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The Interpersonal Theory of Suicide: A Systematic Review and Meta-Analysis of a Decade of Cross-National Research

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Abstract

Over the past decade, the *interpersonal theory of suicide* has contributed to substantial advances in the scientific and clinical understanding of suicide and related conditions. The interpersonal theory of suicide posits that suicidal desire emerges when individuals experience intractable feelings of *perceived burdensomeness* and *thwarted belongingness* and that near-lethal or lethal suicidal behavior occurs in the presence of suicidal desire and *capability for suicide*. A growing number of studies have tested these posited pathways in various samples; however, these findings have yet to be evaluated meta-analytically. This paper aimed to: (1) conduct a systematic review of the unpublished and published, peer-reviewed literature examining the relationship between interpersonal theory constructs and suicidal thoughts and behaviors; (2) conduct meta-analyses testing the interpersonal theory hypotheses; and (3) evaluate the influence of various moderators on these relationships. Four electronic bibliographic databases were searched through the end of March 2016: PubMed, Medline, PsycINFO, and Web of Science. Hypothesis-driven meta-analyses using random effects models were conducted using 122 distinct published and unpublished samples. Findings supported the interpersonal theory: the interaction between thwarted belongingness and perceived burdensomeness was significantly associated with suicidal ideation; and the interaction between thwarted belongingness, perceived burdensomeness, and capability for suicide was significantly related to a greater number of prior suicide attempts. However, effect sizes for these interactions were modest. Alternative configurations of theory variables were similarly useful for predicting suicide risk as theory-consistent pathways. We conclude with limitations and recommendations for the interpersonal theory as a framework for understanding the suicidal spectrum.

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Keywords

interpersonal theory of suicide; perceived burdensomeness; thwarted belongingness; capability for suicide; meta-analysis

Introduction

Suicide is a leading cause of death worldwide, claiming the lives of over 800,000 individuals annually (World Health Organization [WHO], 2014). Death by suicide—intrinsically tragic—additionally produces a profound emotional impact on bereaved loved ones (Cerel, Jordan, & Duberstein, 2008; Pitman, Osborn, King, & Erlangsen, 2014). Understanding the causes of suicide, as well as best practices for the assessment, prevention, and treatment of suicidal behaviors, has been identified as a critical public health priority and global imperative (Caine, 2013; WHO, 2014). Notably, suicide ideation (i.e., thinking about killing oneself) and suicide attempts (i.e., engaging in behavior with the intention of dying but not actually dying) are both potent precursors to death by suicide (Suominen, Isometsä, Ostamo, & Lönnqvist, 2001). To advance the scientific understanding of factors that lead to suicide ideation and attempts—and, in some cases, death by suicide—and elucidate intervention points, it is crucial for suicide research to utilize theoretical frameworks (Klonsky, May, & Saffer, 2016; Prinstein, 2008; Selby, Joiner, & Ribeiro, 2014; Stanley, Hom, Rogers, Hagan, & Joiner, 2015). Such frameworks allow for the systematic organization of various risk and protective factors and ideally are designed specifically to be scientifically testable and falsifiable.

The interpersonal theory of suicide was presented by Joiner (2005) and further expanded upon by Van Orden and colleagues (2010; see also Joiner et al., 2016). A key concept of the interpersonal theory, and a development beyond previous theories of suicide, is its emphasis on providing an explanation for why the vast majority of individuals who think about suicide do not go on to make a suicide attempt. The theory also posits distinct pathways by which suicidal desire and both nonfatal and fatal suicidal behaviors develop. In this regard, the interpersonal theory is the first theory of suicide positioned within what would later be termed the *ideation-to-action* framework (Klonsky & May, 2014; Klonsky et al., 2016; Nock et al., 2016).

In the decade since the interpersonal theory was first posited, it has spurred scores of empirical inquiries into the etiologies of suicide ideation, attempts, and fatalities. Research testing the interpersonal theory has been conducted spanning diverse samples, such as psychiatric inpatients and outpatients (Monteith et al., 2013), prison inmates (Mandracchia & Smith, 2015), undergraduates (Hagan, Podlogar, Chu, & Joiner, 2015), sexual minorities (Silva et al., 2015), military service members (Bryan et al., 2010), physicians (Fink-Miller, 2015), firefighters (Chu, Buchman-Schmitt, Hom, Stanley, & Joiner, 2016), and older adults (Cukrowicz et al., 2013). Moreover, research on the theory has been conducted across samples derived from locations outside of the United States (U.S.), such as South Korea (Chu et al., 2016b) and Australia (Christiansen et al., 2014). Components of the interpersonal theory have additionally led to advancements in the assessment of suicide risk

(Chu et al., 2015; Ribeiro, Bodell, Hames, Hagan, & Joiner, 2013) and treatment recommendations (Joiner & Van Orden, 2008; Joiner, Van Orden, Witte, & Rudd, 2009; Stellrecht et al., 2005). Given the scope of research that has been conducted on the interpersonal theory to date, it is essential to synthesize the literature through a systematic review and meta-analyses to inform future directions in suicide prevention.

Interpersonal Theory of Suicide: Core Constructs and Specific Hypotheses

Before proceeding, we wish to describe the core constructs and specific hypotheses of the interpersonal theory. The reader is referred to Joiner (2005) and Van Orden et al. (2010) for comprehensive accounts of the interpersonal theory of suicide, including its historical significance, rationale, and empirical foundations. To contextualize the current review, in what follows, we will briefly describe the core constructs of the theory and is specific hypotheses. For reference, the causal pathways of the interpersonal theory are depicted in Figure 1.

Thwarted belongingness—Humans have a fundamental need to belong (Baumeister & Leary, 1995) that, when unmet, leads to a range of negative health outcomes (Cacioppo & Cacioppo, 2014; Hawkley & Cacioppo, 2010; Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Holt-Lunstad, Smith, & Layton, 2010), including increased rates of suicide ideation, attempts, and fatalities across the lifespan (Fässberg et al., 2012; Trout, 1980; Turecki & Brent, 2015). Reflecting this particularly potent suicide risk factor, a core construct of the interpersonal theory is termed *thwarted belongingness*. The dimensions of thwarted belongingness include loneliness and the absence of reciprocal care. Components of these dimensions include self-reported loneliness, fewer friends, living alone, non-intact family, social withdrawal, and family conflict (Van Orden et al., 2010).

Perceived burdensomeness—Relatedly, the construct *perceived burdensomeness* also captures a facet of social disconnection, particularly the incorrect mental calculation that individuals make regarding their death being worth more than their life to others. That this construct includes the descriptor *perceived* is important to emphasize. The theory posits that individuals who think about, attempt, and die by suicide mistakenly translate their self-hatred into feelings of expendability. Thus, the dimensions of perceived burdensomeness include perceptions of liability and self-hate (Van Orden et al., 2010). This component of the theory, in particular, has been generative with regard to its contribution to an emerging biobehavioral account of suicidal behavior—the *eusocial theory of suicide* (Joiner, Hom, Hagan, & Silva, 2016; cf. Joiner & Stanley, 2016). In their theoretical paper, Joiner and colleagues (2016) propose that suicide may represent a derangement of what is typically an evolutionarily adaptive set of behaviors (i.e., self-sacrifice for the protection of others) often observed among eusocial species (e.g., naked mole rats, honeybees, and humans—species that utilize a colony-like organization for successful survival). They delineate parallels between eusocial self-sacrificial behaviors observed among non-humans and acute suicide risk factors observed in humans (e.g., overarousal); they also specifically note that perceived burdensomeness may represent a fatal miscalculation by suicidal individuals regarding the need to sacrifice themselves. Further tests of this eusocial framework for understanding suicide risk are certainly needed (see Joiner et al., 2016 for specific recommendations);

however, preliminarily, it appears that it may serve to complement and enhance the interpersonal theory.

Hopelessness—A critical prediction of the theory is that hopelessness about the mutability of both thwarted belongingness and perceived burdensomeness potentiates suicide risk. As will be described below, however, this point has remained largely neglected in empirical tests of the theory, despite its significance (Van Orden, 2014). Due to the lack of appropriate measures of the construct of hopelessness regarding the tractability of both thwarted belongingness and perceived burdensomeness, no studies have directly tested the theory's hypotheses regarding this construct. A few studies, though, have included a proxy measure of general trait hopelessness in tests of the interpersonal theory. The development of a measure of this important piece of the theory will help to clarify the role of the interpersonal theory in predicting suicide risk.

Capability for suicide—The theory recognizes that suicidal behavior is difficult to enact —indeed, it defies our basic biological instinct for survival. In the original accounts of the theory, this construct was referred to as *acquired capability*, with the assumption that capability for suicide develops after repeated exposures to painful and provocative events (e.g., physical abuse, combat exposure, past suicidal behavior), which in turn lowers one's fear of death and elevates one's physical pain tolerance. Recent empirical evidence substantiates retaining the acquired component of capability for suicide; yet, concurrently, work has suggested that capability for suicide may have a substantial genetic component (Smith et al., 2012). In this regard, we believe that the construct is more accurately represented through the use of the broader term *capability for suicide*, which encompasses both the acquired element and potential genetic loadings. Moving forward, we recommend this conceptual and nomenclature shift when discussing and testing the theory.

Theory hypotheses—Drawing from a corpus of studies employing diverse methodologies (e.g., psychological autopsy, correlational, experimental), Joiner (2005) detailed several hypotheses regarding the emergence of suicidal desire and suicidal behaviors. Briefly, thwarted belongingness and perceived burdensomeness are theorized to comprise suicidal desire,[1] and the transition from passive to active suicidal desire occurs when individuals feel hopelessness about the mutability of both of these interpersonal and intrapersonal states. Nonfatal and fatal suicidal behaviors are theorized to emerge when active suicidal desire (i.e., the confluence of thwarted belongingness and perceived burdensomeness, and hopelessness about these feelings' tractability) interacts with an elevated capability for suicide. Of note, the interpersonal theory predicts that these three constructs represent proximal predictors of suicidal behavior and as such, may account for (i.e., statistically mediate) the relationship between various suicide risk factors and suicidal thoughts and behaviors. Van Orden et al. (2010; p. 600) presented the following falsifiable hypotheses:

[1]Of note, emerging research suggests that perceived burdensomeness may have a stronger, more reliably significant association with suicidal ideation (Chu, Rogers, & Joiner, 2016d; Ma et al., 2016). However, in order to test the theory's original predictions, no *a priori* modifications to the overall theory hypotheses are being made.

1. "Thwarted belongingness and perceived burdensomeness are proximal and sufficient causes of passive suicidal ideation;
2. The simultaneous presence of thwarted belongingness and perceived burdensomeness, when perceived as stable and unchanging (i.e., hopelessness regarding these states), is a proximal and sufficient cause of active suicidal desire;
3. The simultaneous presence of suicidal desire and lowered fear of death serves as the condition under which suicidal desire will transform into suicidal intent;
4. The outcome of serious suicidal behavior (i.e., lethal or near lethal suicide attempts) is most likely to occur in the context of thwarted belongingness, perceived burdensomeness (and hopelessness regarding both), reduced fear of suicide, and elevated physical pain tolerance."

It is emphasized that the theory posits distinct pathways by which suicidal desire and suicidal behaviors emerge. Predictions about suicidal ideation are made by only a subset of the theory's components, and the critical component of the theory lies in its focus on lethal or near-lethal suicidal behavior. In reviewing the state-of-the-science on the interpersonal theory, it is important to consider the degree to which studies examining the theory test the specific hypotheses noted above.

Nomenclature for the Continuum of Suicidal Thoughts and Behaviors

Given that the interpersonal theory makes predictions about various points along the continuum of suicidal thoughts and behaviors, a discussion of standardized nomenclature with regard to suicidality is indicated. We endeavor to align with established recommendations regarding suicide nomenclature (Crosby, Ortega, & Melanson, 2011; Silverman, Berman, Sanddal, O'Carroll P, & Joiner, 2007; Silverman, Berman, Sanddal, O'Carroll, & Joiner, 2007). More specifically, CDC uniform definitions include the following (Crosby et al., 2011): *suicidal ideation* refers to serious thoughts of engaging in self-directed potentially injurious behavior with any intent to die (p. 90); *suicide attempts* refers to non-fatal self-directed potentially injurious behavior with any intent to die as a consequence of the behavior that may or may not result in actual physical injury (p. 21); and *suicide fatalities/death by suicide* refers to death caused by self-directed injurious behavior with any intent to die as a consequence of the behavior (p. 23). The construct *suicide risk* (c.f. suicide proneness; i.e., both suicidal ideation and attempts, a propensity to put oneself in situations that may increase the future likelihood of engaging in suicidal thoughts and behaviors) has also received conceptual and empirical inquiry within the peer-reviewed literature, although its operationalized use has been heterogeneous.

Previous Review of the Interpersonal Theory

In 2016, Ma and colleagues conducted a systematic review of the interpersonal theory and identified a total of 58 articles representing 66 distinct studies. The Ma and colleagues (2016) review is noted for its many strengths, including being among the first to synthesize much of the literature on the interpersonal theory. One key component of the review was the suggestion that perceived burdensomeness might have a stronger association with suicidal

ideation than thwarted belongingness (Ma et al., 2016). Despite the import of the review, there are several limitations that necessitate the present study. First, Ma and colleagues (2016) only used a single searcher to identify articles across databases; we extend this approach and minimize the potential for error by having multiple individuals examine the same databases for relevant articles. Relatedly, whereas Ma and colleagues (2016) only searched Medline and PsychINFO, we additionally searched PubMed and Web of Science, potentially expanding the scope of articles to be included. Most notably, meta-analyses were not conducted in the Ma and colleagues (2016) review. A meta-analytic approach offers the advantage of allowing for a more definitive examination of the empirical veracity of the theory. For example, it allows the data to answer if perceived burdensomeness is, indeed, more strongly related to suicidal ideation than thwarted belongingness. Although Ma and colleagues (2016) noted that meta-analyses were not conducted due to the heterogeneity of studies and lack of reporting of effect size data, there are employable strategies that can circumvent these challenges and, therefore, allow for the conduct of a rigorous meta-analysis. That is, moderators can be examined to mitigate concerns regarding study heterogeneity and additional data can be obtained by contacting study authors directly to document previously unreported effect sizes. It is to this end that we conducted the present meta-analysis and review.

The Present Study

As noted, over a decade of cross-national research on the interpersonal theory has been conducted across populations and research groups. These studies have heretofore not been empirically synthesized and collectively evaluated, and as such, empirically-informed refinements to the theory have yet to be considered. Thus, our study expands upon Ma and colleagues' (2016) work by broadening the literature reviewed, utilizing meta-analytic tests of all hypothesized relationships central to the interpersonal theory, and conducting moderation analyses to better understand for whom these important relationships may be most relevant.

The primary purpose of the present study was threefold: (1) to conduct a systematic review of the extant unpublished and published, peer-reviewed literature examining the relationship between interpersonal theory constructs and one or more points along the continuum of suicidal thoughts and behaviors; (2) to conduct meta-analyses on a subset of that literature for which appropriate and necessary data were available; and (3) to evaluate the influence of various moderators on these relationships. In what follows, we additionally discuss the empirical veracity of the theory, identify understudied components of the theory, and point to next steps for theoretical inquiry.

Method

Inclusion Criteria

Three criteria were used to determine whether studies were eligible for inclusion in the systematic review and meta-analyses. To be included, all studies were required to meet both Criteria 1 and 2. For analyses involving capability for suicide, all studies were required to additionally meet Criterion 3.

Criterion 1: At least one effect size was reported or there was sufficient statistical information to calculate at least one effect size for the association between (a) the interpersonal theory of suicide constructs and (b) suicidal thoughts and behaviors.

Criterion 2: The study included (a) any version of the Interpersonal Needs Questionnaire (INQ; e.g., Van Orden et al., 2012) or any other validated measure developed to assess perceived burdensomeness and thwarted belongingness, and (b) at least one measure of suicidal ideation.

Criterion 3: The study included (a) any version of the Acquired Capability for Suicide Scale (ACSS; e.g., Ribeiro et al., 2014) or any other validated measure developed to assess capability for suicide, and (b) at least one measure of suicidal behavior.

Of note, to be included in our analyses, it was not necessary for studies to explicitly state that the study aim was to test the hypotheses of the interpersonal theory. It was also not required that studies use the INQ/ACSS developed by the original authors of the theory. Studies that used translated versions of the INQ/ACSS and/or newly developed measures assessing the interpersonal theory constructs with evidence for the construct validity of these measures (e.g., at least a moderate correlation with the INQ, $r > 0.40$) were all included. Further, both published and unpublished data were included. Unpublished data were obtained from datasets that produced at least one peer-reviewed publication. Unpublished data were included given that, in some instances, data were collected on interpersonal theory and/or suicide-related constructs and not described in the associated peer-reviewed publication. Finally, studies conducted internationally were not systematically excluded; however, we only included studies that were published in English.

Excluded Studies

We excluded studies that assessed the interpersonal theory constructs using single-item proxies. Studies with insufficient data reported to calculate effect sizes were also excluded if we were unable to obtain the necessary data from the authors. These studies included those that computed a total score rather than individual subscale scores for thwarted belongingness and perceived burdensomeness (and subscale scores could not be obtained). Finally, case studies and case series were excluded.

Search for Studies

To identify studies for possible inclusion, we conducted comprehensive systematic searches for relevant studies through March 31, 2016. First, keywords were entered into four electronic databases: PubMed, Medline (Proquest), PsycINFO, and Web of Science. The keywords entered were: (Suic*) AND [(Interpersonal Theory of Suicide) OR (Interpersonal Psychological Theory of Suicide)] AND [(Perceived Burdensomeness) OR (Thwarted Belongingness) OR (Acquired Capability)]. Next, we searched for studies citing the two publications that originally presented the theory: Joiner (2005) and/or Van Orden et al. (2010). We also manually searched the reference lists of relevant manuscripts, including the recent systematic review of the interpersonal theory (Ma et al., 2016). Finally, 24 individuals with documented suicide research experience and who have previously published data

regarding theoretical models of suicidal behavior were contacted to determine if any studies were missed by our searches.

Study Selection

Figure 2 depicts the study selection process. Three authors (CC, IAH, MAH) independently conducted an initial screening of the titles and abstracts for all identified studies to determine their relevance to this study; these authors screened for the presence of measures of the interpersonal theory variables, as well as suicidal thoughts and behaviors. Agreement between the three raters regarding study inclusion was good ($\kappa = 0.77$). After discussion and consultation with an additional author (JMB), studies that could be immediately excluded based on the title and abstract were excluded. This process resulted in 382 potentially relevant reports. Subsequently, 7 reports were excluded since they were not published in English. Four authors (CC, JMB, IHS, MAH) reviewed the manuscripts of the remaining 375 articles. Next, 162 manuscripts without measures of both interpersonal theory variables and suicidal thoughts and behaviors and 24 studies that used single-item proxies for the interpersonal theory variables and/or used suicidal outcome measures that have not been empirically scrutinized with at least some support were excluded. Additionally, 36 manuscripts without effect sizes (e.g., reviews, commentaries, descriptive studies) were excluded. For each of the remaining 153 references, two authors independently read each full-text manuscript to assess whether it met criteria for inclusion. Disagreements were resolved through discussion and consultation with a separate author (RPT).

Data Extraction and Management

Data regarding methodology and outcome measures were entered into a Microsoft Office Excel spreadsheet. Each article was independently coded by two different authors. First, all 153 articles were coded by one of seven authors (CC, JMB, IHS, MAH, CRH, BC, FBR, MSM). Next, three authors (CC, JMB, FBR), who first established strong inter-rater reliability on 6 of the 153 articles (initially 94.7% agreement; discrepancies were discussed until 100% agreement was achieved), independently recoded the remaining 147 articles. All articles were coded by authors with advanced degrees in psychology (i.e., masters- and doctoral-level). The following general and demographic information was extracted from studies: (1) authors; (2) publication year; (3) setting (e.g., inpatient, outpatient, community); (4) military status (i.e., veterans and/or service members); (5) mean age; (6) sex (i.e., proportion male); (7) race/ethnicity for U.S. study samples (i.e., proportion White/Caucasian); (8) psychiatric diagnoses; (9) depression symptom measures and their respective mean scores from the sample; and (10) covariates. Additionally, the following data regarding the variables of interest were entered into the spreadsheet: (1) measures used to assess interpersonal theory of suicide constructs and their respective mean scores from the sample; (2) measures used to assess suicidal thoughts and behaviors (i.e., suicidal ideation, suicide attempts, suicide risk) and their respective mean scores from the sample; (3) bivariate correlations (i.e., Pearson's r) between interpersonal theory of suicide constructs and suicidal symptoms; and (4) regression results of the interaction between interpersonal theory variables and suicidal thoughts and behaviors (i.e., R^2 full model, R^2 change when interaction included in final step; see Meta-Analytic Approach for details below). Inter-rater

reliability for the entering of study descriptive statistics and effect sizes across these articles was good to excellent (κ = 0.83–0.99).

Given that we included any study that fulfilled our inclusion criteria, regardless of the original study hypotheses, we attempted to contact 75 authors of 123 studies (many were authors of multiple studies) that did not report effect sizes between the interpersonal theory and suicide-related constructs; we were unable to locate viable contact information for two authors (2 studies). For cases in which the published manuscript only focused on one interpersonal theory variable and/or one suicide-related variable, we requested data on the unpublished interpersonal theory and/or suicide variables. Of the 73 authors we contacted, we were unable to obtain additional information from 7 authors (i.e., 8 studies); thus, these studies were excluded. Additionally, the authors had access to full datasets for 17 studies conducted by our respective research groups. Studies were excluded if there were insufficient data and we were unable to contact the author to fulfill the inclusion criteria. Following acquisition of additional data, articles were subsequently re-evaluated and, in discussion with other authors (JMB, RPT), 9 additional articles meeting the exclusion criteria were excluded. This search process resulted in 143 samples (i.e., 130 studies). When multiple reports were produced based on the same dataset, we requested the original, full dataset from authors. If the full dataset was unavailable, we used the effect sizes from the study with the largest sample size to diminish redundancy. After redundant studies were excluded, 122 samples were transferred to Comprehensive Meta-Analysis (CMA, version 2.0; Biostat, Inc.) for the meta-analyses.

Interpersonal Theory of Suicide Predictors

We extracted and analyzed data on the three interpersonal theory of suicide constructs. *Thwarted belongingness* and *perceived burdensomeness* were both primarily assessed using the Interpersonal Needs Questionnaire (INQ). Several versions of the INQ were employed by studies included in this manuscript. The original unpublished INQ was composed of 25 items (10 items assessing thwarted belongingness), and the 12-item INQ was later developed to decrease multicollinearity (5 items assessing thwarted belongingness; Van Orden et al., 2008). An 18-item INQ was published in a book on the interpersonal theory (Joiner et al., 2009) and a 10-item INQ was validated for use in military populations (Bryan, 2010). Most recently, the original authors published a 15-item INQ (9 items assessing thwarted belongingness, 6 of which are reverse scored; Van Orden et al., 2012). Despite variations in the lengths of the various INQ versions, items on all versions are rated on a 7-point Likert scale according to the degree to which each item has been true for the respondent recently. INQ subscale scores are obtained by summing scores on relevant items, with higher scores indicating higher levels of thwarted belongingness and perceived burdensomeness. Each of these constructs is conceptualized as unidimensional and multifaceted. While the INQ regards these variables as unidimensional, the INQ may not adequately capture all facets of thwarted belongingness and perceived burdensomeness. Nonetheless, the INQ remains the mostly commonly utilized measure of these constructs and has demonstrated strong psychometric properties, including convergent validity (Van Orden et al., 2008).

The INQ was created and validated as an English-language measure; however, several groups have translated the INQ into other languages, including Spanish (Garza & Pettit, 2010), German (Forkmann & Glaesmer, 2013; Hallensleben et al., 2016), Chinese (Zhang et al., 2013), French (Baertschi et al., 2017; Siefert-Boukaidi, Jover, Staccini, Pringuey, & Benoit, 2013), Portuguese (Campos & Holden, 2015), Slovene (Podlogar et al., 2016), and Korean (Kim & Yang, 2015; Suh et al., 2017). To our knowledge, only one study has created a new measure of interpersonal needs; however, this measure only assesses perceived burdensomeness (Perceived Burdensomeness Scale; Peak et al., 2016). Nevertheless, nearly all studies in this meta-analysis utilized the INQ (i.e. 95.65%).

Capability for suicide was assessed primarily using the Acquired Capability for Suicide Scale (ACSS). Similarly, several versions of the ACSS have emerged across studies. The original, unpublished ACSS contained 20 items, with 7 items assessing fearlessness about death, 1 item assessing pain tolerance, and the remaining 12 items assessing painful and provocative events. However, others have used an unpublished 8-item version of the original ACSS. Only two English-language versions of the ACSS have been subject to psychometric evaluation and published in the peer-reviewed literature: a 5-item ACSS (Bender et al., 2007; Van Orden et al., 2008) and a 7-item measure of fearlessness about death, specifically (ACSS-FAD; Ribeiro et al., 2014). In all ACSS versions, each item is rated on a 5-point Likert scale according to the degree to which each item has been true for the respondent recently. The ACSS total score is obtained by summing all scores on each item, with higher scores indicating higher levels of fearlessness about engaging in self-harming behaviors. Recently, researchers have translated the ACSS into German (Spangenberg et al., 2016), Chinese (Zhang et al., 2013), Urdu (Shakir, Atta, & Malik, 2016), and Korean (Suh et al., 2017); however, the ACSS has been primarily administered in English.

Given that the most recent publication validating the ACSS-FAD retained only items measuring fearlessness about death, Ribeiro and colleagues (2014) highlighted a need to better capture the other facets of capability for suicide. In response to this call, two new measures of capability for suicide have surfaced. Wachtel and colleagues (2014, 2015) validated a new measure of capability, the German Capability for Suicide Questionnaire (GCSQ), which uniquely includes one item assessing self-perceptions of capability for suicide in addition to items measuring fearlessness about death and pain tolerance. However, George and colleagues (2016) noted that the GCSQ does not assess direct means of acquiring capability (e.g., mental rehearsal). George and colleagues (2016) devised the Acquired Capability With Rehearsal Suicide Scale, which reflects fearlessness about death, pain tolerance, and preparations for suicide.

Hopelessness

Although the interpersonal theory includes a prediction about the perceived intractability of feelings of thwarted belongingness and perceived burdensomeness, the INQ does not directly assess hopelessness about these feelings. Researchers seeking to approximate this component of the theory have included self-report measures of hopelessness. We extracted continuous measures of current or recent feelings of hopelessness, such as the Beck Hopelessness Scale (BHS; Beck & Steer, 1988).

Suicidal Thoughts and Behavior Outcomes

We extracted and analyzed outcome data on self-reported suicidal thoughts and behaviors. There were three primary outcomes: suicidal ideation, suicidal behavior, and suicide risk. *Suicidal ideation* was assessed according to continuous symptom measures such as the Beck Scale for Suicide Ideation (BSS; Beck & Steer, 1991), Depressive Symptom Index-Suicidality Subscale (DSI-SS; Metalsky & Joiner, 1997), Geriatric Suicidal Ideation Scale (GSSI; Heisel & Flett, 2006) and Modified Scale for Suicidal Ideation (MSSI; Miller, Norman, Bishop, & Dow, 1986). *Suicidal behavior* was assessed using both continuous (i.e., self-reported number of prior suicide attempts) and dichotomous (e.g., yes/no history of suicide attempts) measures of suicide attempt history. Some studies utilized questions derived from the Suicide Attempt and Self-Injury Interview (SASII; Linehan, Comtois, Brown, Heard, & Wagner, 2006) to assess suicide attempt history. *Suicide risk* (c.f. suicide proneness) was evaluated using measures that assess both suicidal ideation and behavior and do not distinguish between these outcomes, a limitation that we discuss in the Discussion. Measures of suicide risk included the Suicidal Behaviors Questionnaire-Revised (SBQ-R; Osman et al., 2001) and Life Attitudes Schedule-Short Form (LAS-SF; Rohde, Seeley, Langhinrichsen-Rohling, & Rohling, 2003).

Moderators

We also evaluated moderators of the relationship between the interpersonal theory of suicide variables and suicide-related outcomes. Depressive symptoms were assessed according to continuous symptom measures, including the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), Beck Depression Inventory-Second Edition (BDI-II; Beck, Steer, & Brown, 1996), Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001), or Depression subscale of the Depression, Anxiety, and Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995). Additionally, we evaluated various sample characteristics as moderators: (1) age; (2) clinical status (i.e., psychiatric inpatient/outpatient or not); (3) student status (i.e., college undergraduate or not); (4) sex; (5) military status (i.e., veterans/service members or not); and (6) race/ethnicity (i.e., percentage White/Caucasian). We also examined study methodology, including whether the assessment format (i.e., web-based or not) moderated the relationship between study variables, whether a measure other than the original INQ/ACSS was used, and whether a translated (non-English-language) measure was used. Finally, we investigated three moderators related to the study's publication: (1) whether this manuscript's senior author (TEJ), an originator of the interpersonal theory of suicide, was an author of the published study (similar to the approach of Starr & Davila, 2008); (2) whether the effect sizes were published or unpublished; and (3) the impact factor of the journal in which the article was published, at the time of publication. Impact factors were obtained from web-based searches and were coded based on the year in which the article was published. These impact factors were examined descriptively and used as a moderator in our meta-analyses. Unfortunately, consistent with guidelines (Borenstein, 2009), there were insufficient data to examine whether study design (i.e., cross-sectional vs. longitudinal) moderated results (4.1% longitudinal, see Results for details). There was also insufficient information reported in studies to evaluate specific diagnostic statuses as moderators; however, we were able to examine clinical status (i.e., clinical vs. nonclinical sample) as a moderator.

Meta-Analytic Approach

Data extraction—In all included samples, Pearson's correlations (r) and/or regression R-squared (R^2) values were reported in the manuscript or we requested the raw data from the authors and calculated the necessary effect sizes directly. First, we obtained correlations between the three interpersonal theory variables (refer to Table 3 for results). Next, we obtained correlations between the three interpersonal theory variables and suicide ideation, risk, and/or attempts for each sample where available (see Table 4 for Results). These correlations were directly entered into meta-analyses. Subsequently, hierarchical multiple regression (continuous dependent variables) and logistic regression (dichotomous dependent variables) results were recorded to evaluate the following models that directly test the hypotheses of the interpersonal theory:

- **(H1)** Interaction of perceived burdensomeness and thwarted belongingness, and its association with (continuous) suicidal ideation (Table 5);
- **(H2)** Interaction of perceived burdensomeness, thwarted belongingness, and hopelessness, and its association with (continuous) suicidal ideation (Table 6);
- **(H3)** Interaction of perceived burdensomeness, thwarted belongingness, and capability for suicide, and its association with (continuous and dichotomous) suicide attempt history (Table 7); and
- **(H4)** Interaction of perceived burdensomeness, thwarted belongingness, capability for suicide, and hopelessness, and its association with (continuous and dichotomous) suicide attempt history (Table 8).

As noted previously, there is evidence that perceived burdensomeness may be a more robust indicator of suicide risk than thwarted belongingness (Chu et al., 2016d; Ma et al., 2016). To shed light on whether perceived burdensomeness may play a more important role than thwarted belongingness in predicting suicidal behavior, the two following alternative pathways examine whether leaving one component out of the three-way interaction has an impact:

- **(H5)** Interaction of capability for suicide and perceived burdensomeness, and its association with (continuous and dichotomous) suicide attempt history (Table 9);
- **(H6)** Interaction of capability for suicide and thwarted belongingness, and its association with (continuous and dichotomous) suicide attempt history (Table 10); and
- **(H7)** All aforementioned hypotheses (H1 to H6) with (continuous) suicide risk as the outcome (Tables 5–10).

Finally, a crucial component of theory testing involves the investigation of pathways that are *not* proposed to emerge (Gawronski & Bodenhausen, 2015). In the context of the interpersonal theory, we examined the following alternative pathways between the interpersonal theory variables and suicidal thoughts and behaviors:

(H8) Interaction of perceived burdensomeness and thwarted belongingness, and its association with (continuous and dichotomous) suicide attempt history (Table 11); and

(H9) Interaction of perceived burdensomeness, thwarted belongingness, and capability for suicide, and its association with (continuous) suicidal ideation (Table 12).

These latter two pathways reverse the interpersonal theory's two main predictions, in that the interaction between perceived burdensomeness and thwarted belongingness is expected by the theory to predict ideation more so than attempts, whereas the interaction between perceived burdensomeness, thwarted belongingness, and capability is posited to predict attempts more so than ideation. An important point is that the theory is silent regarding these alternative pathways (H5, H6, H8, H9), though it is reasonable to expect that the pathways specifically predicted by the theory may be more supported than the alternative pathways, at least somewhat.

We requested these data from authors of studies that did not report the above information without the use of covariates (see Appendix 1 in the Supplementary Materials for details regarding the studies that provided additional data). For multiple regression analyses, the R^2 of the interaction (i.e., last) step of the regression and the R^2 value of the total model (inclusive of lower-order factors) were extracted. R^2 values were transformed into Pearson's r by taking the square root of the R^2 value and entering it into meta-analyses. For logistic regression analyses, the odds ratios (OR) were extracted; ORs were converted into Cohen's d and subsequently to Pearson's r, consistent with the approach employed by Bonett (2007).

Analytic plan

Data were manually entered into the CMA software, which then computed a weighted mean effect size. In a random effects model, a study is weighted based on its own population, not sample size, providing a more balanced assignment of weights (Borenstein, Hedges & Rothstein, 2007). Random effects models were utilized since we anticipated that effect sizes would vary across studies and this model approach allows for a greater degree of generalizability (Hedges & Vevea, 1998). We examined the significance of the chi-square Q statistic to determine whether there was substantial heterogeneity of effect sizes; a significant Q-value rejects the null that studies are homogeneous and indicates the presence of substantial heterogeneity. Although the Q-value provides evidence that the true (between) effects vary, it does not evaluate the degree of between-study dispersion (Borenstein et al., 2007); thus, we also evaluated the I-squared (I^2) index. In CMA, $I^2 = (Q - df/Q) * 100$, where Q = total variance, df = expected dispersion under the null (i.e., number of studies minus one), and $Q - df$ is the between-studies variance that exceeds the expected amount (Borensten et al., 2007). The I^2 value represents the amount of variability across studies that is due to heterogeneity as opposed to chance-related sampling error (25% = small heterogeneity; 50% = medium heterogeneity; 75% = large heterogeneity). Thus, higher I^2 values indicate that a greater degree of heterogeneity was accounted for by the model.

First, we tested the bivariate relationships between the interpersonal theory variables. We also tested the relationships between the interpersonal theory and suicide-related variables.

Post hoc, we noted that the magnitude of the relationship between perceived burdensomeness and suicide-related variables was greater than that between thwarted belongingness and suicide-related variables. Thus, we tested whether the two correlations were significantly different using the Fisher *r*-to-*z* transformation, which calculates a value of *z* that can be applied to assess the significance of the difference between two dependent correlation coefficients with one variable in common (Raghunathan, Rosenthal, & Rubin, 1996). To account for the dependency between these two correlations, *z* values were corrected by incorporating the association between perceived burdensomeness and thwarted belongingness, according to procedures recommended by Steiger (1980). *Post hoc* analyses were conducted using a web utility created by Lee and Preacher (2013).

To test the interpersonal theory, we examined the relationship between suicidal ideation and (1) the interaction of thwarted belongingness and perceived burdensomeness, and (2) the interaction of thwarted belongingness, perceived burdensomeness, and hopelessness. Further, we meta-analyzed the relationship between suicide attempt history (measured continuously and dichotomously) and the interaction of thwarted belongingness, perceived burdensomeness, and capability for suicide. Given previous evidence that perceived burdensomeness may be a more pernicious predictor of suicidal behavior than thwarted belongingness (Chu et al., 2016d; Ma et al., 2016), we also examined the relationship between suicide attempt history (measured continuously and dichotomously) and (1) the interaction of perceived burdensomeness and capability for suicide, and (2) the interaction of thwarted belongingness and capability for suicide. The effects of both the full model (inclusive of the lower-order variables) and the interaction (beyond the lower factors) were examined. Given that some studies utilized measures of suicide risk (e.g., SBQ-R) to test the interpersonal theory, we also examined the association between all interpersonal theory variables and suicide risk. Not all samples included all the interpersonal theory variables and/or multiple suicide-related variables (i.e., ideation, risk, attempts); thus, sample sizes varied for each meta-analytic model.

Finally, for all the aforementioned models, we examined whether results were significantly moderated by sample characteristics, study methodology, and publication-related factors (see Moderators for details). Moderation analyses were not conducted on models that did not achieve statistical significance and/or where there was insufficient statistical power. To evaluate the significance of these moderators, we examined the I^2 value of the goodness-of-fit test (i.e., test that unexplained variance is zero), which indicates whether there is a significant degree of heterogeneity that is unexplained by the moderators.

Publication bias

We used several methods to determine whether our findings were impacted by publication bias. First, we examined Egger's linear regression intercept test (Egger et al., 1997), which is particularly appropriate for meta-analyses using a large number of studies. A significant *T*-value indicates potential publication bias. Next, Duval and Tweedie's trim and fill method (2000a, 2000b) was used to investigate possible bias. This procedure iteratively removes the smallest studies from the positive side of the funnel plot and computes effects at each iteration until the funnel plot is symmetric about a new effect size. Thus, the trim and fill

analysis provides estimates of the overall effect size with correction for bias. We also examined symmetry of the funnel plot of both observed and imputed studies. Trim and fill estimates for the random-effects model were obtained for each meta-analysis and are presented in Tables 3 through 12; funnel plots of observed and imputed studies (standard error by Fisher's *z*) are available for all models in Appendix 4 in the Supplementary Materials. Finally, given that this manuscript's senior author was a coauthor on 26 of the published articles (i.e., 21.3% of samples), we examined whether his authorship moderated our meta-analytic results (described in detail above) as another metric of potential bias.

Results

Study Selection

A flowchart describing the study inclusion selection process is presented in Figure 1. A total of 382 titles and abstracts were examined; 229 were excluded after reviewing the title and abstract, and an additional 17 were excluded after the entire article was coded and we were unable to obtain missing data. This yielded a total of 143 samples (from 130 articles) with a total *N* of 59,698 (see Tables 3 to 12 for the *n* [sample size] and *k* [number of samples] in each model). With articles using redundant datasets treated as one sample, 122 samples (114 articles) were analyzed.

Sample Characteristics

Of the 143 samples, the majority was cross-sectional (92.3%), published between 2011 and 2015 (91.6%), and conducted in the U.S. and Canada (83.9%). Approximately half were conducted using web-based methodologies (46.2%). Studies primarily targeted young adults, with the average age of participants ranging from 18–25 years (48.3%), and adults over 25 years of age (48.9%). Only four studies examined youth under the age of 18 years (2.8%). On average, the percentage of males in the sample was less than half (mean = 44.6%) and the percentage of White/Caucasian participants was over half (mean = 63.4%). Military samples were used in 16.8% of the studies. Many studies were conducted in undergraduate students (44.0%) and community-dwelling adults (33.6%); 22.4% of studies examined clinical populations. Notably, sample sizes ranged from 30 to 6,133, with the majority ranging from 100–399 (59.4%). The characteristics of all 143 samples are summarized in Table 1. Seven samples completed a non-English-language version of the INQ and/or the ACSS; languages included Chinese, German, Korean, Portuguese, and Spanish. The INQ was not used in five samples and the ACSS was not used in three samples—these studies used proxies drawn from multiple measures (e.g., Christensen et al., 2013), the Perceived Burdensomeness Scale (Peak et al., 2016), and the Acquired Capability With Rehearsal for Suicide Scale (George et al., 2016). The measures administered in each sample are summarized in Table 2. Detailed information on each included sample is presented in Appendix 1 in the Supplementary Materials.

Cross-sectional studies—Analysis of the cross-sectional studies revealed a fair distribution of included populations. While the plurality of these studies consisted of students (41.5%), 34.1% utilized community-based samples and 24.5% included clinical populations (8.9% inpatient and 15.6% outpatient). Regarding geographic distribution,

83.0% of the cross-sectional studies occurred within the U.S. and Canada and 4.4% of studies examined U.S. military service members living abroad; the remaining studies collected data outside of the U.S. (12.6%). Military veterans and/or service members were used in 17.8% of studies. A review of the reported findings of the cross-sectional studies revealed the following: 54.3% of studies examining thwarted belongingness and suicidal thoughts and behaviors reported significant results; 79.1% of studies examining perceived burdensomeness and suicidal thoughts and behaviors reported significant results; 40% of studies examining capability for suicide and suicide attempts reported significant results; 57.5% of studies examining the interaction between thwarted belongingness and perceived burdensomeness reported that the interaction was significantly associated with suicidal outcomes; and 23.5% of studies assessing the three-way interaction between thwarted belongingness, perceived burdensomeness, and capability for suicide reported a significant association with suicidal outcomes.

Prospective studies—With respect to the prospective studies, the majority utilized student samples (63.6%), whereas the remaining studies included clinical (18.2%) and community (18.2%) populations. None of the available prospective studies included military populations. Thus, the predictive validity of the interpersonal theory of suicide could not be accurately assessed for military personnel. Regarding global distribution, all prospective studies were conducted in the U.S. or Canada. As for individual study outcomes of the prospective studies, the following results were reported: 37.5% of studies that examined associations between thwarted belongingness and suicidal thoughts and behaviors reported significant results; 80% of the studies that assessed the association between perceived burdensomeness and suicidal thoughts and behaviors reported that the association was significant; 100% of studies examining capability for suicide and suicide attempts reported significant results; 100% of the studies assessing the thwarted belongingness and perceived burdensomeness interaction as it relates to suicidal thoughts and behaviors at follow-up reported that the association was significant; and finally, 100% of studies assessing the three-way interaction between thwarted belongingness, perceived burdensomeness, and capability for suicide reported a significant association with suicidal outcomes at follow-up.

Meta-analytic Models

Of the 54 models tested, 9 were conducted with fewer than 6 samples, and 8 were conducted with 6 to 8 samples. Thus, caution is warranted when interpreting findings based on relatively few samples. Summaries of the meta-analytic models discussed below are presented in Tables 3 to 12 – direct relationships between the interpersonal theory and suicide-related variables are presented in Tables 3 and 4. Tables 5 to 8 present the models testing the main hypotheses of the interpersonal theory, and Tables 9 to 12 present the models of alternative pathways between the interpersonal theory variables. Effect sizes for the models testing main hypotheses of the interpersonal theory are presented in Appendix 3 in the Supplementary Materials. Although the effects sizes for both the full model and the interaction were analyzed, we discuss the interaction effects below as these are directly relevant to testing the specific predictions of interpersonal theory (see Tables 3 to 12 for details regarding the effect sizes for the full models). The reader may find it useful to refer to Figure 1, which depicts the causal pathways proposed by the interpersonal theory.

Testing the Direct Relationship between the Interpersonal Theory Variables and Suicidal Thoughts and Behaviors

Are the interpersonal theory variables related at the bivariate level (Table 3)?—As expected, perceived burdensomeness and thwarted belongingness were significantly related—the Q-test was significant (3515.1), and the I^2 value (97.3%) indicated that a large degree of variability was due to heterogeneity rather than chance. The test of the null was significant, with a moderate-to-large effect size ($r = 0.57$, $p < 0.001$, $k = 97$, $N = 44{,}484$). The magnitude of this relationship suggests that these variables, though related, are not redundant. Capability for suicide was not significantly related to perceived burdensomeness ($r = 0.05$, $p = 0.054$; $k = 43$; $N = 23{,}319$; $Q = 487.3$; $I^2 = 91.4\%$) or thwarted belongingness ($r = 0.01$, $p = 0.638$; $k = 43$; $N = 23{,}319$; $Q = 356.7$; $I^2 = 88.2\%$).

Are the interpersonal theory variables individually related to suicidal ideation, suicide risk, and suicide attempt history (Table 4)?—Individually, thwarted belongingness was significantly and moderately related to suicidal ideation ($r = 0.37$, $p < 0.001$; $k = 84$; $N = 37{,}952$) and suicide risk ($r = 0.33$, $p < 0.001$; $k = 24$; $N = 9{,}108$), and weakly related to suicide attempt history measured continuously ($r = 0.11$, $p = 0.010$; $k = 29$; $N = 10{,}986$). Similarly, perceived burdensomeness was significantly and moderately related to suicidal ideation ($r = 0.48$, $p < 0.001$; $k = 84$; $N = 37{,}894$) and suicide risk ($r = 0.42$, $p < 0.001$; $k = 23$; $N = 9{,}002$), and weakly related to suicide attempt history measured continuously ($r = 0.25$, $p < 0.001$; $k = 30$; $N = 17{,}119$). In these models, Q-values were all significant (314.0–1063.8) and the I^2 value (>88.6%) indicated that much of the variability is due to heterogeneity rather than chance. In line with the interpersonal theory of suicide, both perceived burdensomeness and thwarted belongingness were more strongly related to suicidal ideation and suicide risk than suicide attempts. Notably, *post hoc* two-tailed tests of differences between dependent correlations indicated that suicidal ideation ($z = 26.26$, $p < 0.001$), suicide risk ($z = 10.19$, $p < 0.001$), and suicide attempt history ($z = 16.21$, $p < 0.001$) all exhibited significantly stronger relationships with perceived burdensomeness than with thwarted belongingness.

Capability for suicide was significantly and weakly related to suicidal ideation ($r = 0.10$, $p = 0.020$; $k = 29$; $N = 9{,}782$) and suicide attempts measured continuously ($r = 0.09$, $p = 0.027$; $k = 32$; $N = 18{,}356$); the Q-values were significant (483.6 and 871.2, respectively) and the I^2 values (94.2% and 96.4%, respectively) indicated a large degree of heterogeneity. Capability for suicide was not related to suicide risk ($r = 0.09$, $p = 0.083$; $k = 17$; $N = 6{,}760$) and there was substantial heterogeneity between samples ($Q = 231.7$; $I^2 = 93.1\%$). That a weak significant relationship between capability for suicide and attempt history emerged is seemingly contradictory to this theory; however, an essential point, as we will discuss further, is that the interpersonal theory does *not* predict a main effect of capability on suicide risk. Rather, according to the theory, capability is only relevant to (lethal) behavior in the context of suicidal desire variables. Thus, the main effect is only meaningful in the context of the three-way interaction.

Testing the Interpersonal Theory of Suicide

What are the effects of the two-way interaction between perceived burdensomeness and thwarted belongingness on suicidal ideation and suicide risk (Table 5)?—Consistent with the interpersonal theory of suicide, the interaction between thwarted belongingness and perceived burdensomeness was significantly associated with suicidal ideation (see Figure 3 for forest plot). Beyond the lower-order factors, the interaction between thwarted belongingness and perceived burdensomeness ($r = 0.14$, $p < 0.001$; $k = 46$; $N = 19{,}042$) accounted for a significant amount of variance in suicidal ideation; Q-tests were significant (174.5) and the I^2 value (74.2%) indicated that a significant amount of variability was due to heterogeneity rather than chance. Although suicide risk does not distinguish between suicidal thoughts and attempts, a similar pattern of findings emerged when suicide risk was entered as the outcome variable—the interaction of thwarted belongingness and perceived burdensomeness was significantly related to suicide risk ($r = 0.12$, $p < 0.001$; $k = 8$; $N = 4{,}084$). However, in this interaction model, heterogeneity was not significant ($Q = 2.6$; $I^2 < 0.001\%$), suggesting that a significant amount of variability accounted for by the interaction of thwarted belongingness and perceived burdensomeness was due to chance.

What are the effects of the three-way interaction between perceived burdensomeness, thwarted belongingness, and hopelessness on suicidal ideation and suicide risk (Table 6)?—The interaction between perceived burdensomeness, thwarted belongingness, and hopelessness accounted for a significant amount of the variance in suicidal ideation ($r = 0.15$, $p = 0.014$; $k = 3$; $N = 740$) but not risk ($r = 0.02$, $p = 0.525$; $k = 4$; $N = 699$), beyond the lower-order factors. However, Q-values were not significant for both models (1.8–5.6) and I^2 values indicated small to moderate amounts of variability accounted for heterogeneity and not chance ($I^2 < 0.001\% – 64.3\%$). Of note, the higher-order effects appeared similar to other models with greater power (higher k and N).

What are the effects of the three-way interaction between perceived burdensomeness, thwarted belongingness, and capability for suicide on suicide attempt history and suicide risk (Table 7)?—Consistent with the interpersonal theory of suicide hypotheses, the interaction between thwarted belongingness, perceived burdensomeness, and capability for suicide was significantly associated with suicide attempt history when measured continuously (see Figure 4 for forest plot and Figure 5 for a plot of the effect of the three-way interaction on continuous suicide attempts). Beyond the lower-order factors, the three-way interaction ($r = 0.11$, $p < 0.001$; $k = 13$; $N = 7{,}312$; $Q = 58.2$; $I^2 = 79.4\%$) accounted for a significant amount of variance in suicide attempt history. Further, the three-way interaction was not significantly related to suicide attempt history when measured dichotomously ($r = 0.02$, $p = 0.201$; $k = 22$; $N = 11{,}610$; $Q = 49.6$; $I^2 = 57.7$); however, the three-way interaction was significantly related to attempt history when both dichotomous and continuous attempts were collapsed ($r = 0.06$, $p < 0.001$; $k = 27$; $N = 13{,}590$; $Q = 95.7$; $I^2 = 72.8\%$). When dichotomous and continuous suicide attempts were collapsed, there was moderate heterogeneity in the effect sizes. That the three-way interaction did not correlate with dichotomous suicide attempt history may reflect

diminished outcome variance and power to detect significant effects. Finally, the three-way interaction also accounted for a significant amount of variance in suicide risk beyond the lower-order factors, albeit the effect size was small ($r = 0.07$, $p = 0.009$; $k = 5$; $N = 3,548$) and both the Q-value (6.41) and I^2 value (37.6%) did not indicate significant heterogeneity.

What is the effect of the four-way interaction between perceived burdensomeness, thwarted belongingness, capability for suicide, and hopelessness on suicide risk (Table 8)?—To approximate the final component of the interpersonal theory, we examined the effect of the four-way interaction of the three interpersonal theory variables and general trait hopelessness on suicidal behavior. There were no published data on the effect of the four-way interaction on suicide attempt history. Two samples allowed us to test the association between the four-way interaction and suicide risk. Results indicated that the four-way interaction was not significantly associated with suicide risk beyond the lower-order factors ($r = 0.06$, $p = 0.234$; $k = 2$; $N = 428$; $Q = 1.0$; $I^2 = 3.5\%$). Again, it is notable that the effect size appears similar to other models with greater power; however, we were notably underpowered to draw conclusions from these results. As such, findings should be interpreted with caution.

Testing Alternative Pathways Between the Interpersonal Theory Variables

What is the effect of the two-way interaction between perceived burdensomeness and capability for suicide (Table 9) and the two-way interaction between thwarted belongingness and capability for suicide (Table 10) on suicide attempt history and suicide risk?—To shed light on whether leaving one component out of the three-way interaction impacts findings, two alternative pathways were examined. First, we examined whether the interaction between capability for suicide and perceived burdensomeness was significantly associated with suicide attempt history. Beyond the lower-order factors, the interaction between capability for suicide and perceived burdensomeness accounted for a significant amount of variance in suicide attempt history measured continuously ($r = 0.12$, $p = 0.002$; $k = 11$; $N = 6,273$; $Q = 62.6$; $I^2 = 84.0\%$) and when continuous and dichotomous attempts were collapsed ($r = 0.05$, $p = 0.004$; $k = 25$; $N = 12,172$; $Q = 72.2$; $I^2 = 66.8\%$). However, the two-way interaction of perceived burdensomeness and capability for suicide was not significantly related to dichotomous suicide attempts ($r = 0.003$, $p = 0.753$; $k = 19$; $N = 10,143$; $Q = 0.02$; $I^2 < 0.001\%$) or suicide risk ($r = 0.19$, $p = 0.096$; $k = 3$; $N = 868$; $Q = 19.5$; $I^2 = 89.8\%$).

The same pattern emerged when we examined the interaction between capability for suicide and thwarted belongingness, and its association with suicide attempt history. The interaction between capability for suicide and thwarted belongingness, beyond the lower-order factors, accounted for a significant amount of variance in suicide attempt history measured continuously ($r = 0.18$, $p < 0.001$; $k = 12$; $N = 6,378$; $Q = 106.2$; $I^2 = 89.6\%$), and when continuous and dichotomous attempts were collapsed ($r = 0.08$, $p < 0.001$; $k = 25$; $N = 12,172$; $Q = 138.7$; $I^2 = 82.7\%$). Again, the two-way interaction was not significantly associated with dichotomous suicide attempts ($r = 0.002$, $p = 0.831$; $k = 19$; $N = 10,143$; $Q = 0.05$; $I^2 < 0.001\%$) or suicide risk ($r = 0.01$, $p = 0.796$; $k = 3$; $N = 868$; $Q = 3.8$; $I^2 = 47.4\%$). Altogether, these findings suggest that the effect of removing one component of the three-

way interaction on suicidal symptoms is mixed—relative to the effect of the three-way interaction, the two-way interactions both predicted slightly more variance in continuous suicide attempt history, less variance in dichotomous suicide attempt history, and about the same amount of variance when continuous and dichotomous attempts were collapsed.

What is the effect of the two-way interaction between perceived burdensomeness and thwarted belongingness on suicide attempt history (Table 11) and the effect of the three-way interaction between perceived burdensomeness, thwarted belongingness, and capability for suicide on suicidal ideation (Table 12)?—Finally, we tested two pathways that are not expected to emerge in the context of the interpersonal theory of suicide. First, we investigated the interaction between perceived burdensomeness and thwarted belongingness and its association with suicide attempt history. This two-way interaction significantly predicted suicide attempt history measured continuously ($r = 0.20$, $p = 0.003$; $k = 13$; $N = 3{,}292$; $Q = 170.4$; $I^2 = 93.0\%$) and when continuous and dichotomous attempts were collapsed ($r = 0.09$, $p = 0.003$; $k = 28$; $N = 13{,}614$; $Q = 294.4$; $I^2 = 90.8\%$). However, the interaction between perceived burdensomeness and thwarted belongingness was not significantly associated with suicide attempt history measured dichotomously ($r = 0.002$, $p = 0.861$; $k = 20$; $N = 11{,}287$); the Q-test was not significant (0.03) and the I^2 value (< 0.001) indicated that variability may be due to chance rather than heterogeneity. Next, we examined whether the interaction between thwarted belongingness, perceived burdensomeness, and capability for suicide was significantly associated with suicidal ideation. The results supported this pathway—beyond lower-order factors, the three-way interaction predicted a significant amount of variance in suicidal ideation ($r = 0.07$, $p < 0.001$; $k = 25$; $N = 12{,}189$; $Q = 60.1$; $I^2 = 60.1\%$). Contrary to the assumptions of the interpersonal theory of suicide, both alternative pathways emerged as significant and the interaction of thwarted belongingness and perceived burdensomeness was a stronger predictor of suicide attempt history than the three-way interaction. Nevertheless, it is notable that with regard to suicidal ideation, theory-consistent pathways outpaced the alternative paths.

Characteristics Moderating the Relationship Between the Interpersonal Theory and Suicidal Thoughts and Behaviors

Below, we summarize the variables that significantly moderated the tested models. Data were not sufficient to examine the role of moderators in all models; details regarding the moderation analyses are presented alongside each meta-analytic model in Appendix 2 in the Supplementary Materials.

Moderators of the bivariate relationships between the interpersonal theory variables (Appendix 2, Table 3)—With respect to the bivariate relationship between perceived burdensomeness and thwarted belongingness, the results were significantly moderated by student status, sex, and military status. Specifically, the relationship between thwarted belongingness and perceived burdensomeness was stronger among online studies ($b = 0.22$, SE = 0.06; $z = 3.88$, $r = 1.00$, $p < 0.001$), college student samples ($b = 0.13$, SE = 0.05; $z = 2.26$, $r = 0.98$, $p = 0.024$), and reports that did not use a military sample ($b = -0.19$, SE = 0.08; $z = -2.27$, $r = -0.98$, $p = 0.023$) and/or had a smaller percentage of males ($b =$

−0.005, SE = 0.001; $z = -3.59$, $r = -1.00$, $p < 0.001$). However, the I^2 values remained significant ($I^2 > 96.7\%$), indicating that these moderators did not account for a substantial portion of variance.

Moderators of the bivariate relationships between the interpersonal theory variables and suicidal thoughts and behaviors (Appendix 2, Table 4A, 4B, and 4C)—The relationship between thwarted belongingness and suicidal ideation was stronger among older ($b = 0.002$, SE = 0.001; $z = 2.01$, $r = 0.97$, $p = 0.045$; $I^2 = 88.7\%$) and/or non-military samples ($b = -0.11$, SE = 0.05; $z = -2.15$, $r = -0.97$, $p = 0.032$; $I^2 = 88.0\%$). The relationship between thwarted belongingness and suicide risk was significantly stronger among online studies ($b = 0.19$, SE = 0.10; $z = 1.98$, $r = 0.96$, $p = 0.048$; $I^2 = 91.0\%$). Additionally, the relationship between thwarted belongingness and (continuous) attempt history was stronger among studies conducted online ($b = 0.17$, SE = 0.08; $z = 2.09$, $r = 0.97$, $p = 0.036$; $I^2 = 94.3\%$) and weaker among samples with more severe depressive symptoms ($b = -0.07$, SE = 0.03; $z = -2.62$, $r = -0.99$, $p < 0.001$; $I^2 = 75.3\%$). Further, the relationship between perceived burdensomeness and suicidal ideation was stronger in non-military samples ($b = -0.13$, SE = 0.05; $z = -2.40$, $r = -0.98$, $p = 0.017$; $I^2 = 90.9$). Perceived burdensomeness exhibited a stronger relationship with suicide risk in online studies ($b = 0.17$, SE = 0.08; $z = 2.05$, $r = 0.97$, $p = 0.041$; $I^2 = 88.5\%$), college student samples ($b = 0.21$, SE = 0.08; $z = 2.56$, $r = 0.99$, $p = 0.010$; $I^2 = 90.2\%$), and studies that did not use a military sample ($b = -0.19$, SE = 0.08; $z = -2.30$, $r = -0.98$, $p = 0.022$; $I^2 = 88.1\%$), and/or had a smaller percentage of males ($b = -0.005$, SE = 0.001; $z = -3.57$, $r = -1.00$, $p < 0.001$; $I^2 = 86.0\%$). Further, the association between perceived burdensomeness and suicide attempt history was stronger in studies with the senior author of this manuscript as an author ($b = 0.17$, SE = 0.08; $z = 2.18$, $r = 0.98$, $p = 0.030$; $I^2 = 94.3\%$). With regard to the association between capability for suicide and suicidal ideation, the effect was stronger among studies employing non-INQ/ACSS measures ($b = 0.63$, SE = 0.16; $z = 3.97$, $r = 1.00$, $p < 0.001$; $I^2 = 87.8\%$). The relationship between capability for suicide and attempt history was also stronger in studies that used non-INQ/ACSS measures ($b = 0.36$, SE = 0.11; $z = 3.27$, $r = 1.00$, $p = 0.001$; $I^2 = 90.2\%$). Notably, for all these moderators, I^2 values remained significant, suggesting that these moderators did not account for a large portion of variance.

Moderators of the pathways hypothesized by the interpersonal theory (Appendix 2, Tables 5–7)—The full model testing the relationship between the interaction of thwarted belongingness with perceived burdensomeness and suicidal ideation was significantly stronger in samples with a smaller percentage of males ($b = -0.002$, SE = 0.0009; $z = -2.65$, $r = -0.99$, $p = 0.008$; $I^2 = 89.8\%$). Beyond lower-order factors, the interaction effect was stronger among samples with a lower proportion of White/Caucasian participants ($b = -0.001$, SE = 0.0005; $z = -2.39$, $r = -0.98$, $p = 0.017$; $I^2 = 72.3\%$) and studies using non-English-language measures of the interpersonal theory variables ($b = 0.10$, SE = 0.05; $z = 2.21$, $r = 0.98$, $p = 0.027$, $I^2 = 73.0\%$).

Regarding the full model testing the relationship between the three-way interaction and suicide attempt history, the effect appeared to be diminished in online studies ($b = -0.36$, SE = 0.18; $z = -2.06$, $r = -0.97$, $p = 0.039$; $I^2 = 97.2$), and stronger in studies with higher impact

factors (b = 0.18, SE = 0.08; z = 2.29, r = 0.98, p = 0.022; I^2 = 97.3) and the senior author of this manuscript as an author (b = 0.44, SE = 0.19; z = 2.26, r = 0.98, p = 0.024; I^2 = 97.9). In contrast, when continuous and dichotomous attempts were collapsed, the effect of the three-way interaction was significantly weaker in studies with the senior author of this manuscript as an author (b = −0.08, SE = 0.03; z = −2.56, r = −0.99, p = 0.010; I^2 = 55.3). Of note, in the main interpersonal theory models, the I^2 values remained significant, suggesting that these moderators did not account for a substantial amount of variance in suicidal thoughts and behaviors. The main interpersonal theory models were not moderated by any other tested variables.

Moderators of the alternative pathways (Appendix 2, Tables 8–11)—The effect of capability for suicide and perceived burdensomeness on continuous and dichotomous suicide attempt history was stronger in studies using non-INQ/ACSS measures of the interpersonal theory of suicide (b = 0.14, SE = 0.05; z = 2.73, r = 0.99, p = 0.006, I^2 = 51.9%). Further, in the full model testing the effect of capability for suicide and perceived burdensomeness on suicide risk was weaker among studies published in journals with higher impact factors (b = −0.19, SE = 0.09; z = −2.06, r = −0.97, p = 0.039, I^2 = 67.0%).

Additionally, the effect of capability for suicide and thwarted belongingness on continuous and dichotomous suicide attempt history was significantly stronger in studies published in journals with a higher impact factor (b = 0.05, SE = 0.002; z = 2.03, r = 0.97, p = 0.042, I^2 = 84.4%). Further, in the full model, the effect of the three-way interaction of the interpersonal theory variables on suicidal ideation was significantly stronger in samples with a smaller proportion of males (b = −0.003, SE = 0.001; z = −2.31, r = −0.98, p = 0.021, I^2 = 92.1%) and/or non-military samples (b = −0.21, SE = 0.09; z = −2.38, r = −0.98, p = 0.017, I^2 = 90.4%). Again, I^2 values remained significant for all moderators of these alternative pathway, suggesting that these moderators did not account for large portions of variance in the outcome variables.

Investigating Journal Impact Factors

Impact factors were discernable for 120 of the included studies; the mean impact factor was 2.26 (SD = 1.13; range = 0.56–7.43). These findings signal that, on average, studies were published in journals for which articles published in the past two years were cited an average of 2.26 times, demonstrating a degree of impact on subsequent research. Caution is warranted when interpreting these results as they may have been impacted by a number of factors, such as author preferences for publication in a particular journal regardless of impact factor and/or the number of submissions received by a journal at a particular time. Additionally, we recognize that there is controversy in utilizing the impact factor as a metric of scientific rigor (see Eyre-Walker & Stoletzki, 2013). However, we present these data for informed readers to draw their own conclusions regarding their utility.

Investigating Possible Publication Bias

Although we contacted authors of papers assessing constructs of the interpersonal theory and suicidal symptoms twice over a three-month period to acquire additional data from published manuscripts, we were unable to reach all authors (i.e., 66 of 73 contacted authors

responded with relevant data) and we did not obtain unpublished data from other sources. As such, publication bias is possible. Caution is warranted when interpreting results for which publication bias statistics could not be generated.

Egger's test—Given significant Egger's test values (ET; $p < 0.05$), publication bias likely impacted in the following models: (1) the bivariate relationship between thwarted belongingness and perceived burdensomeness (ET = 4.17 [95% confidence interval [CI] = 1.79,6.54], $p < 0.001$); (2) the bivariate relationship between thwarted belongingness and suicidal ideation (ET = 2.70 [95% CI = 1.49,3.91], $p < 0.001$); (3) the effect of the interaction between capability for suicide and perceived burdensomeness on (continuous) suicide attempt history (full model; ET = 6.77 [95% CI = 1.41,12.12], $p = 0.017$]; and finally, (4) the effect of the three-way interaction of capability for suicide, perceived burdensomeness, and thwarted belongingness on suicidal ideation (full model; ET = 3.63 [95% CI = 0.72,6.54], $p = 0.017$). Notably, these aforementioned models were not specifically hypothesized by the interpersonal theory. No publication bias was indicated for the models testing the specific predictions of the interpersonal theory, including: (1) the effect of the interaction of thwarted belongingness and perceived burdensomeness on suicidal ideation, the full model (ET = 3.36 [95% CI = 1.36,5.36], $p = 0.101$) and the interaction (ET = 0.22 [95% CI = −1.19,1.62], $p = 0.757$); (2) the effect of the three-way interaction of thwarted belongingness, perceived burdensomeness, and capability for suicide on continuous suicide attempts, full model (ET = 5.73 [95% CI = −4.03,15.50], $p = 0.225$) and interaction (ET = 1.89 [95% CI = −0.33,4.11], $p = 0.088$); and (3) the effect of the three-way interaction of thwarted belongingness, perceived burdensomeness, and suicide capability on both continuous and dichotomous suicide attempts (ET = 0.49 [95% CI = −1.14,2.13], $p = 0.540$). Details are provided in Tables 3 to 12.

Duval and Tweedie's trim and fill estimates and funnel plot symmetry—Funnel plot asymmetry was reported in 66.7% of all tested models (36 of 54 models; see Appendix 4 in the Supplementary Materials for plots). Trim and fill statistics and funnel plots could not be generated for two models (i.e., Table 8). In meta-analyses in which asymmetric funnel plots were found, the estimated number of missing studies ranged from 1 to 30 (mean = 6.14, standard deviation (SD) = 7.01, mode = 1). Funnel plot asymmetry was found in 44.4% of the models that tested the main hypotheses of the interpersonal theory (8 of 18 models), with a moderate number of missing studies (mean = 3.25, SD = 2.43, range = 1 to 8, mode = 2; Tables 6 and 7). Among these 8 models, the adjustments for publication bias had no effect on the conclusions for 7 of the models. However, for the meta-analysis testing the association between the interaction of thwarted belongingness, perceived burdensomeness and capability for suicide and continuous attempt history (interaction only model; Table 7), the funnel plot was moderately asymmetrical, with trim and fill analysis indicating that 6 effect sizes below the mean were missing. If these effect sizes had been published and factored into analyses, it is estimated that the weighted, pooled correlation would have dropped to 0.04 (CI: −0.02, 0.10) from 0.11 (CI: 0.05, 0.17). Thus, conclusions for this model cannot be considered robust due to possible publication bias. Of note, for models testing the relationship between the interaction of perceived burdensomeness and thwarted belongingness and suicidal ideation and suicide risk (full and interaction models,

with and without hopelessness; Tables 5 and 6), trim and fill analyses indicated that funnel plot asymmetry did not impact study conclusions.

Publication status as a moderator—Finally, the publication status of the effect sizes was examined as a moderator in all models. Many suicide-related, peer-reviewed publications incorporated one or more of the interpersonal theory variables; however, fewer of these publications statistically and specifically tested the interpersonal theory hypotheses. For this reason, of the 143 samples in this meta-analysis, published effect sizes were obtained from 10.5% of the samples ($n = 15$) and unpublished effect sizes were obtained from 89.5% of the samples ($n = 128$). Publication status emerged as a significant moderator in three of the tested meta-analytic models—(1) the relationship between capability for suicide and (continuous) attempt history ($b = 0.14$, SE = 0.07; $z = 2.07$, $r = 0.97$, $p = 0.038$; $I^2 = 93.3\%$); (2) the effect of the interaction between capability for suicide and perceived burdensomeness on continuous and dichotomous suicide attempt history ($b = 0.07$, SE = 0.03; $z = 2.01$, $r = 0.99$, $p = 0.044$, $I^2 = 60.6\%$); and (3) the effect of the three-way interaction on continuous and dichotomous suicide attempt history ($b = 0.08$, SE = 0.03; $z = 2.50$, $r = 0.99$, $p = 0.013$; $I^2 = 56.1$). In all three models, published effect sizes were larger than the unpublished effect sizes and meta-analyses based on the unpublished effect sizes yielded non-significant results (see Table 13 for the results of meta-analyses based on published versus unpublished effect sizes). Publication status was not a significant moderator in any other tested pathways.

Discussion

Over the past decade, the interpersonal theory of suicide has guided research into the causes of suicidal thoughts and behaviors. In this investigation, we meta-analyzed published and unpublished effects sizes from data on the interpersonal theory of suicide constructs, as well as suicidal ideation, suicide attempt history, and suicide risk. We also tested the impact of various moderators, including sample characteristics (i.e., depressive symptoms, sex, age, % White/Caucasian, clinical status, military status), study format (i.e., online questionnaire, non-English-language and/or non-INQ/ACSS measures), and publication characteristics (i.e., authorship of the originator of this theory, publication status, journal impact factor). We identified 143 samples (from 130 articles) with a total of 59,698 participants.

Support, Albeit Mixed, for the Interpersonal Theory of Suicide Hypotheses

Overall, our findings support the interpersonal theory of suicide's hypotheses. Univariate analyses revealed significant weak-to-moderate positive relationships between (1) greater thwarted belongingness and more severe suicidal ideation ($r = 0.37$), greater suicide risk ($r = 0.33$), and (continuous) suicide attempt history ($r = 0.11$), and (2) greater perceived burdensomeness and more severe suicidal ideation ($r = 0.48$), greater suicide risk ($r = 0.42$), and (continuous) suicide attempt history ($r = 0.25$). Greater capability for suicide was significantly related to suicide attempts and ideation, albeit the effects were weak[2] (rs =

[2]It is worth noting that the theory does not hypothesize that capability for suicide will exert a main effect on suicide-related outcomes. Rather, the theory postulates that near-lethal or lethal suicidal behavior will only emerge in the context of both suicide capability and suicidal desire.

0.09–0.10) and capability was not a significant correlate of suicide risk alone. Given the magnitude of these main effects, it is notable that, in line with the theory, the interaction of thwarted belongingness and perceived burdensomeness was significantly correlated with suicide ideation and risk, beyond main effects (*r*s = 0.12–0.14). Also, the interaction between the three theory constructs was significantly associated with a greater number of suicide attempts (measured continuously, and when continuous and dichotomous attempts were collapsed) and suicide risk, beyond main and two-way interaction effects; however, effect sizes were, again, small (*r*s = 0.06–0.11). Additionally, the three-way interaction between theory constructs was not significantly related to attempts when attempt history was measured dichotomously. Together, these findings are largely consistent with the theory, revealing expected significant associations between interpersonal theory constructs and suicide-related outcomes. Nonetheless, several issues should be noted.

First, although moderate effect sizes were generally observed for the full models, the interaction effect sizes (exclusive of lower-order variables) were relatively weak, ranging from small to moderate. These results challenge the clinical utility of employing the interpersonal theory to predict suicide risk, at least within the methodological limitations of existing tests of the theory that are noted herein. This concern is not only specific to the interpersonal theory but also corresponds with the broader suicide risk factor literature. For instance, the effect sizes in our study study fall within the range of the effect sizes reported in prior meta-analyses of suicide risk factors. In two separate meta-analyses, the odds ratios for most risk and protective factors ranged from 1.0 to 2.5 (i.e., *r*s ~ 0.26–0.57; Franklin et al., 2017) and few exceeded 3.0 (*r* ~ 0.64; Large et al., 2011). These findings suggest that *within the confines of the existing literature on the interpersonal theory of suicide (for which notable limitations are abundant, as noted below)*, the theory's three constructs and their interaction appear to not be better predictors of suicide risk than many traditional and often-studied risk factors (e.g., suicide attempt history, demographic variables, psychiatric diagnoses, social factors); however, we emphasize these results do not necessarily imply that the theory is incorrect or incapable of predicting suicide deaths. Indeed, in evaluating the evidence for a theory, one must consider assumptions regarding how its propositions are operationalized and its constructs are measured; these assumptions guide interpretations regarding a theory's falsification or viability (Duhem, 1908; Gawronski & Bodenhausen, 2015; Popper, 1934; Quine, 1953). Thus, more stringent tests of the interpersonal theory's assumptions are needed to evaluate the theoretical and clinical utility of the theory.

As noted, the interpersonal theory of suicide was designed to explain the occurrence of lethal or near-lethal suicidal behaviors. However, strikingly few studies have examined mortality as an outcome (Ribeiro, Yen, Joiner, & Siegler, 2015; Van Orden, Smith, Chen, & Conwell, 2016). This dearth of studies is understandable—suicide is a low base-rate event and amassing datasets of the psychological states of suicide decedents represents a considerable challenge. There are also difficulties inherent in examining suicide as an outcome prospectively, rather than retrospectively. Even so, to test key predictions of the interpersonal theory, future research must examine the interaction of thwarted belongingness and perceived burdensomeness (as well as the perceived intractability of these states) and capability for suicide with mortality as an outcome. Indeed, the relatively small effect sizes yielded by this meta-analysis may be due to imprecise testing of the theory's propositions.

The theory was designed to explain the occurrence of lethal or near-lethal suicidal behaviors, but the extant literature has overwhelmingly neglected to test this hypothesis. Likewise, the literature has primarily focused on the experience of thwarted belongingness and perceived burdensomeness broadly, rather than their perceived intractability. Thus, moving forward, it will be critical to adjust our approach to directly test the interpersonal theory hypotheses originally posited by Joiner (2005) and Van Orden and colleagues (2010).

Interestingly, pathways *not* predicted by the interpersonal theory emerged as significant—notably, theory-consistent effects outpaced those of alternative pathways in some instances, though the differences were small. For example, relative to the three-way interaction (r = 0.07), the two-way interaction of thwarted belongingness and perceived burdensomeness (r = 0.14) predicted more variance in suicidal ideation. Furthermore, as expected, the three-way interaction predicted more variance in continuous suicide attempts (r = 0.11) than in suicidal ideation (r = 0.07). However, the alternative pathways predicted more variance in suicide attempt history than theory-congruent paths. Although the three-way interaction between theory constructs was among the strongest predictive combinations (rs = 0.11, 0.06), the two-way interaction between perceived burdensomeness and thwarted belongingness was an even stronger predictor of continuous suicide attempts (r = 0.20) and of both dichotomous and continuous attempts when collapsed (r = 0.09). This pattern of results may reflect the complex nature of capability: depending on the context, it can have admirable qualities (e.g., resolve, endurance) as well as ones that can be sad, savage, and lethal (e.g., a violent suicide attempt). For example, among first responders, capability is an admirable job requirement. In the context of a lethally suicidal major depressive episode, that same capability turns from admirable to tragic. The theory predicts that the key lever of this flip is the combination of perceived burdensomeness and thwarted belongingness. It is conceivable, however, that capability remains protective for some people, including in the midst of suicidal crises, yet it may become a significant danger for others. If so, this would conceptually complicate matters. Moreover, as we will discuss, even absent this complexity, there are substantial measurement issues regarding capability.

Relatedly, models with suicide attempts measured dichotomously largely produced non-significant findings. The dichotomization of outcome variables in regressions analyses can significantly diminish power (among other limitations, including residual confounding and bias based on the selected cutpoint; see Royston, Altman, & Sauerbrei, 2006 for discussion). Thus, additional studies are needed to power these models, particularly given that the theory was designed to prospectively predict who will make a suicide attempt, a dichotomous behavior in nature. Relatedly, analyses where suicide risk served as our outcome variable also often yielded non-significant findings. Since suicide risk measures (e.g., SBQ-R) do not delineate between suicidal ideation and behaviors, they do not allow specific tests of the theory. Additionally, meta-analytic models with suicide risk and/or dichotomous attempts as the outcome variable generally included fewer samples and/or smaller Ns—this may, in part, explain the inconsistent findings. Nevertheless, to enhance the variance of the outcome measure and statistical power, it is recommended that future studies use a continuous outcome (i.e., *number* of attempts), precise definitions of suicide-related terms (e.g., Crosby, Ortega, & Melanson, 2011), and response options that allow for nuanced reporting of suicidal behavior (see Hom, Joiner, & Bernert, 2015 and Millner, Lee, & Nock, 2015 for

discussions of the limintations of single-item assessments of attempt history). It may also be useful for studies to employ the same suicidal symptom measures to enhance interpretability of meta-analytic findings (Batterham et al., 2015).

Additionally, although the interpersonal theory of suicide clearly articulates that suicidal desire emerges when individuals believe their thwarted belongingness and perceived burdensomeness to be intractable (Joiner, 2005; Van Orden et al., 2010), no study to date has directly accounted for intractability in measurement or analyses. Rather, all studies included in this review utilized the INQ, which does not measure hopelessness about perceived burdensomeness and thwarted belongingness. Individuals experiencing elevated levels of these two constructs may have felt hopeless about their tractability; however, without direct tests of this hopelessness, our capacity to draw conclusions regarding the theory is significantly hampered. An indirect approach (e.g., assessing general hopelessness with the BHS) has been used in the literature (e.g., Hagan et al., 2015). However, our meta-analytic findings suggest this approach did not yield significant effects—albeit here too, we were underpowered. Thus, studies are needed to establish the psychometric properties of such a measure and evaluate whether the hopelessness regarding these constructs' tractability predicts suicidal desire, as well as lethal/near-lethal attempts when capability for suicide is also present.

Regarding the possibility that suicidal thoughts and behaviors may be more strongly correlated with perceived burdensomeness than thwarted belongingness (e.g., Bryan et al., 2010; Ma et al., 2016), our findings partially supported this hypothesis. Univariate results indicated that perceived burdensomeness was more strongly associated with suicidal thoughts and behaviors than thwarted belongingness. However, multivariate results suggested that the interaction of capability for suicide and thwarted belongingness exhibited a stronger relationship with suicide attempt history than the interaction of capability for suicide and perceived burdensomeness both when attempts are measured continuously (rs = 0.18 and 0.12, respectively) and when both continuous and dichotomous attempts are collapsed (rs = 0.08 and 0.05, respectively). These findings suggest that individually, perceived burdensomeness may be a more important contributor to suicidal behavior; however, in the context of capability for suicide, thwarted belongingness may play a greater role. Alternatively, perceived burdensomeness may be a particularly robust longitudinal predictor of suicidal thoughts and behaviors. One recent study found that, while the interaction of thwarted belongingness and perceived burdensomeness accounted for the relationship between NSSI and suicidal thoughts and behaviors, only perceived burdensomeness significantly mediated the prospective prediction of risk (Chu et al., 2016d). However, Bryan and colleagues (2010b), and others (e.g., Bryan et al., 2012a; Van Orden et al., 2008b), have reported this pattern using cross-sectional study designs. Thus, as additional longitudinal investigations of the interpersonal theory are conducted, future meta-analyses may be able to determine whether perceived burdensomeness is, indeed, a stronger prospective predictor of suicidal behavior.

Finally, we used several indices of publication bias to evaluate our results. Regarding the theory's basic tenants, trim and fill analyses suggested that the relationship between the three-way interaction of theory variables and continuous attempt history may have been

impacted by publication biases. However, trim and fill analyses did not suggest that any bias influenced models testing the relationship between thwarted belongingness, perceived burdensomeness, and suicidal ideation. Moderation analyses also did not indicate that publication biases affected the models testing the theory's key hypotheses. Regarding other models, results suggested that publication bias likely occurred in those testing the (1) relationship between thwarted belongingness and perceived burdensomeness, (2) interaction effect of capability for suicide and perceived burdensomeness on (continuous) attempt history; (3) interaction effect between capability for suicide and thwarted belongingness on suicide risk; and (4) three-way interaction effect of theory constructs on suicidal ideation. Overall, the robustness of models with significant indices of publication bias should be considered with caution since their pooled correlations are likely lower as a result. Nevertheless, most of our models evidenced no effect of publication bias adjustments on general conclusions, supporting our findings' robustness.

Of note, whether the senior author of this paper was involved in a project generally did not moderate findings; this variable only emerged as a significant moderator in three (< 9%) of 34 tested models. In two of the three cases, effects were stronger in studies including this author, and in the last case, the meta-analytic effect was weaker with the author's inclusion. Also, the I^2 value remained significant for each of the models in which the moderator was significant, suggesting that the moderation effect did not account for a significant amount of variance in our outcome variable, and any significant effect observed may have been due to Type I error.

Moderator Effects

With our relatively modest effect sizes, we reasoned that certain methodological characteristics might be associated with stronger effect sizes. Significant moderators emerged in some of the tested models; however, overall, I^2 values remained significant, suggesting that these factors do not account for a substantial amount of variance in suicidal outcomes. That we did not find any significant moderators for the models testing the theory's main hypotheses suggests that the theory is robust to variations in study population and characteristics. However, the lack of significant moderation effects may have been due to the restricted range of effect sizes and insufficient power given the heterogeneity of study settings (as discussed above and by Ma et al., [2016]). Tests of moderators of theory hypotheses necessitate three-way and four-way interaction variables and require large sample sizes.

In general, we did not observe any clear patterns in the moderators that may have influenced pathways between the interpersonal theory and suicidal variables; however, one broad trend was noted. Across included studies, thwarted belongingness and perceived burdensomeness exhibited a weaker relationship with suicide ideation and risk in studies in military samples and samples with a greater percentage of males, as well as in studies that did not use web-based methodologies. This finding supports prior researchers' hypotheses that membership in a military cohort, which emphasizes and facilitates the development of close interpersonal bonds, may enhance social connections and diminish thwarted belongingness (Bohnert, Aikins & Edidin, 2007; Bryan, Jennings, Jobes & Bradley, 2012). In this environment,

thwarted belongingness may not be elevated among those with high perceived burdensomeness and/or suicide risk, limiting the variance in thwarted belongingness. Of note, given that military culture often emphasizes courage, physical and mental toughness, and self-reliance (Bryan et al., 2012), the weaker association between thwarted belongingness and suicide risk in military samples may also reflect an underreporting of suicidal symptoms (cf. Anestis & Green, 2015; Ribeiro et al., 2015). Similarly, weaker effect sizes were seen in studies not using web-based methodologies. Given that online protocols may provide participants with greater privacy, this finding may also reflect underreporting in studies that are not conducted exclusively online.

Limitations and Directions for Future Research from the Lens of the Interpersonal Theory

While this systematic review and meta-analysis indicated that the propositions of the interpersonal theory of suicide largely stand up to empirical scrutiny, these suicide risk correlates demonstrated only modest-at-best clinical significance, consistent with the broader risk factor literature (Franklin et al., 2017). In addition to a need for improved measures of intractability and suicidal outcomes, other research gaps and directions for future research were indicated.

Study sample and design—Our review revealed few prospective studies (6.9%), with most studies (93.1%) employing a cross-sectional study design. Further, many studies evaluating the three-way interaction between the theory's constructs tested its cross-sectional association with prior suicide attempts. Given that the theory asserts that its three primary constructs together predict *future* suicide risk (Joiner, 2005; Van Orden et al., 2010), there is a clear need for longitudinal studies. Further, as nearly half (48.3%) of the studies in this meta-analysis examined young adults attending a U.S. college, our results may not represent other populations of interest, particularly individuals at elevated risk for suicide death. Longitudinal studies recruiting high-risk individuals (e.g., inpatient and military populations) are needed. Given the low base rate of suicidal behaviors, a leveraging of a multi-site study or web-based recruitment approach may be advantageous. To shed light on the trajectory to suicide, there is also a need for studies using adolescent sample since there are high rates of suicidal behaviors in this group and many of these symptoms onset during childhood and persist into adulthood (Moran et al., 2012). Currently, there are a limited number of international studies examining the interpersonal theory with validated measures; moving forward, it will be vital to expand tests of the theory beyond the U.S.—particularly as the theory proposes that its tenets can be universally applied.

Data analysis considerations—Suicide attempt history is often not normally distributed, especially in community samples. Thus, research has called for improved statistical specificity when testing the interpersonal theory in the context of positively skewed suicide-related outcome variables (Cukrowicz et al., 2013); however, Cukrowicz and colleagues' (2013) study is the only one, to our knowledge, that has employed a statistical approach to account for excess zeroes. To explore this approach, we meta-analyzed effect sizes obtained using negative binomial regression for all models with continuous suicide attempt history as the dependent variable (i.e., H3, H5, H6, H8); we did not present these analyses in the main manuscript due to the limited number of included studies ($k < 10$; see

Appendix 5). Within the context of limited data, our results were different from those obtained in models based on non-skew-adjusted analyses—in general, we found larger but non-significant interaction effect sizes for meta-analytic models based on negative binomial analyses. As these exploratory findings are limited, it is recommended that future studies consider analytic approaches that adjust for the distribution of suicidal outcome variables, such as zero-inflated negative binomial analyses (Cukrowicz et al., 2013).

Measurement of interpersonal theory constructs and suicidal ideation and behavior—Another limitation of prior research is the varied measurement of theory constructs and lack of clear recommendations regarding the measures or versions that allow for accurate assessment of each construct. In this review, five versions of the INQ (10-, 12-, 15-, 18-, and 25-item versions) were utilized to measure thwarted belongingness and perceived burdensomeness. Though studies have sought to establish the psychometric properties and factor structures of each of these INQ versions (e.g., Bryan, 2011; Hill et al., 2015; Marty, Segal, Coolidge, & Klebe, 2012), it is unclear which version of the INQ offers the greatest utility, particularly among high-risk samples. Likewise, only two versions of the ACSS have been validated and published (Ribeiro et al., 2014; Van Orden, Witte, Gordon, Bender, & Joiner, 2008); however, at least five versions of the ACSS were used to measure capability for suicide (4-, 5-, 7-, 13-, and 20-item versions). There is no consensus regarding which version may best capture fearlessness about death and elevated pain tolerance. Given that various measure versions may not be associated with current suicidal ideation to the same degree, even when completed by the same individuals (Hill et al., 2015), these inconsistencies challenge our ability to clearly interpret meta-analytic findings. Furthermore, since the factor structure of self-report symptom measures may vary depending on the population completing the measure (e.g., Biehn, Elhai, Fine, Seligman, & Richardson, 2012), the relative dearth of studies establishing these measures' factor structures across populations is concerning and prevents discernment of what may account for observed study findings.

It may also be advantageous for future research to explore alternative methods of assessing these constructs. For one, thwarted belongingness and perceived burdensomeness are multifaceted and the INQ only captures one facet of each. The development and rigorous evaluation of comprehensive measures of these constructs (e.g., assessing frequency of social contact, intractability of feelings of burdensomeness and thwarted belongingness) may be useful in definitively testing the theory's propositions. Beyond self-report measures, studies have also used a behavioral approach-motivation task (e.g., Ribeiro et al., 2014), the measurement of capability for suicide utilizing pain tolerance tasks (e.g., Franklin, Hessel, & Prinstein, 2011), and the measurement of perceived burdensomeness using a ball-tossing task (Silva et al., 2016). More work is needed to refine and develop behavioral proxies. Though individuals may be more willing to report their feelings of social isolation or perception of being a burden than suicidal ideation (Podlogar et al., 2015), individuals may still be reluctant to disclose this sensitive information due to stigma concerns (Anestis & Green, 2015; Corrigan & Watson, 2002; Hom, Stanley, Podlogar, & Joiner, 2017b; Podlogar et al., 2015). Implicit measurement of suicide-related constructs (e.g., through reaction time-based tasks) may be an effective strategy to circumvent these concerns (Nock & Banaji,

2007; Nock et al., 2010); though, more research is needed on this front, particularly with regard to their utility in military samples (Chiurliza et al., 2016). Lastly, since capability for suicide likely has a genetic component (Smith et al., 2012), studies utilizing biological indices of theory variables and translational approaches are needed.

Need for focus on acute risk factors—Though the interpersonal theory may illuminate *which* individuals are likely to die by suicide, the theory is less specific regarding *when* such self-harm may occur. Thus, a focus on integrating acute suicide risk factors (e.g., agitation, insomnia, nightmares) with the interpersonal theory may further suicide prevention efforts. This future direction dovetails with emerging evidence that highlights the import of acute suicide risk factors (Hendin, Al Jurdi, Houck, Hughes, & Turner, 2010; Rogers et al., 2017; Stanley, Rufino, Rogers, Ellis, & Joiner, 2016; Tucker, Michaels, Rogers, Wingate, & Joiner, 2016). Additional studies evaluating short-term suicide risk factors—over hours or days—will be important in improving our understanding of how the interpersonal theory may contribute to risk prediction.

Intervention—One overarching goal of the interpersonal theory is to aid risk detection and suicide prevention efforts. If the interpersonal theory is able to identify at-risk individuals based on elevated levels of each of its three primary constructs, one might expect that therapeutic intervention aimed at reducing the severity of these constructs may reduce suicide risk (Chu et al., 2015; Joiner et al., 2009). If further work indicates that this theory is a valid predictor of suicide risk, it will be critical to develop and empirically test the efficacy and effectiveness of interventions designed to target its constructs. Such treatments may focus on the bolstering of interpersonal effectiveness skills to enhance social support (e.g., Dialectical Behavior Therapy [Linehan, 2015]; Cognitive Behavioral Analysis System of Psychotherapy [McCullough, 2003]), restructuring of negative automatic thoughts surrounding beliefs that one is a burden on others or on society (e.g., Cognitive Behavioral Therapy [CBT]; Beck, 1983), improving engagement in social activities to build meaningful social connections (e.g., Behavioral Activation; Martell, Addis, & Jacobsen, 2001), and reducing experiences, such as insomnia, that may increase isolation and thwarted belongingness (e.g., CBT for Insomnia; Edinger, Wohlgemuth, Radtke, Marsh, & Quillian, 2001; for research examining the link between insomnia, isolation, and social functioning, see Chu et al., 2016b; 2017; Hom et al., 2017a). Future research should seek to examine the malleability of the interpersonal theory constructs and the effect of manipulating thwarted belongingness and perceived burdensomeness on suicidal outcomes.

Notably, interventions that reduce capability for suicide remain a largely unexplored area within suicide prevention research. Research by Franklin and colleagues (2016) found that utilization of a game-like evaluative conditioning mobile application significantly reduced engagement in self-injurious behaviors across three randomized controlled trials, potentially by increasing individuals' aversion to self-injury. Further exploration of these and other interventions designed to increase aversion to suicidal behaviors and fear regarding death may therapeutically impact capability for suicide among at-risk individuals. Mobile applications may have the added benefit of circumventing barriers to care in this population (Kazdin & Blase, 2011; see Hom, Stanley, & Joiner, 2015 for review).

Importantly, the central multiplicative relationships posited by the theory should temper near-term prediction implications. The reduction of thwarted belongingness, perceived burdensomeness, and capability for suicide may reduce likelihood for death by suicide, but the use of these constructs as the *sole* clinical predictors of suicide is not currently supported by empirical data. These findings are unsurprising since scholars postulate that suicide likely culminates due to the influence of hundreds of risk factors. Thus, the use of machine learning approaches and advanced predictive models may be useful in the clinical prediction of risk (Franklin et al., 2016); however, here too the data are not yet settled. Given that small-to-moderate univariate relationships between theory constructs and suicidal thoughts and behaviors were found in this meta-analysis, the inclusion of theory constructs in these predictive algorithms may enhance their accuracy, but cannot yet be solely relied upon.

Strengths and Limitations of the Current Review and Meta-Analysis

There are several strengths of the current systematic review and meta-analysis that allowed for the comprehensive evaluation and aggregation of nearly a decade of research testing the interpersonal theory of suicide. Most notably, we employed a rigorous and thorough search strategy to identify relevant peer-reviewed papers, and each bivariate correlation included in our meta-analysis was double-entered prior to analysis to reduce data entry errors. Additionally, we vigorously pursued study authors to obtain data not reported within their manuscripts and utilized a conservative data analytic approach (Borenstein et al., 2007), both of which enhanced the quality of the current review and meta-analytic findings. Despite the inherent limitations associated with the use of varying operational definitions and measurements for suicide-related variables, this review adjusted for the use of different measures of suicide ideation and attempts and incorporated studies using a non-specific suicide measure (i.e., assessing suicide risk).

Nevertheless, this review and meta-analysis is not without its limitations. First, since only studies vetted by the peer-review process were included, and additional findings were only successfully obtained from a portion of suicidologists that we contacted, we were unable to incorporate other unpublished findings that may have reported relevant results. Second, only studies published in English were included in our review, and perhaps, as a result, the vast majority of included studies were conducted in the U.S. Thus, included studies demonstrated a strong North American bias, reducing generalizability to other regions and cultures. Third, we were unable to reach the authors of 8.13% of the studies requiring additional data, which may have influenced the accuracy of our findings. Fourth, like other meta-analyses, some of our results may have been influenced by publication bias (Easterbrook, Gopalan, Berlin & Matthews, 1991; Mervis, 2014). While the majority of the included effect sizes were unpublished, which mitigates these concerns, we were nonetheless unable to determine the extent to which publication bias influenced the accuracy of our results. Though null results are not considered interpretable, if numerous studies testing the interpersonal theory consistently yield null results, this pattern of findings should be evaluated, since the goal is not to reify the theory (Van Orden, 2014), but to refine and enhance its explanatory power (cf. Joiner et al., 2016). Finally, due to heterogeneity of studies included in the meta-analysis may have produced underinflated effects.

Conclusions

This meta-analysis of a decade of cross-national research on the interpersonal theory of suicide provides some evidence regarding theory hypotheses. Importantly, our review revealed several gaps in the literature that require further empirical investigation. In the coming decade, additional studies using reliable and robust measures and that rigorously test the interpersonal theory of suicide's specific hypotheses, as well as its predictive capacity regarding death by suicide, are needed. Research that targets the shortcomings of the present literature will greatly contribute to model refinement and our understanding of the utility of the interpersonal theory of suicide for the prevention, management, and treatment of suicidal thoughts and behaviors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Public Significance

This meta-analysis generally found support for the interpersonal theory of suicide–thwarted belongingness and perceived burdensomeness were significant correlates of suicidal ideation severity, and thwarted belongingness, perceived burdensomeness, and capability for suicide were significantly associated with suicide attempt history. Effect sizes for these relationships were weak-to-moderate, suggesting potentially modest clinical significance. However, there was insufficient research on the theory's specific hypotheses, including its capacity for predicting death by suicide and the role of viewing thwarted belongingness and perceived burdensomeness as intractable in suicidal desire.

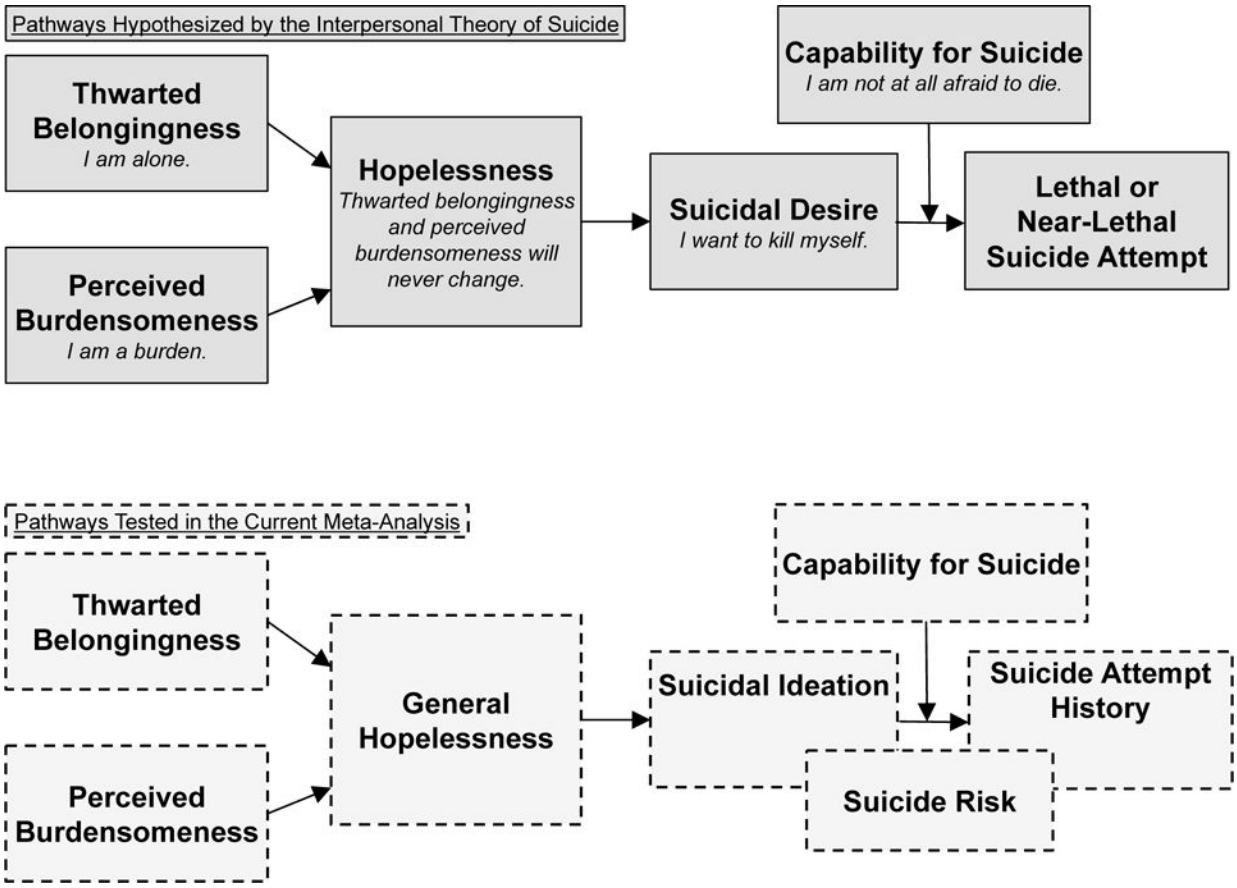

Figure 1.

Causal pathways to lethal or near-lethal suicidal behavior from the perspective of the Interpersonal Theory of Suicide (Joiner, 2005; Van Orden et al., 2010) are depicted with solid lines; sample items are presented in italics. Pathways tested in the current meta-analysis are indicated with dotted lines. Suicide risk represents an amalgamation of both suicidal ideation and suicide attempts.

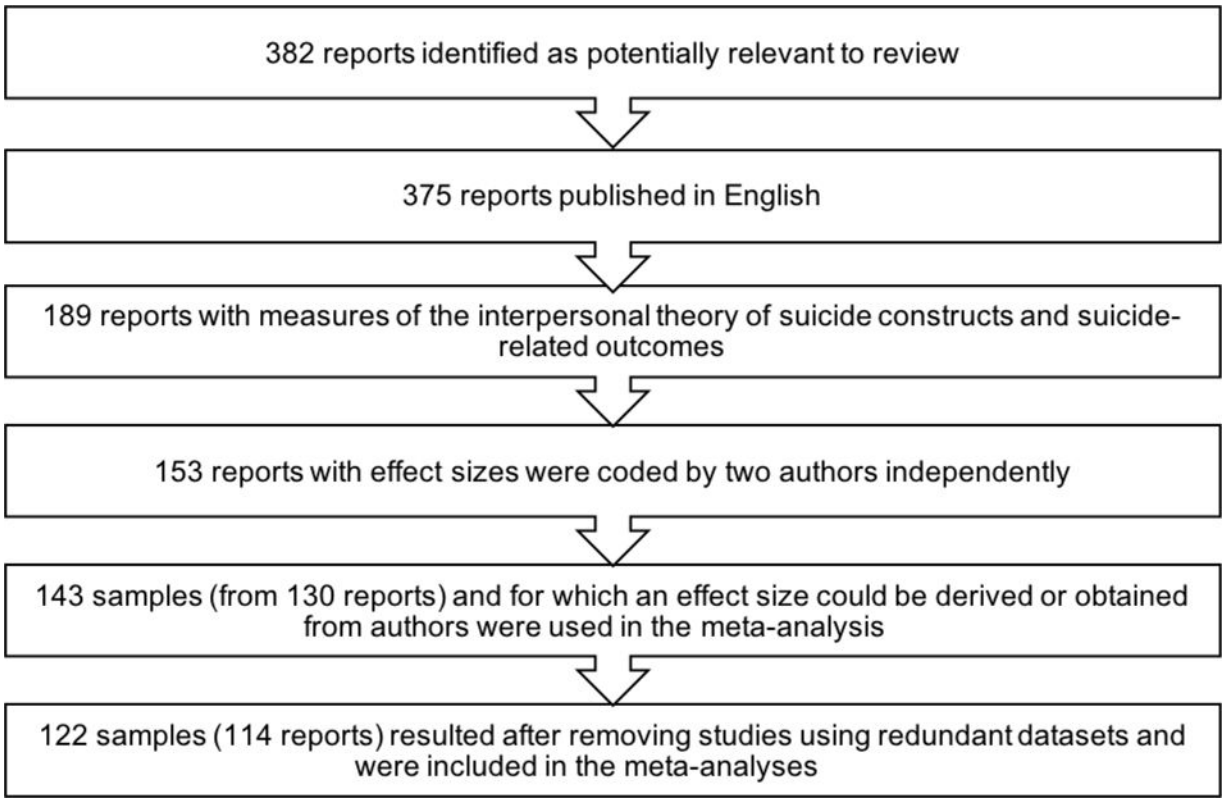

Figure 2.
Flow chart of screening process.

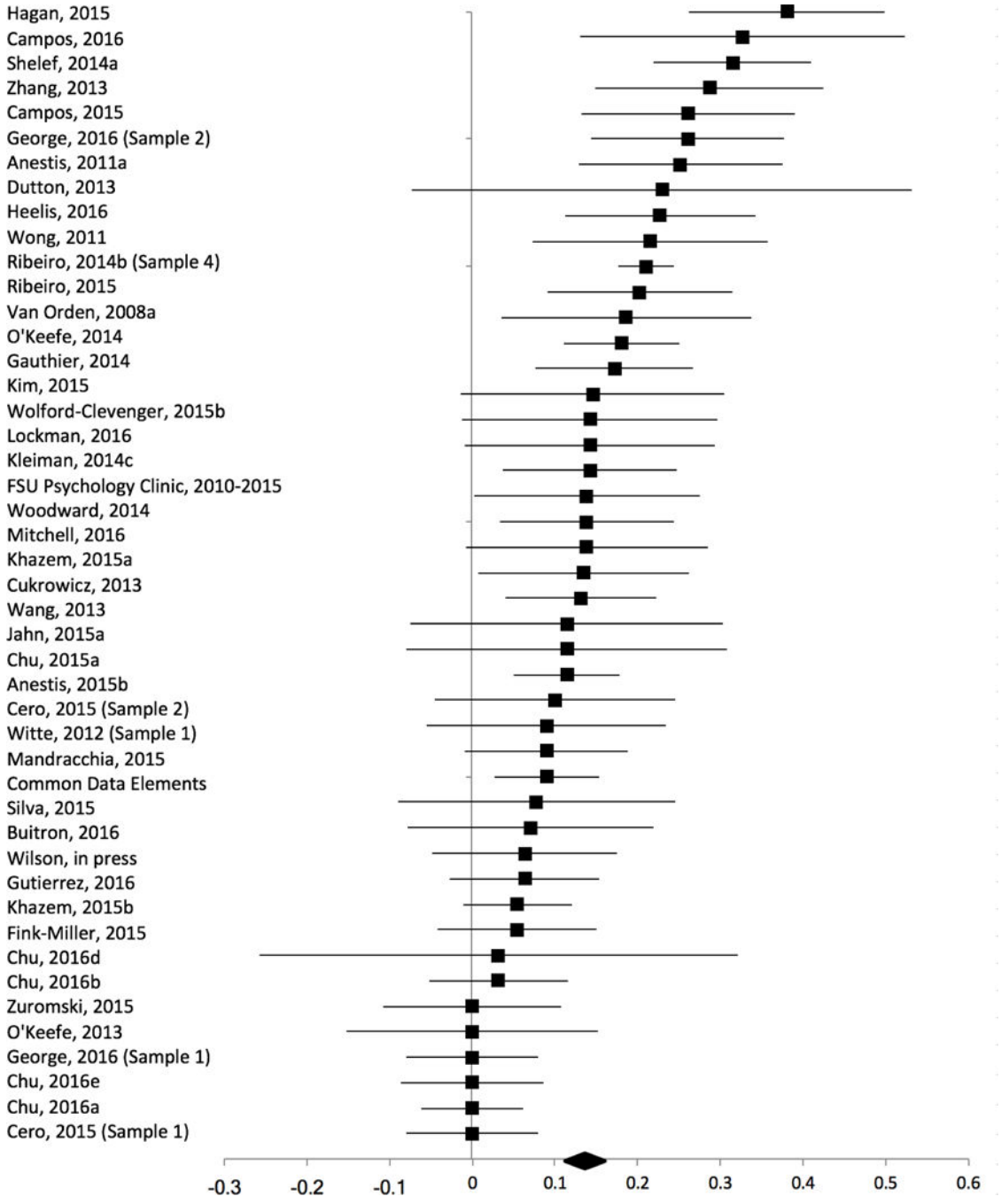

Figure 3.

Forest plot depicting the Fisher's *z* effects for the interaction between thwarted belongingness and perceived burdensomeness predicting suicidal ideation. The first author and publication date are listed.

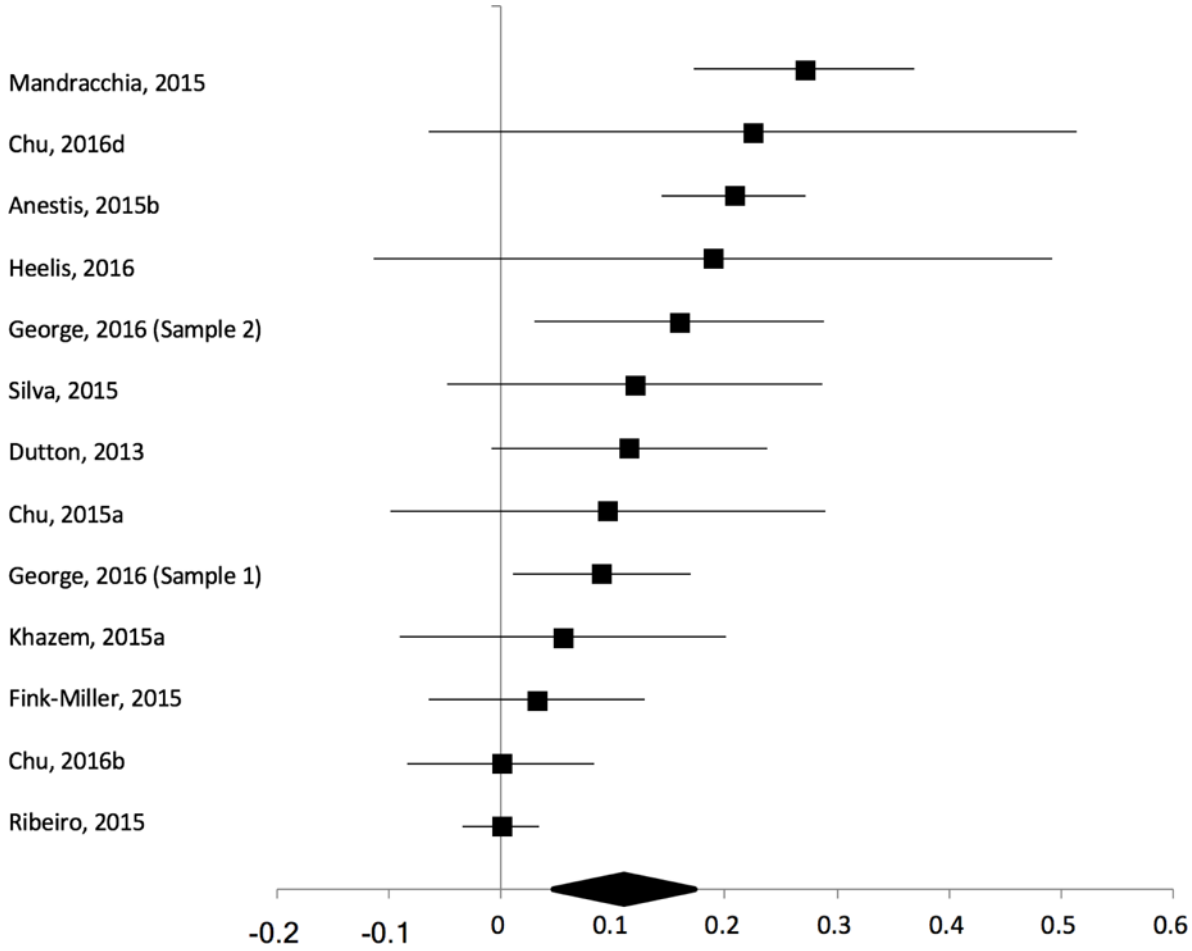

Figure 4.

Forest plot depicting the Fisher's *z* effects for the interaction between thwarted belongingness, perceived burdensomeness, and capability for suicide predicting (continuous) suicide attempt history.

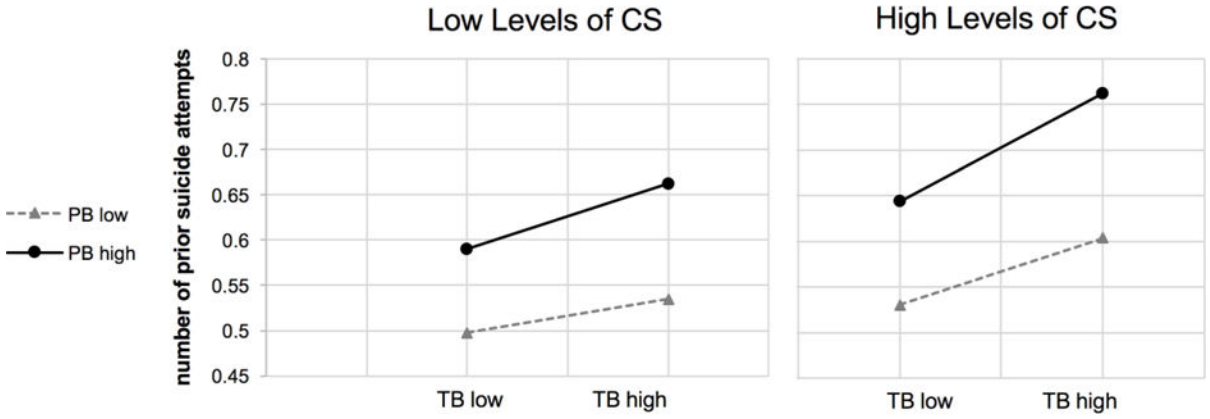

Figure 5.

Plot of the interpersonal theory of suicide constructs predicting suicide attempt history (measured continuously). The interaction between thwarted belongingness and perceived burdensomeness at low (1 standard deviation below the mean) and high (1 standard deviation above the mean) levels of capability for suicide are presented. The effects obtained from the interaction models (not full models) were used to construct this plot.

Table 1

Characteristics of Samples Included in the Meta-Analysis and Systematic Review of the Interpersonal Theory of Suicide (Total k = 143).

Variable	Category	*k*
Location	United States / Canada	120
	Outside of United States / Canada	17
	United States Military Living Abroad	6
Article Publication Year	2005–2010	12
	2011–2015	131
Mean Age of Sample	Youth (<18 years)	4
	Young Adults (18–24 years)	69
	Adults (25+ years)	60
	Older Adults (60+ years)	10
Military Sample	Yes	24
	No	119
Sample Type	Inpatient	11
	Outpatient	21
	Undergraduate Students	63
	Community	48
Web-Based Study	Yes	66
	No	77
Study Design	Cross-Sectional	132
	Longitudinal	11
Sample Size	<100	15
	100–199	43
	200–399	42
	400–699	22
	700+	21

Note. *k* = number of samples.

Table 2

Measures Used in the Samples Included in the Meta-Analysis and Systematic Review of the Interpersonal Theory of Suicide (Total k = 143).

Variable	Category	*k*
Assessed Capability for Suicide	Yes	64
	No	79
Acquired Capability for Suicide Scale (ACSS) Measures	ACSS-4	2
	ACSS-5	21
	ACSS-FAD-7	13
	ACSS-13	1
	ACSS-20	24
	Other (not ACSS)	3
Assessed Thwarted Belongingness/Perceived Burdensomeness	Yes	115
	No	28
Interpersonal Needs Questionnaire (INQ) Measures	INQ-10	9
	INQ-12	27
	INQ-15	53
	INQ-18	15
	INQ-25	6
	Other (not INQ)	5
Assessed Suicidal Ideation	Yes	93
	No	50
Suicidal Ideation Measures	BSS (items 1–19)	40
	DSI-SS	19
	GSSI	9
	PANSI (Neg. Subscale)	4
	MSSI	6
	SIDAS	1
	Other	14
Assessed Suicide Attempts	Yes	34
	No	109
Suicide Attempt Measures	Continuous	8
	Dichotomous (lifetime)	24
	Dichotomous (last year)	1
	Dichotomous (last 6 months)	1
Assessed Suicide Risk	Yes	31
	No	112

Variable	Category	*k*
Suicide Risk Measures	SBQ-R	22
	LAS-SF	3
	PSF	2
	SHBQ	1
	Other	3

Note. *k* = number of samples. FAD = fearlessness about death. BSS = Beck Scale for Suicide Ideation. DSI-SS = Depressive Symptom Inventory – Suicidality Subscale. GSSI = Geriatric Scale for Suicidal Ideation. PANSI = Positive and Negative Suicide Ideation Inventory. MSSI = Modified Scale for Suicide Ideation. SIDAS = Suicidal Ideation Attributes Scale. SBQ-R = Suicidal Behavior Questionnaire-Revised. LAS-SF = Life Attitudes Schedule-Short Form. PSF = Psychiatric Symptom Frequency Scale. SHBQ = Self-Harm Behavior Questionnaire.

Table 3

Bivariate Relationships Among Interpersonal Theory Variables.

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
TB, PB	97	0.57 (0.53,0.61), $p < 0.001$	3515.14 (96), $p < 0.001$	97.27	44,484	4.17 (1.79,6.54), $p < 0.001$	0.49 (5403.69)	30
CS, PB	43	0.05 (−0.001,0.10), $p = 0.054$	487.25 (42), $p < 0.001$	91.38	23,319	−1.51 (−3.38,0.36), $p = 0.110$	0.09 (605.59)	10
CS, TB	43	0.01 (−0.03,0.05), $p = 0.638$	356.65 (42), $p < 0.001$	88.22	23,319	−0.15 (−1.80,1.50), $p = 0.855$	0.05 (506.37)	10

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported.

TB = thwarted belongingness. PB = perceived burdensomeness. CS = capability for suicide.

Table 4

Bivariate Relationships Between Interpersonal Theory Variables and Suicidal Ideation, Suicide Risk, and Suicide Attempt History.

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
TB, SI	84	0.37 (0.34,0.40), $p < 0.001$	725.88 (83), $p < 0.001$	88.57	37,952	2.70 (1.49,3.91), $p < 0.001$	0.31 (1077.79)	23
TB, Risk	24	0.33 (0.25,0.41), $p < 0.001$	352.10 (23), $p < 0.001$	93.47	9,108	0.74 (−2.65,4.13), $p = 0.656$	0.29 (448.04)	4
TB, Attempt C	29	0.11 (0.03,0.19), $p = 0.010$	520.90 (28), $p < 0.001$	94.62	10,986	−3.55 (−8.07,0.97), $p = 0.119$	−0.01 (1261.25)	13
PB, SI	84	0.48 (0.44,0.50), $p < 0.001$	1063.80 (83), $p < 0.001$	92.20	37,894	0.83 (−0.79,2.45), $p = 0.309$	0.41 (1821.21)	26
PB, Risk	23	0.42 (0.35,0.49), $p < 0.001$	314.02 (22), $p < 0.001$	92.99	9,002	0.64 (−2.75,4.00), $p = 0.703$	0.42 (314.02)	0
PB, Attempt C	30	0.25 (0.18,0.32), $p < 0.001$	613.65 (29), $p < 0.001$	95.27	17,119	0.47 (−2.80,3.74), $p = 0.770$	0.32 (875.28)	9
CS, SI	29	0.10 (0.02,0.19), $p = 0.020$	483.61 (28), $p < 0.001$	94.21	9,728	1.91 (−2.14,5.95), $p = 0.342$	0.17 (973.64)	9
CS, Risk	17	0.09 (−0.01, 0.19), $p = 0.083$	231.65 (16), $p < 0.001$	93.09	6,760	−3.10 (−6.79,0.60), $p = 0.094$	0.13 (258.57)	3
CS, Attempt C	32	0.09 (0.01,0.17), $p = 0.027$	871.18 (31), $p < 0.001$	96.44	18,356	−3.05 (−6.25,0.15), $p = 0.061$	0.09 (871.18)	0

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported.

TB = thwarted belongingness. PB = perceived burdensomeness. CS = capability for suicide. SI = suicidal ideation. Risk = suicidal ideation and behavior (c.f. suicide risk). C = attempts measured continuously.

Table 5

Effect of Two-Way Interaction Between Perceived Burdensomeness and Thwarted Belongingness on Suicidal Ideation (H1) and Suicide Risk (H7).

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
PBxTB -> SI								
Full	58	0.58 (0.54,0.61), $p < 0.001$	723.52 (57), $p < 0.001$	92.12	23,971	3.36 (1.36,5.36), $p = 0.101$	0.58 (723.52)	0
Interaction	46	0.14 (0.11,0.17), $p < 0.001$	174.49 (45), $p < 0.001$	74.21	19,042	0.22 (−1.19,1.62), $p = 0.757$	0.14 (174.49)	0
PBxTB -> Risk								
Full	12	0.55 (0.49,0.59), $p < 0.001$	46.77 (11), $p < 0.001$	76.48	5,018	0.36 (−2.20,2.93), $p = 0.760$	0.55 (46.77)	0
Interaction	8	0.12 (0.09,0.15), $p < 0.001$	2.63 (7), $p = 0.917$	<0.001	4,084	−0.28 (−1.26,0.71), $p = 0.502$	0.12 (2.63)	0

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported. See H1 and H7 in the Meta-Analytic Approach Section.

TB = thwarted belongingness. PB = perceived burdensomeness. CS = capability for suicide. SI = suicidal ideation. Risk = suicidal ideation and behavior (c.f. suicide risk).

Table 6

Effect of Three-Way Interaction Between Perceived Burdensomeness, Thwarted Belongingness, and Hopelessness on Suicidal Ideation (H2) and Suicide Risk (H7).

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
PBxTBxH -> SI								
Full Model	4	0.63 (0.57,0.68), $p < 0.001$	11.33 (3), $p = 0.010$	73.53	6,873	2.28 (−1.25,5.82), $p = 0.109$	0.59 (23.52)	2
Interaction	3	0.15 (0.03,0.27), $p = 0.014$	5.60 (2), $p = 0.061$	64.27	740	2.28 (−1.63,16.78), $p = 0.89$	0.15 (5.60)	0
PBxTBxH -> Risk								
Full Model	5	0.56 (0.50,0.63), $p < 0.001$	12.99 (4), $p = 0.011$	69.22	6,832	0.07 (−4.03,4.18), $p = 0.959$	0.56 (12.99)	0
Interaction	4	0.02 (−0.05,0.10), $p = 0.525$	1.76 (3), $p = 0.624$	<0.001	699	1.57 (−2.45,5.59), $p = 0.235$	0.02 (1.76)	0

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported. See H2 and H7 in the Meta-Analytic Approach Section.

TB = thwarted belongingness. PB = perceived burdensomeness. CS = capability for suicide. H = hopelessness. SI = suicidal ideation. Risk = suicidal ideation and behavior (c.f. suicide risk).

Table 7

Effect of the Three-Way Interaction Between Perceived Burdensomeness, Thwarted Belongingness, and Capability for Suicide on Suicide Attempt History (H3) and Suicide Risk (H7).

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
TBxPBxCS -> Attempt C								
Full Model	14	0.53 (0.39,0.65), $p < 0.001$	557.64 (13), $p < 0.001$	97.67	5,279	5.73 (−4.03,15.50), $p = 0.225$	0.58 (914.45)	2
Interaction	13	0.11 (0.05,0.17), $p < 0.001$	58.24 (12), $p < 0.001$	79.39	7,312	1.89 (−0.33,4.11), $p = 0.088$	0.04 (125.26)	6
TBxPBxCS -> Attempt D								
Interaction	22	0.02 (−0.01,0.05), $p = 0.201$	49.60 (21), $p < 0.001$	57.66	11,610	0.10 (−1.30,1.50), $p = 0.879$	0.04 (56.88)	8
TBxPBxCS -> Attempt C/D								
Interaction	27	0.06 (0.02,0.10), $p = 0.001$	95.67 (26), $p < 0.001$	72.82	13,590	0.49 (−1.14,2.13), $p = 0.540$	0.06 (97.39)	2
TBxPBxCS -> Risk								
Full Model	8	0.50 (0.42,0.57), $p < 0.001$	53.89 (7), $p < 0.001$	87.01	4,315	−0.74 (−5.50,4.02), $p = 0.716$	0.48 (62.50)	1
Interaction	5	0.07 (0.02,0.13), $p = 0.009$	6.41 (4), $p = 0.171$	37.57	3,548	1.67 (−0.65,3.98), $p = 0.106$	0.05 (13.51)	2

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported. See H3 and H7 in the Meta-Analytic Approach Section.

TB = thwarted belongingness. PB = perceived burdensomeness. CS = capability for suicide. Attempt C = attempt history measured continuously. Attempt D = attempts measured dichotomously (i.e., yes/no). Attempt C/D = attempt history; analyses predicting attempts measured continuously and dichotomously were collapsed. Risk = suicidal ideation and behavior.

Table 8

Effect of the Four-Way Interaction Between Perceived Burdensomeness, Thwarted Belongingness, Capability for Suicide, and Hopelessness on Suicide Risk (H4/H7).

Model	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
TBxPBxCSxH -> Risk								
Full Model	2	0.63 (0.36,0.80), $p < 0.001$	10.29 (1), $p = 0.001$	90.28	428	n/a	n/a	n/a
Interaction	2	0.06 (−0.04,0.16), $p = 0.234$	1.04 (1), $p = 0.309$	3.52	428	n/a	n/a	n/a

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. n/a = data unavailable due to insufficient data. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported. Refer to H4/H7 in the Meta-Analytic Approach Section. There were insufficient data to test the four-way interaction predicting suicide attempt history (H4); however, we obtained two effect sizes for the four-way interaction predicting suicide risk (H7).

TB = thwarted belongingness. PB = perceived burdensomeness. CS = capability for suicide. H = hopelessness. Risk = suicidal ideation and behavior.

Table 9

Effect of Two-Way Interaction Between Perceived Burdensomeness and Capability for Suicide on Suicide Attempt History (H5) and Suicide Risk (H7).

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
CSxPB -> Attempt C								
Full Model	14	0.39 (0.26,0.51), $p < 0.001$	467.09 (13), $p < 0.001$	97.22	7,729	6.77 (1.41,12.12), $p = 0.017$	0.42 (1276.31)	1
Interaction	11	0.12 (0.05,0.20), $p = 0.002$	62.57 (10), $p < 0.001$	84.02	6,273	2.45 (−0.14,5.04), $p = 0.061$	0.16 (202.67)	2
CSxPB -> Attempt D								
Interaction	19	0.003 (−0.02,0.02), $p = 0.753$	0.02 (18), $p > 0.999$	<0.001	10,143	0.007 (−0.02, 0.04), $p = 0.627$	0.003 (0.02)	1
CSxPB -> Attempt C/D								
Interaction	25	0.05 (0.02,0.09), $p = 0.004$	72.22 (24), $p < 0.001$	66.77	12,172	1.14 (−0.32,2.61), $p = 0.121$	0.06 (77.06)	4
CSxPB -> Risk								
Full Model	7	0.42 (0.31,0.52), $p < 0.001$	40.38 (6), $p < 0.001$	85.14	1,802	0.42 (−8.35,9.19), $p = 0.907$	0.39 (59.38)	1
Interaction	3	0.19 (−0.03,0.40), $p = 0.096$	19.50 (2), $p < 0.001$	89.84	868	9.18 (0.24,18.13), $p = 0.051$	0.19 (19.50)	0

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported. See H5 and H7 in the Meta-Analytic Approach Section.

PB = perceived burdensomeness. CS = capability for suicide. Attempt C = attempt history measured continuously. Attempt D = attempts measured dichotomously (i.e., yes/no). Attempt C/D = attempt history; analyses predicting attempts measured continuously and dichotomously were collapsed. Risk = suicidal ideation and behavior.

Table 10

Effect of Two-Way Interaction Between Thwarted Belongingness and Capability for Suicide on Suicide Attempt History (H6) and Suicide Risk (H7).

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
TBxCS -> Attempt C								
Full Model	14	0.36 (0.21,0.50), $p < 0.001$	582.14 (13), $p < 0.001$	97.77	7,729	5.85 (−0.84,12.54), $p = 0.081$	0.45 (1861.83)	4
Interaction	12	0.18 (0.09,0.27), $p < 0.001$	106.15 (11), $p < 0.001$	89.64	6,378	2.76 (−0.34,5.86), $p = 0.075$	0.19 (120.79)	1
TBxCS -> Attempt D								
Interaction	19	0.002 (−0.02,0.02), $p = 0.831$	0.05 (18), $p > 0.999$	<0.001	10,143	−0.04 (−0.09, 0.008), $p = 0.097$	0.003 (0.09)	8
TBxCS -> Attempt C/D								
Interaction	25	0.08 (0.03,0.13), $p < 0.001$	138.68 (24), $p < 0.001$	82.69	12,172	1.43 (−0.63, 3.49), $p = 0.164$	0.09 (162.61)	3
TBxCS -> Risk								
Full Model	7	0.37 (0.25,0.48), $p < 0.001$	45.10 (6). $p < 0.001$	86.70	1,802	−1.18 (−10.37, 8.00), $p = 0.754$	0.37 (45.10)	0
Interaction	3	0.01 (−0.06,0.08), $p = 0.796$	0.29 (2), $p = 0.87$	<0.001	868	1.11 (−0.92, 3.14), $p = 0.09$	0.01 (0.29)	0

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported. See H6 and H7 in the Meta-Analytic Approach Section.

TB = thwarted belongingness. CS = capability for suicide. Attempt C = attempt history measured continuously. Attempt D = attempts measured dichotomously (i.e., yes/no). Attempt C/D = attempt history; analyses predicting attempts measured continuously and dichotomously were collapsed. Risk = suicidal ideation and behavior.

Table 11

Effect of Two-Way Interaction Between Thwarted Belongingness and Perceived Burdensomeness on Suicide Attempt History (H8).

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
PBxTB -> Attempt C								
Full Model	12	0.36 (0.26,0.46), $p < 0.001$	109.0 (11), $p < 0.001$	89.91	3,104	2.23 (−3.31,7.77), $p = 0.391$	0.38 (123.11)	1
Interaction	13	0.20 (0.07,0.33), $p = 0.003$	170.35 (12), $p < 0.001$	92.96	3,292	−1.19 (−8.17,5.79), $p = 0.714$	0.13 (184.66)	3
PBxTB -> Attempt D								
Interaction	20	0.002 (−0.02,0.02), $p = 0.861$	0.03 (19), $p > 0.999$	<0.001	11,287	0.02 (−0.02, 0.06), $p = 0.233$	0.002 (0.03)	2
PBxTB -> Attempt C/D								
Interaction	28	0.09 (0.03,0.15), $p = 0.003$	294.39 (27), $p < 0.001$	90.83	13,614	2.07 (−0.67,4.80), $p = 0.133$	0.12 (379.23)	7

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, *Q-values*, and the number of studies trimmed are reported. See H8 in the Meta-Analytic Approach Section.

TB = thwarted belongingness. CS = capability for suicide. Attempt C = attempt history measured continuously. Attempt D = attempts measured dichotomously (i.e., yes/no). Attempt C/D = attempt history; analyses predicting attempts measured continuously and dichotomously were collapsed.

Table 12

Effect of Three-Way Interaction Between Thwarted Belongingness, Perceived Burdensomeness, and Capability for Suicide on Suicidal Ideation (H9).

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
TBxPBxCS -> SI								
Full Model	26	0.59 (0.54,0.63), $p < 0.001$	351.24 (25), $p < 0.001$	92.88	12,382	3.63 (0.72,6.54), $p = 0.017$	0.64 (1113.81)	7
Interaction	25	0.07 (0.04,0.10), $p < 0.001$	60.13 (24), $p < 0.001$	60.09	12,189	−1.06 (−2.40,0.28), $p = 0.115$	0.04 (164.40)	7

Note. *k* = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported. See H9 in the Meta-Analytic Approach Section.

PB = perceived burdensomeness. TB = thwarted belongingness. CS = capability for suicide. SI = suicidal ideation.

Table 13

Models Significantly Moderated by Publication Status—Published and Unpublished Effect Sizes.

Models	k	r (95% CI)	Q (df)	I^2	N	ET (95% CI)	Trim&Fill Est.(Q)	Studies Trimmed
CS, Attempt C								
All	*32*	*0.09 (0.01,0.17), p = 0.027*	*871.18 (31), p < 0.001*	*96.44*	*18,356*	*−3.05 (−6.25,0.15), p = 0.061*	*0.09 (871.18)*	*0*
Published	13	0.17 (0.06,0.27), *p* = 0.003	222.98 (12), *p* < 0.001	94.62	9,867	−4.10 (−7.43,−0.77), *p* = 0.020	0.17 (222.98)	0
Unpublished	19	0.03 (−0.05,0.11), *p* = 0.431	225.38 (18), *p* < 0.001	92.01	10,026	0.84 (−2.67,4.34), *p* = 0.622	−0.06 (367.04)	8
CSxPB -> Attempt C/D								
All	*25*	*0.05 (0.02,0.09), p = 0.004*	*72.22 (24), p < 0.001*	*66.77*	*12,172*	*1.14 (−0.32,2.61), p = 0.121*	*0.06 (77.06)*	*4*
Published	14	0.08 (0.02,0.15), *p* = 0.010	56.96 (13), *p* < 0.001	77.18	4,666	0.77 (−3.43,4.97), *p* = 0.695	0.10 (65.09)	3
Unpublished	11	0.007 (−0.02,0.03), *p* = 0.524	1.35 (10), *p* > 0.99	< 0.001	7,506	0.44 (0.09,0.80), *p* = 0.021	0.007 (1.80)	1
TBxPBxCS -> Attempt C/D								
All	*27*	*0.06 (0.02,0.10), p = 0.001*	*95.67 (26), p < 0.001*	*72.82*	*13,590*	*0.49 (−1.14,2.13), p = 0.540*	*0.06 (97.39)*	*2*
Published	15	0.09 (0.04,0.14), *p* < 0.001	50.16 (14), *p* < 0.001	72.09	5,899	−2.87 (−5.50,−0.24), *p* = 0.035	0.09 (50.96)	1
Unpublished	12	0.007 (−0.02,0.03), *p* = 0.534	6.84 (11), *p* = 0.812	< 0.001	7,691	0.89 (0.13,1.65), *p* = 0.025	0.006 (9.07)	1

***Note*.** Meta-analyses were conducted separately for published and unpublished effect sizes. Results based on all effect sizes—published and unpublished—are provided for comparison.

k = number of samples. CI = confidence interval. ET = Egger's Regression Intercept test, 2-tailed *p*-value is reported; significance indicates potential publication biases. Trim&Fill = Duval's Trim & Fill test, random effects estimates, Q-values, and the number of studies trimmed are reported.

PB = perceived burdensomeness. TB = thwarted belongingness. CS = capability for suicide. Attempt C = attempt history measured continuously. Attempt C/D = attempt history; analyses predicting attempts measured continuously and dichotomously were collapsed.