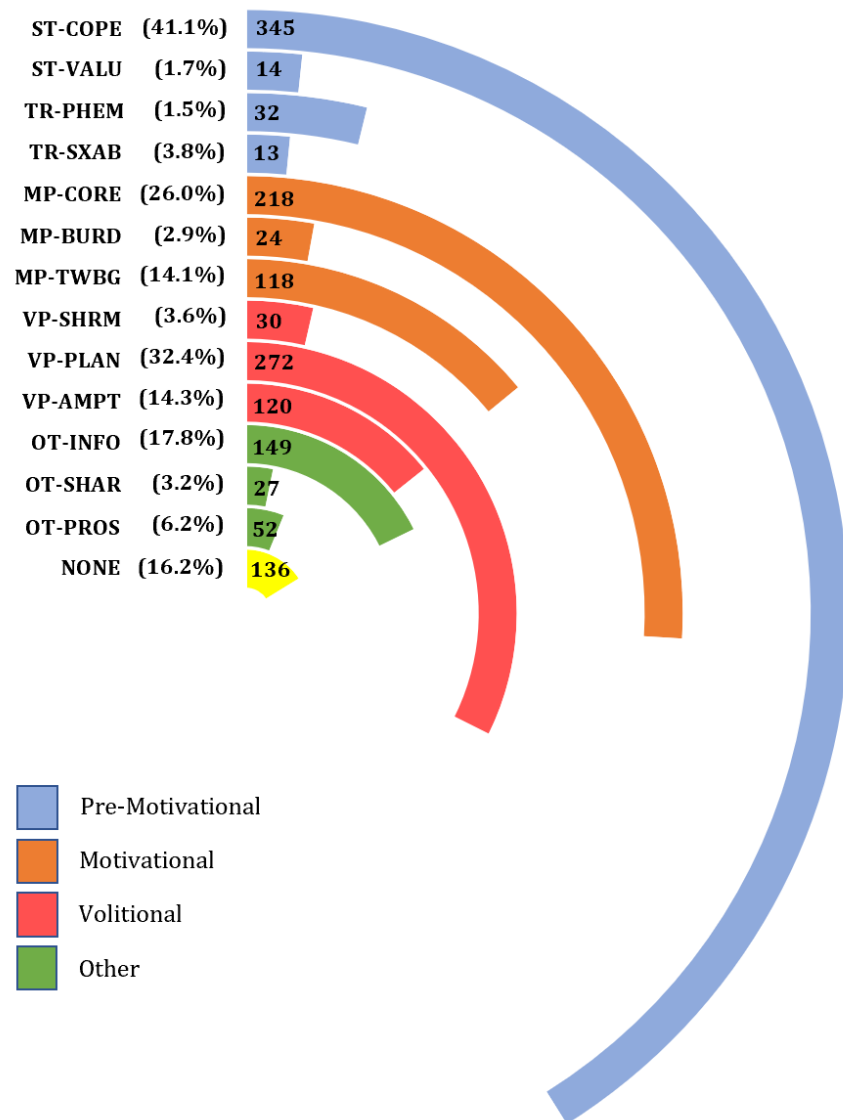
Of the 20 items comprising the inventory, 13 were found to have at least a moderate level of agreement ($\kappa > 0.4$) among raters. Due to poor agreement, the remaining 7 items—(i) aspiration/deprivation strain (ST-ASDP), (ii) ruminative behaviors (MP-RUMI), (iii) pain catastrophizing (MP-PCAT), (iv) lack of purpose (MP-PURP), (v) pain tolerance (VP-PAIN), (vi) fearlessness death (VP-FEAR), and (vii) vivid death imagery (VP-IMAG)—were not considered in subsequent modeling. Table 3 summarizes the results of the interrater agreement analyses among the 13 items deemed acceptable for analysis. These items are roughly equally represented across the IMV model stages from which they were derived (4 items for pre-motivational, 3 items for motivational, 3 for volitional, 3 for other). Both sexual abuse trauma (TR-SXAB) and self-harm behaviors (VP-SHRM) had almost perfect agreement ($\kappa = 0.80$ – 1.0), previous suicide attempt (VP-AMPT), information seeking (OT-INFO), and information sharing (OT-SHAR) had substantial agreement ($\kappa = 0.61$ – 0.80), and the remaining seven items had moderate agreement ($\kappa = 0.41$ – 0.60).

Table 3. Interrater Agreement of Modeled Inventory Items

Item	Posts with Agreement (%)	Averaged Cohen's Kappa	Averaged Fleiss' Kappa	Agreement Interpretation
ST-COPE	76.2	0.644	0.553	moderate
ST-VALU	97.4	0.448	0.573	moderate
TR-SXAB	99.6	0.833	0.929	almost perfect
TR-PHEM	94.6	0.576	0.513	moderate
MP-CORE	72.2	0.491	0.486	moderate
MP-BURD	95.9	0.535	0.549	moderate
MP-TWBG	83.2	0.506	0.411	moderate
VP-PLAN	80.3	0.650	0.590	moderate
VP-AMPT	92.0	0.735	0.684	substantial
VP-SHRM	98.0	0.790	0.839	almost perfect
OT-INFO	88.7	0.708	0.619	substantial
OT-SHAR	97.7	0.708	0.818	substantial
OT-PROS	91.1	0.500	0.480	moderate

Note. Cohen's kappa for each item was calculated by assessing pairwise agreement between all raters and averaging across pairs. Fleiss' kappa for each item was calculated by averaging across imputed data (see 2.8). Interpretation of scores follows literature standards: ≤ 0.2 = none to slight agreement; 0.21–0.40 = fair agreement; 0.41–0.60 = moderate agreement; 0.61–0.80 = substantial agreement; 0.81–1.00 = almost perfect agreement. Seven items (not shown in the table) were discarded due to agreement that fell below moderate for at least one of Cohen's kappa or Fleiss' kappa calculations.

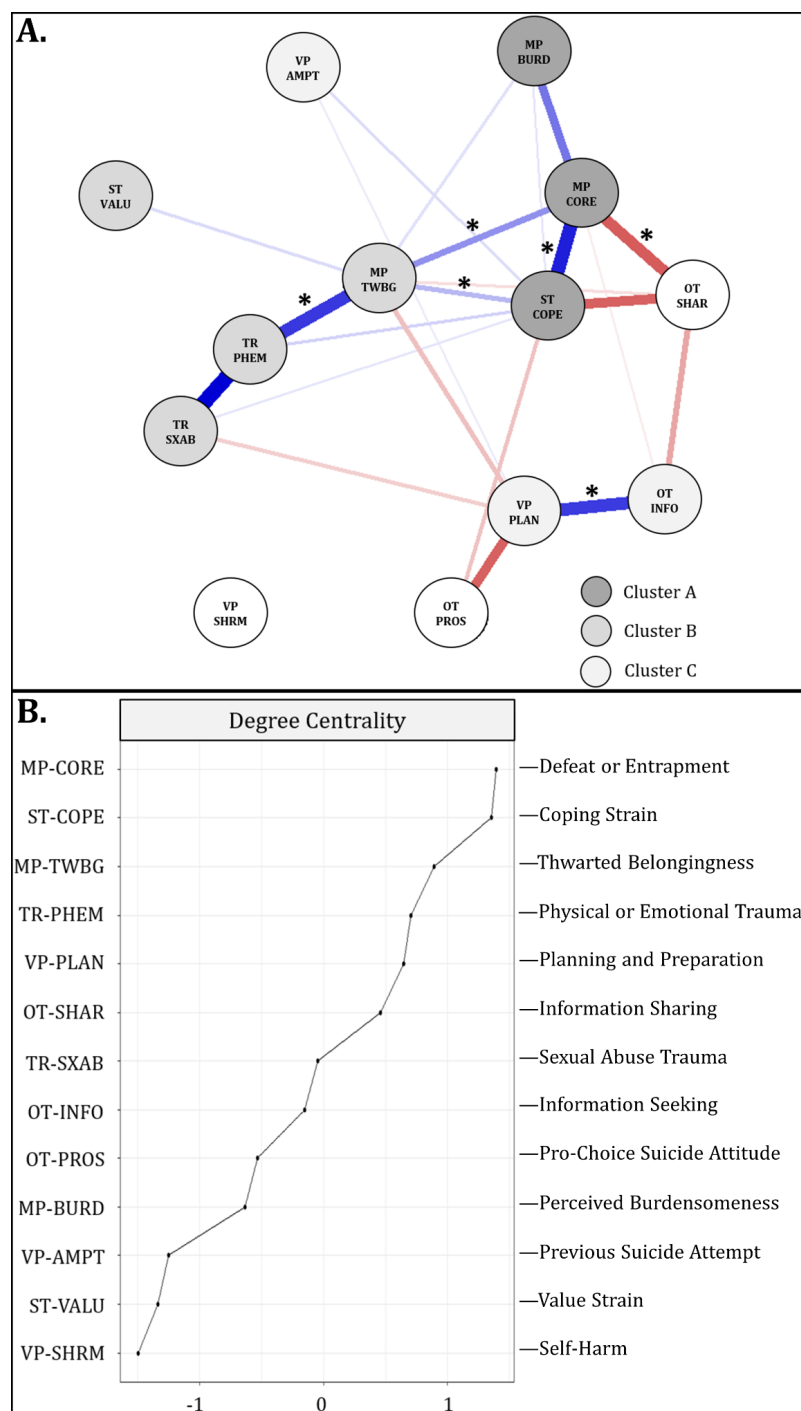
Total counts of item occurrences are presented in Figure 1. Across the 839 posts, coping strain-related stressors (ST-COPE) occurred the most frequently, appearing in approximately 41% of posts, with planning and preparation (VP-PLAN) and defeat or entrapment (MP-CORE) occurring next highest in frequency at approximately 32% and 26%, respectively. By IMV stage, volitional phase items, dominated by VP-PLAN, were the most prevalent content, present in over half of all posts (50.3%). Pre-motivational stressors and traumas, largely consisting of ST-COPE, were second highest at approximately 48% of posts, and motivational stage items, dominated by MP-CORE, were represented in approximately 43% of posts. Approximately 16% of posts did not contain content related to any of the 13 items.

Figure 1. Frequency of Modeled Inventory Items across Posts

Note. Counts and percentages are based on the rating team's consensus of each item's presence across $N=839$ posts.

3.2 Network Modeling

The Ising network model, shown in Figure 2A, estimated several significant associations between items. The strongest significant positive associations were seen between (i) feelings of defeat or entrapment (MP-CORE) and mention of stressors that predispose individuals to coping-related strain (ST-COPE), (ii) discussion of suicide plans and preparations (VP-PLAN) and appeals for suicide-related information (OT-INFO), and (iii) mention of physical or emotional trauma (TR-PHEM) and feelings of thwarted belongingness (MP-TWBG). Two additional significant, albeit less strong, positive associations were estimated between (i) MP-CORE and MP-TWBG as well as between (ii) ST-COPE and MP-TWBG. The tie between MP-CORE and suicide-related information sharing (OT-SHAR) was the only negative association estimated to be significant. The 95% confidence intervals for each edge in the estimated network are available as Supplemental File 3. Louvain communities, labeled in Figure 2A, identified three clusters whose membership highlighted, and largely recapitulated, observed patterns in the strength and significance between items. Figure 2B shows the ranked, normalized degree centrality of all items in the network. MP-CORE and ST-COPE are implicated as most central, suggesting that these items represent the most highly integrated OP content across the forum, co-occurring most strongly overall with other items when all item co-occurrences are taken into account.

Figure 2. Estimated Ising Network

Note. (A) Items are modeled as nodes with edges representing partial correlations (blue=positive; red=negative) between items. Edges denoted with asterisks (*) were found to be significant after performing $k=1000$ iterations of non-parametric bootstrap resampling. Clusters were defined

through Louvain community detection with default resolution. Non-shaded nodes represent items that did not cluster. (B) Items are ranked in order by descending degree centrality. MP-CORE, ST-COPE, and MP-TWBG represent the most central nodes in the network.

4. Discussion

This work leveraged the IMV model of suicide to develop a 20-item inventory for online written expression of STB. Using this inventory alongside a network modeling approach, the thematic content of STB was characterized within a unique digital community free from the censoring mechanisms of social media platforms and the greater World Wide Web. Three prominent themes of STB expression emerged which highlighted pre-motivational coping strain-related stressors and physical/emotional traumas, motivational feelings of defeat/entrapment and thwarted belongingness, and volitional discussions surrounding planning and preparation. Moreover, the core component of the IMV model, defeat/entrapment, was observed in network modeling to be the most centrally expressed construct. Current findings echoed empirical connections among STB risk factors reported in the literature and served to illustrate how digital STB communication may differ in presentation from in-person expression.

The centrality of defeat/entrapment in the estimated network aligns with the structural foundation of the IMV model. The IMV model posits that progression to suicidal ideation and intent requires feelings of defeat and subsequently, entrapment, whose states of attainment are moderated by one or more ancillary factors. Feelings of defeat and entrapment are thus hypothesized to be central to the formation and progression of STB. The documented prevalence (Figure 1) and connectivity (Figure 2) of defeat/entrapment (MP-CORE) relative to all other modeled constructs not only supports this framework, but also implicates defeat/entrapment as an important component of digital STB expression. A close second in centrality, and the most prevalent item, coping strain-related stressors (ST-COPE) exhibited significant connections with thwarted belongingness (MP-TWBG) and defeat/entrapment. ST-COPE is a summative pre-motivational construct which, when considered independently, indicates that adverse life events

or perspectives that predispose an individual to coping-related strain are important foci of forum conversation. The IMV model frames pre-motivational stressors and diatheses as necessary precursors to motivational feelings of defeat and its related moderators; the centrality of coping stressors alongside motivational defeat/entrapment in the estimated network suggests a heightened importance of integration between the first two phases of the IMV in describing the expression of STB on the forum, with the third volitional phase presenting as more independent in its expressive manifestation. Despite the prevalence of planning and preparation (VP-PLAN) across the forum, it is much less integrated with other items.

The significantly positive association found between defeat/entrapment and coping strain-related stressors in the estimated network represented the first major content theme of STB expression: *stressful contexts of powerlessness*. Given the anonymity and constituency of Sanctioned Suicide, users are comfortable sharing intimate details about their life. Results indicated that these details were often shared alongside feelings of hopelessness or an inability to escape from the mental, emotional, or physical consequences of their circumstances. This perceived powerlessness is given at least a partial origin as users search for advice or commiseration among their peers. There is a wide array of evidence connecting various coping stressors to perceived powerlessness. Comorbid psychopathology is one common example, where studies on clinical populations have found that anxiety and affective comorbidity in combination with psychosis or schizophrenia led to significantly higher levels of entrapment among patients (Gumley et al., 2004; Karatzias et al., 2007). Hopelessness, a hallmark of the defeatist mindset, was also found to exacerbate the impact of a number of other stressors, including homelessness, unemployment, bereavement, and physical health problems, on STB-related outcomes (Steeg et al., 2016). In this light, the association between defeat/entrapment and

copied stressors online is unsurprising; however, its prominence suggests that this medium may serve as a wealth of information for future efforts seeking to better understand the triggers of involuntary defeat and the escalation of STB in the general population.

The significantly positive association found between physical/emotional trauma and thwarted belongingness in the estimated network represented the second major content theme of STB expression: *trauma-mediated alienation*. Accounts of past or ongoing physical/emotional trauma were often expressed alongside a perceived disconnection from friends, family, and society. This co-occurrence of expression suggests an association in manifestation which has been documented in various contexts (Brake et al., 2019; Schönfelder et al., 2019; N. B. Smith et al., 2018; Wolford-Clevenger et al., 2016). A study conducted on a non-clinical population found significant correlations between childhood physical/emotional/sexual abuse and thwarted belongingness with emotional abuse exhibiting the largest association (N. B. Smith et al., 2018). Echoing this, research within a clinical inpatient sample with depression found significant associations between childhood emotional abuse and thwarted belongingness (Schönfelder et al., 2019). Additionally, a third study conducted on a college student population found physical dating violence to be correlated with feelings of thwarted belongingness (Wolford-Clevenger et al., 2016). The current work adds to the broad evidence suggesting a key connection between physical/emotional trauma and thwarted belongingness and highlights this connection within online expression. Furthermore, and in line with the IPTS model of suicide, its prominence within Sanctioned Suicide speaks to the theoretical importance of thwarted belongingness as a motivational moderator for STB with the added focus on physical and emotional traumas as potential key factors in the development of this dangerous mindset.

The significantly positive association found between planning and information-seeking in the estimated network represented the third major content theme of STB expression:

crowdsourced preparation. This theme is likely unique to the digital environment of Sanctioned Suicide as it is only possible to detect within a setting boasting a combination of minimal censorship and maximal anonymity. While there are no known studies which have addressed this association explicitly, the finding is supported by research on search behaviors of at-risk individuals (Areán et al., 2021; Harris et al., 2009; Kemp & Collings, 2011). There is evidence that STB-related online activity is elevated in those who report greater STB risk-related symptoms, have perceptions of decreased social support, and are less likely to engage in help-seeking behaviors, leading to a greater propensity for individuals to visit “pro-suicide” sites and search for suicide methods relative to others at-risk who do not utilize the internet for STB-related purposes (Harris et al., 2009). Despite the marginalized status of “pro-choice” suicide sources on the internet, searches for “suicide methods” are among the most frequently performed by higher-risk individuals (Kemp & Collings, 2011). As a risk factor, shifts in online information seeking behaviors, including queries relating to methodology, present as warning signs for suicide as early as two months prior to an attempt (Areán et al., 2021). The current study adds to these findings by uncovering a prominent association between high-risk, volitional stage suicidal planning and preparation and methods-related search behavior. Clearly, a forum consisting of like-minded individuals offers a font of easily garnered, and frequently tapped, information on suicide techniques. Further development of STB risk detection tools within digital contexts may benefit from a focus on information seeking behaviors as they may be a signal for volition and thus represent advanced status along the ideation-to-action continuum.

In addition to the themes discussed above, weaker, significantly positive associations were found between thwarted belongingness and each of defeat/entrapment and coping stressors. These are substantiated within the context of suicide risk through detected associations of thwarted belongingness with hopelessness (Tucker et al., 2018), entrapment (Lucht et al., 2020), chronic pain (Wilson et al., 2013), eating disorder symptoms (Kwan et al., 2017), and social alienation (Bauer et al., 2018). The estimated network thus places increased emphasis on the contributions of thwarted belongingness to STB, with perceived burdensomeness—an equally important and complementary component to IPTS—modeled much less prominently. This result is contrary to what has been previously observed, albeit in largely non-digital contexts. A large meta-analysis of research utilizing IPTS found stronger associations of suicidal ideation, risk, and history of past attempts with perceived burdensomeness (Chu et al., 2017). Thwarted belongingness, while recognized as having empirical connections with defeat, entrapment, and suicidal ideation, is generally less predictive than perceived burdensomeness (De Beurs et al., 2019; Forkmann & Teismann, 2017; Lockman & Servaty-Seib, 2016). The cause of this discrepancy could stem in part from the unique context of this study's data or from an inability to simultaneously account for more IMV-derived items in modeling and analysis. However, the latter possibility does not undercut thwarted belongingness as a potentially important component of STB digital expression.

Despite the insights offered by this analysis, there are several important limitations. First, the developed item inventory was difficult to consistently apply, as reflected in poor interrater reliability in seven of the 20 items. Consequently, only ratings of 13 items were robust enough to warrant inclusion in modeling and analysis. While these remaining items were equally represented across IMV stages, necessary omission of TSMs and three VMs created an estimated

network that may differ from a hypothetical network informed by data robust enough to include all 20 items. Second, the data consisted only of OPs, thus STB expression was described solely from the perspective of an initiating party and not necessarily from the content that may naturally follow in response to others. Third, STB was profiled using broad constructs, thus preventing the ability to study more specific associations among particular stressors, topics, or frequently utilized words. Fourth, the cross-sectional nature of the analysis, while useful for establishing a descriptive baseline of prominent themes, nevertheless precluded the ability to discern shifting patterns of content over time. Last, the anonymity of the data source prevented sociodemographic reporting which limited notions of cohort representation and generalizability beyond the forum's status as a globally accessible community on the World Wide Web.

Future work will aim to build on this initial foray into the manifestation of uncensored STB online through more detailed modeling of semantic content as well as patterns in social structure, both across the community and within temporal contexts. Such research will hopefully serve to more fully develop and highlight unique digital phenotypes that contribute to a better understanding of STB presentation in an era dominated by virtual sociality.

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The Authors declare that there is no conflict of interest.

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