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Review

Cognition and self-injurious thoughts and behaviors: A systematic review of longitudinal studies

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HIGHLIGHTS

- Cognition may help predict and prevent self-injurious thoughts and behaviors (SITBs).
- Most research on cognition and SITBs pertains to recurrent suicidal ideation.
- Evidence for SITB-themed cognitions is preliminary, and reveals robust and proximal risk factors.
- Negatively-valenced cognitive risk factors are common, robust, yet modestly predictive.
- Treatment research should examine the mediating and moderating effects of cognition.

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ABSTRACT

There is a long tradition in suicide research, accompanied by recent developments in nonsuicidal self-injury (NSSI) research, of examining cognitive processes as potential precursors of risk. But these cognitive processes are often studied separately, and are rarely integrated or directly compared with each other. In an effort to synthesize this literature, this systematic review ($n = 109$ longitudinal studies conducted over the past 10 years) demonstrates how specific cognitive processes predict self-injurious thoughts and behaviors (SITBs), and examines whether intervening on features of cognition may help mitigate SITB risk. Our review reveals that cognitive processes, measured using self-report and behavioral measures, are most often linked to recurrent suicidal ideation. Overall, several patterns emerged. First, SITB-themed cognitions were robust risk factors and proximally associated with SITB outcomes. Second, negatively-valenced cognitive risk factors were the most commonly studied risk factors, relatively robust, and modestly related to SITB outcomes. Third, cognitive deficits (i.e., basic cognitive processes not characterized by thematic content or negative valence) produced mixed findings that suggest a more distal relationship to SITB outcomes. Moreover, our review of treatment articles revealed that while many interventions are informed by the cognitive literature, potential cognitive mechanisms of treatment change are rarely studied. We conclude by outlining key ways that future research can generate more comprehensive cognitive profiles of self-injurious and suicidal individuals.

1. Introduction

Most people assume that it is better to be alive than dead, or that it is better to be physically unharmed than harmed. But there is a substantial proportion of individuals who either consider, desire, or act toward self-harm and death. Suicide is the 10th leading cause of death in the United States (Center for Disease Control and Prevention (CDC), 2017), and 3–9% of individuals have experienced suicidal thoughts and behaviors (i.e., suicidal ideation, suicide attempt; Nock et al., 2008). In

addition to suicidal self-injury, 18% of individuals have intentionally hurt themselves in the absence of intent to die (i.e., nonsuicidal self-injury; Muehlenkamp, Claes, Havertape, & Plener, 2012). These complex and physically threatening clinical outcomes, hereafter referred to as *self-injurious thoughts and behaviors* (SITBs), warrant greater attention. The current review focuses on SITB outcomes including *nonsuicidal self-injury* (NSSI; actions intended to hurt oneself in the absence of intent to end one's own life), *suicidal ideation* (i.e., thought or desire to end one's own life), *suicide attempt* (i.e., action intended to end one's own

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life), and *suicide death*.

Many attempts have been made to understand why people desire or try to hurt themselves. Earlier efforts to address this question stemmed from Beck's (1979) cognitive theory of depression. Acknowledging that "suicide is the lethal complication of depression," Beck (1979) and colleagues readily extended his theory to suicide (Beck, Kovacs, & Weissman, 1975; Wenzel, Brown, & Beck, 2009). The establishment of Beck's theory was followed by decades of research assessing constructs relevant to cognitive models for both depression and suicide (Beck, 1991). This research primarily focused on negative thought content (e.g., hopelessness, negative automatic thoughts). At the same time, a parallel line of research applying a neuropsychological lens to suicide risk had also emerged. This research demonstrated that cognitive deficits within the domains of attention, memory, and executive functioning, for instance, were associated with suicidal ideation and lethality of suicide attempts (e.g., Ellis, Berg, & Frazen, 1992; Keilp et al., 2001; Neuringer, 1964; Patsiokas, Clum, & Luscomb, 1979). Finally, and more recently, research on cognition began extending to NSSI—a clinical outcome that is associated with, yet distinct from, suicidal thoughts and behaviors.

Several key challenges within this literature exist. First, cognitive risk factors are often explored individually and are rarely discussed in conjunction with one another. Although several notable reviews about cognition and SITB outcomes exist, they tend to focus on a single cognitive domain at a time (e.g., executive functioning, attention, memory; Richard-Devantoy et al., 2012; Richard-Devantoy, Berlim & Jollant, 2015; Richard-Devantoy, Ding, Turecki & Jollant, 2016). This approach offers a helpful but partial understanding of the potential role of cognition in SITB risk. And similar to the depression literature (Gotlib & Joormann, 2010), negatively-valenced cognitive risk factors and cognitive deficits are rarely considered side-by-side. Synthesizing these disparate research efforts represents an initial step toward forming more comprehensive cognitive profiles of self-injurious and suicidal individuals.

Second, the temporal association between cognition and SITB outcomes remains unclear. Most research in this area, albeit promising, has featured cross-sectional study designs (e.g., Keilp et al., 2013; Richard-Devantoy, Berlim, & Jollant, 2014). Significant associations may thereby reflect maladaptive cognitive processes that emerge either before, during, or after SITBs occur. Beyond this, recent meta-analyses on prospective studies of SITB risk feature a wide variety of predictors (e.g., Franklin et al., 2017), but their broad scope prevents an in-depth summary of cognition specifically. There is a pressing need to synthesize *cognitive risk factors*, which both correlate with and temporally precede SITB outcomes (Kraemer et al., 1997), in order to elucidate the etiology of SITBs and identify discrete, modifiable targets of intervention.

To address these knowledge gaps, this systematic review offers both depth and breadth around the topic of cognition and SITB outcomes. We review recently examined cognitive risk factors of SITB outcomes and summarize why and how cognitive processes may relate to these outcomes – whether that is *increasing* the likelihood of SITBs via risk factor research, or *mitigating* the likelihood of SITBs via treatment research. The present review also serves to highlight key knowledge gaps within the literature. We focus on longitudinal studies where cognitive processes were assessed at least once prior to SITB assessment, in addition to treatment studies that have been informed by the cognitive literature.

2. Methods

2.1. Search strategy

Searches were conducted through Pubmed, PsycInfo, and ProQuest

Digital Dissertations¹ for empirical studies published between 2007 and June 26, 2017. The search was conducted in line with PRISMA guidelines (Fig. 1; Moher et al., 2009). The following search terms were used in combination to search within titles and abstracts: "memory," "language," "cognitive control," "attention*," "percept*," "intelligen*," "executive function*," "impuls*," "cogniti*," "neurocogniti*," "neuropsych*," "bias," "risk factor," "longitudinal," "longitudinally," "predict*," "prospective," "prospectively," "later," "follow-up," "followed," "self-injury," "suicidality," "self-harm," "suicide," "suicidal behavior," "suicide attempt," "suicide death," "suicide plan," "suicidal thoughts," "suicidal ideation," "SITB," "parasuicide," "self-mutilation," "self-cutting," "cutting," "self-burning," "self-poisoning," "deliberate self-harm," "DSH," "nonsuicidal self-injury," or "NSSI."² These search terms were derived in part from recent meta-analyses of prospective risk factors for suicidal behaviors (e.g., Franklin et al., 2017) and from prior systematic reviews of cognitive factors for psychopathology (e.g., Daglas et al., 2015). Search results were limited to empirical studies available in English with human samples. Duplicate studies found across databases were removed. Additional empirical studies were extracted from reviews and meta-analyses featuring cognitive processes and SITB outcomes.

2.2. Inclusion criteria

Empirical studies were included if they met the following criteria:

- Published in English AND;
- Reported presence of SITB outcomes AND;
- Included at least one cognitive construct (i.e., thought content or information processing bias) AND;
- Featured a longitudinal study design AND;
 - IF it did not test an intervention: Featured the assessment of at least one cognitive construct at a time point preceding the assessment of at least one SITB outcome OR;
 - IF it did test an intervention: Was a randomized controlled trial (RCT) that either measured a cognitive construct and SITB outcome repeatedly across treatment OR featured an intervention informed by the cognitive literature (e.g., cognitive behavioral therapy)

2.3. Exclusion criteria

Empirical studies were excluded if they met any of the following criteria:

- Did not report quantitative analyses from an individual study (e.g., case studies, commentaries, qualitative studies). Reviews and meta-analyses were archived and used for the purpose of finding more individual studies.
- Did not report assessment of a cognitive construct
- Did not report assessment of a SITB outcome
- IF it did not test an intervention: Did not report non-SITB cases or a separate non-SITB comparison group
- IF it did test an intervention: Did not follow an RCT study design

2.4. Study selection

Five independent coders reviewed abstracts in parallel. During this

¹ To increase the relevance of ProQuest results, the search was limited to theses and dissertations categorized under the subjects of behavioral sciences, mental health, neuroscience, public health, social work, and psychology. Dissertations with no subject assigned were searched as well.

² Upon inspection of the full text, papers that did not include a discrete SITB outcome (NSSI, suicidal ideation, suicide attempt, suicide death) were excluded.

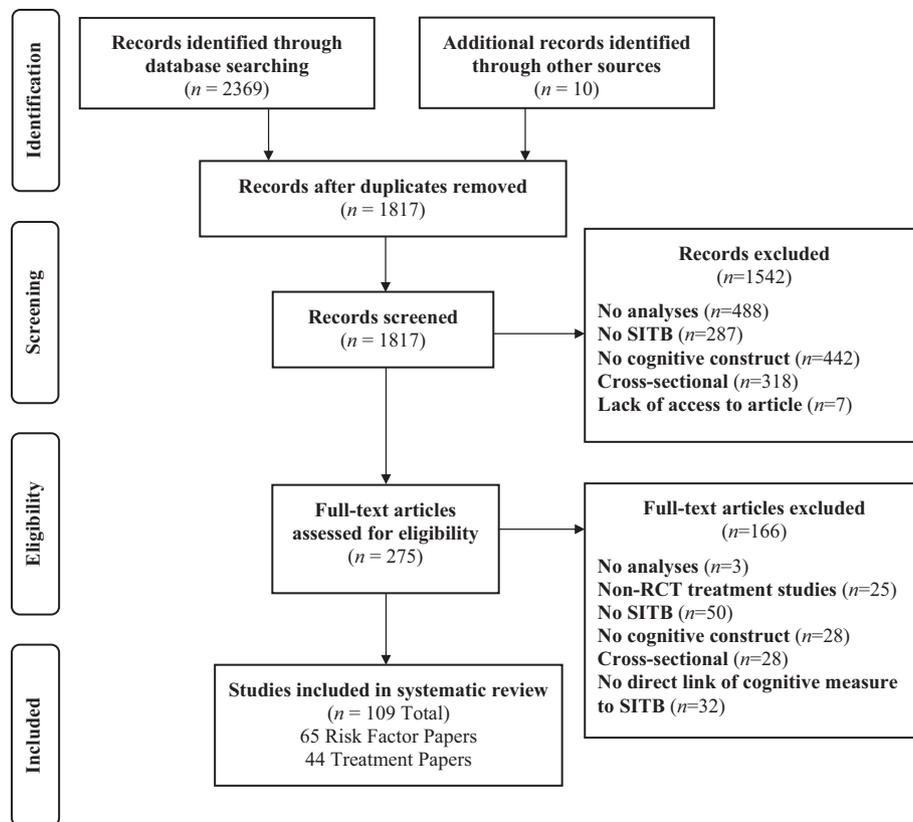


Fig. 1. PRISMA Flow Diagram.

initial phase of abstract reviews, studies were included if they featured assessment of at least one SITB outcome and at least one cognitive construct in the abstract—even if a statistic or analysis relating the two variables was not explicitly reported.³ The master coder (CC) was a researcher with a doctoral degree in clinical psychology who has studied cognitive vulnerabilities for SITB outcomes for the past 10+ years. Based on 100 reviewed abstracts, coders demonstrated almost perfect inter-rater reliability with the master coder on inclusion and exclusion decisions ($\kappa = 0.85$; Landis & Koch, 1977). Uncertainties concerning inclusion or exclusion of an article were resolved through discussions with the master coder. Coders determined final inclusion of the study based on review of full-text articles.

2.5. Data extraction

Information about sample characteristics (baseline n , clinical severity, gender composition, age), study design features (length of follow-up period), SITB outcomes, cognitive construct(s), and individual findings (directionality, significance) were extracted from the full articles of included studies via double coding. Sources of discrepancies were reviewed and resolved by study authors. Inter-rater agreement on each variable ranged from substantial ($\kappa = 0.77$) to perfect ($\kappa = 1.0$).

3. Results

In total, 65 prospective risk factor articles were included (Table 1; Supplemental Table 1), in addition to 44 treatment RCTs. We provide

³ While this helps address reporting bias at the abstract level (i.e., the tendency to highlight significant findings in the abstract and underreport null findings that are otherwise reported in the full article), we acknowledge that this does not address the broader problem of reporting bias in full articles.

an initial overview of the cognitive risk factors literature and then summarize each risk factor category assessed: *SITB-themed cognitive risk factors*, *negatively-valenced cognitive risk factors*, and *cognitive deficits*. Treatment articles that either feature cognitive processes or are informed by the cognitive literature are subsequently described.

3.1. Cognitive risk factor studies

Overall search results are first reported, summarizing the 65 cognitive risk factor studies. Regarding sample characteristics, most risk factor studies featured adult-only or mixed (i.e., adult and youth) samples (66%), with a minority specifically focusing on youth-only (34%). Samples were often non-psychiatric (63%), with few psychiatric samples (24%) or non-psychiatric samples with some psychopathology (13%). Regarding study design features, the follow-up time period of these risk factor studies ranged from < .5 months to 39 years, and was on average 3.2 years.

Regarding SITB outcomes, over half of all findings (55%) examined suicidal ideation. NSSI (25%) and suicide attempt (18%) were less frequently examined. Suicide death (2%) was rarely linked to preceding cognitive risk factors.

Regarding assessments, 78% of those used to capture cognitive risk factors were based on self-report measures, with some of the most common including the *Beck Hopelessness Scale*, *Barratt Impulsiveness Scale*, and *UPPS Impulsive Behavior Scale*. The remaining findings (22%) were based on behavioral measures (e.g., *Wisconsin Card Sorting Test*, *Wechsler Intelligence Scale for Children*, *Implicit Association Tests*, *Modified Stroop Tasks*).

Cognitive risk factors were ultimately organized according to their phenomenological qualities: those that involved death-, suicide-, cutting-themed thought content (i.e., SITB-themed cognitive risk factors); those that involved either negative thought content or the biased processing of negative information (i.e., negatively-valenced cognitive risk

Table 1
Longitudinal studies featuring cognitive risk factors for SITB outcomes (2007–2017), bivariate associations.

Study no.	Study author(s) & year	n	Sample	Age	Follow-up	Cognitive risk factor(s)	SITB outcomes	Maladaptive cognitions significantly associated with greater SITB outcome?
1	Alati, Gunnell, Najman, William, and Lawlor (2009)	1975	Non-Psychiatric	Youth	7 yrs	C - (Raven's Standard Progressive Matrices, Wide Range Achievement Test 3)	SI, SP, SA	Yes (Raven's Standard Progressive Matrices-SI, SA)†
2	Andrews, Martin, Hasking, and Page (2013)	2640	Non-Psychiatric	Youth	11.7 mo	N - (Emotion Regulation Questionnaire - Cognitive Reappraisal)	NSSI	Yes
3	Barnes et al. (2017)	176	Psychiatric	Adult	6 mo	S - (Death Implicit Association Test)	SA	Yes
4	Black and Mildred (2013)	285	Non-Psychiatric	Adult	12.2 mo	N, C - (UPPS Scale)	NSSI	Yes†
5	Brent et al. (2015)	701	Non-Psychiatric with Ppath	Mixed	5.6 yrs	N, C - (BIS, BHS, Buss Durkee Hostility Inventory)	SA	Yes
6	Burke et al. (2016)	324	Non-Psychiatric	Youth	24 mo	N, P - (Adolescent Cognitive Style Questionnaire, Children's Response Styles Questionnaire, Self-Referent Encoding Task)	SI	Yes
7	Capron, Allan, Ialongo, Leen-Feldner, and Schmidt (2015)	613	Non-Psychiatric	Youth	2 yrs	N - (Anxiety Sensitivity Index)	SI	Yes
8	Capron, Cougle, Ribeiro, Joiner, and Schmidt (2012)	1081	Non-Psychiatric	Mixed	5 wks	N - (Anxiety Sensitivity Index)	SI	Yes†
9	Cha et al. (2010)	124	Psychiatric	Adult	6 mo	N, S - (Modified Stroop Task, suicide interference scores & negative interference scores)	SA	Yes (Modified Stroop Task, suicide interference scores-SA)†
10	Chandrasekaran and Gnanaselane (2008)	341	Psychiatric	Adult	2 yrs	N - (Hopelessness Scale)	SA	Yes (Hopelessness Scale-SA)
11	Chang et al. (2014)	4810	Non-Psychiatric	Youth	8–9 yrs	C - (Wechsler Intelligence Scale for Children-III)	SI, SP, NSSI, SA	No
12	Chioqueta and Stiles (2007a)	102	Non-Psychiatric	Adult	3 mo	N - (Automatic Thoughts Questionnaire, Dysfunctional Attitudes Scale)	SI	Yes
13	Chioqueta and Stiles (2007b)	102	Non-Psychiatric	Adult	3 mo	N - (Automatic Thoughts Questionnaire, Dysfunctional Attitudes Scale)	SI	Yes
14	Crane et al. (2016)	5792	Non-Psychiatric	Youth	3 yrs	N, P - (Autobiographical Memory Test)	SI, SP	Yes
15	DeLisle (2007)	362	Non-Psychiatric	Mixed	4 mo	N - (BHS, Cognitive Triad Inventory, Extended Attributional Style Questionnaire)	SI	Yes
16	Ellis et al. (2016)	124	Psychiatric	Adult	6 wks	N, S - (BHS, Death Implicit Association Task)	SI	Yes ‡
17	Freeland (2011)	1253	Non-Psychiatric	Mixed	24 mo	C - (Zuckerman-Kuhlman Personality Questionnaire)	SI	No▲
18	Galfalvy, Huang, Oquendo, Currier, and Mann (2009)	343	Non-Psychiatric with Ppath	Adult	1 yr	C - (BIS)	SA	No
19	Garisch and Wilson (2016)	1162	Non-Psychiatric	Youth	5 mo	C - (BIS)	NSSI	No
20	Gilletta et al. (2013)	348	Non-Psychiatric	Mixed	6–18 mo	C - (BIS)	NSSI	No†
21	Gilletta et al. (2015)	138	Psychiatric	Youth	3 mo	C - (UPPS Scale)	SI	Yes
22	Glenn et al. (2017)	662	Non-Psychiatric	Youth	1 yr	S - (Self-Injury Implicit Association Test)	NSSI	Yes
23	Glenn and Klonsky (2011)	81	Non-Psychiatric	Mixed	1 yr	N, S, C - (Self-Injury Implicit Association Test; UPPS Scale)	NSSI	No
24	Guerry and Prinstein (2009)	143	Psychiatric	Youth	3, 6, 9, 15, 18 mo	N - (Children's Attributional Style Questionnaire-Revised)	NSSI	Yes
25	Handley et al. (2016)	532	Psychiatric	Adult	6 mo	N - (BHS, Dysfunctional Attitude Scale)	SI	Yes
26	Hankin and Abela (2011)	103	Non-Psychiatric	Youth	2.5 yrs	N - (Adolescent Cognitive Style Questionnaire, Children's Response Style Questionnaire, Children's Dysfunctional Attitudes Scale)	NSSI	Yes (Adolescent Cognitive Style Questionnaire-NSSI)
27	Hiramura et al. (2008)	546	Non-Psychiatric	Mixed	2 wks	N - (Automatic Thoughts Questionnaire-Revised)	SI	Yes
28	Kleiman, Miller, and Riskind (2012)	209	Non-Psychiatric	Mixed	26 days	N - (Cognitive Style Questionnaire)	SI	No
29	Kleiman, Law, and Anestis (2014a)	245	Non-Psychiatric with Ppath	Mixed	50 days	N - (Cognitive Style Questionnaire, Interpersonal Needs Questionnaire)	SI	Yes
30	Kleiman, Riskind, et al. (2014b)	171	Non-Psychiatric	Mixed	45 days	N - (Cognitive Style Questionnaire, Interpersonal Needs Questionnaire)	SI	Yes
31	Klonsky, Kotov, Bakst, Rabinowitz, and Bromet (2012)	628	Psychiatric	Mixed	6, 24, 48, 120 mo	N - (BHS)	SA	Yes†
32	Links et al. (2012)	102	Psychiatric	Adult	1–6 mo	N, C - (BHS; BIS)	SI	Yes (BHS-SI; BIS-SI)

(continued on next page)

Table 1 (continued)

Study no.	Study author(s) & year	n	Sample	Age	Follow-up	Cognitive risk factor(s)	SITB outcomes	Maladaptive cognitions significantly associated with greater SITB outcome?
33	Liu and Mustanski (2012)	246	Non-Psychiatric	Mixed	12, 24 mo	C - (BIS, Brief Sensation Seeking Scale)	SI	Yes (BIS-SI) †
34	McLaughlin (2013) - Study 1	707	Non-Psychiatric	Mixed	3 mo	N - (Defeat Scale, Internal and External Entrapment Scales, Response Styles Summary)	SI	Yes
	McLaughlin (2013) - Study 2	128	Non-Psychiatric	Mixed	6 mo	P, N - (Brief COPE, Defeat Scale, Future Thinking Task, Internal and External Entrapment scales, Response Styles Summary)	SI, SA	Yes (Future Thinking Task-SI; Internal and External Entrapment Scales-SI; Re-sponse Styles Summary-SD) ●
35	Miller (2015)	322	Non-Psychiatric	Mixed	2-4 mo	N - (BHS; Defeat Scale, Entrapment Scale, RRS)	SI	Yes (Defeat Scale-SI; Entrapment Scale-SI, RRS-SI)
36	Miller et al. (2016)	143	Psychiatric	Mixed	3-4 wks	N - (Interpersonal Needs Questionnaire)	SI	Yes
37	Miranda et al. (2012)	96	Non-Psychiatric	Adult	6 mo	N, C - (BHS; Wisconsin Card Sorting Task)	SI	Yes
38	Miranda et al. (2013)	96	Non-Psychiatric	Adult	2-3 yrs	N, C - (BHS, RRS; Wisconsin Card Sorting Task)	SI	No
39	Miranda and Nolen-Hoeksema (2007)	1324	Non-Psychiatric	Adult	1 yr	N - (RRS)	SI	Yes †
40	Morrison (2008)-Study 1	99	Non-Psychiatric	Mixed	35 days	N, P - (Dot-Probe Task, RRS)	SI	Yes (RRS-SI) ◆
	Morrison (2008)-Study 2	250	Non-Psychiatric	Mixed	81 days	N - (BHS, RRS)	SI	Yes
	Morrison (2008)-Study 3	151	Psychiatric	Mixed	81 days	N, P - (BHS, Dot-Probe Task, RRS)	SI	No
41	Mustanski and Liu (2013)	237	Non-Psychiatric	Mixed	1 yr	N, C - (BIS; Brief Hopelessness Scale)	SA	Yes (Brief Hopelessness Scale-SA)
42	Nicolai (2015)	142	Non-Psychiatric	Adult	8 wks	N, C - (RRS; UPPS Scale)	NSSI	Yes (RRS-NSSI)
43	Nock, Hwang, Sampson, and Kessler (2010)	157	Psychiatric	Adult	6 mo	S - (Death Implicit Association Task)	SA	Yes (Death Implicit Association Task-SA) †
44	O'Connor and Noyce (2008)	232	Non-Psychiatric	Mixed	11 wks	N - (RRS)	SI	Yes
45	O'Connor et al. (2013)	70	Psychiatric	Mixed	48 mo	N - (BHS, Defeat Scale, Entrapment Scale)	SA	Yes
46	Oser et al. (2008)	9359	Non-Psychiatric	Mixed	33, 39 yrs	C - (Boerge Prien's Test, Harnquist School Test)	SA, SD	Yes (Boerge Prien's Test-SD at 33 yrs; Boerge Prien's Test-SA at 33 yrs; Harnquist School Test-SA at 39 yrs)
47	Panagioti et al. (2015)	52	Non-Psychiatric with Ppath	Adult	13-15 mo	N - (BHS, Defeat Scale, Combined Defeat/Entrapment Scales, Entrapment Scale)	SI	Yes
48	Peterson and Fischer (2012)	489	Non-Psychiatric	Mixed	8 mo	N, C - (UPPS Scale)	NSSI	No †
49	Prinstein et al. (2008)	143	Psychiatric	Youth	6, 9, 18 mo	N - (Hopelessness Scale for Children)	SI, SA	No †
50	Riley et al. (2015)	1158	Non-Psychiatric	Adult	9 mo	C - (UPPS Scale)	NSSI	Yes
51	Roley-Roberts (2016)	121	Non-Psychiatric with Ppath	Adult	1 mo	N - (Interpersonal Needs Questionnaire)	SI	No †
52	Selby et al. (2013)	47	Non-Psychiatric with Ppath	Mixed	1-14 days	N - (Cognitive Emotion Regulation Questionnaire)	NSSI	Yes
53	Sheehy (2015)	59	Non-Psychiatric with Ppath	Adult	1 mo	N - (Defeat Scale, Entrapment Scale, BHS)	SI	Yes (BHS-SI; Entrapment Scale-SI)
54	Sörberg et al. (2013)	49321	Non-Psychiatric	Adult	36 yrs	C - (IQ test performance)	SA	Yes
55	Stange et al. (2015)	72	Non-Psychiatric with Ppath	Adult	3 yrs	N - (Cognitive Style Questionnaire, RRS)	SI	No
56	Tatnell et al. (2014)	2637	Non-Psychiatric	Mixed	12 mo	N - (Emotion Regulation Questionnaire - Cognitive Reappraisal)	NSSI	No
57	Thiel (2016)	379	Non-Psychiatric	Adult	10 wks	N - (Interpersonal Needs Questionnaire, Helplessness-Hopelessness-Helplessness Scale)	SI	No †
58	Thompson, Ho, and Kingree (2007)	18924	Non-Psychiatric	Youth	1, 7 yrs	C - (Impulsivity-Unnamed 3-item measure)	SI, SA	No †
59	Tsypes and Gibb (2016)	209	Non-Psychiatric with Ppath	Youth	6 mo-2 yrs	N - (Children's Response Styles Scale, Children's Cognitive Style Questionnaire, Children's Attributional Style Questionnaire, Hopelessness Scale for Children)	SI	Yes (Hopelessness Scale for Children-SI)
60	Voon et al. (2014a)	2637	Non-Psychiatric	Mixed	12 mo-24 mo	N - (Emotion Regulation Questionnaire - Cognitive Reappraisal; Ruminative Thought Style Questionnaire)	NSSI	Yes (Emotion Regulation Questionnaire-NSSI) †
61	Voon et al. (2014b)	2637	Non-Psychiatric	Youth	3 yrs	N - (Emotion Regulation Questionnaire - Cognitive Reappraisal; Ruminative Thought Style Questionnaire)	NSSI	Yes (Emotion Regulation Questionnaire-NSSI); Ruminative Thought-Style Questionnaire-NSSI) †
62	Webb et al. (2011)	8890	Psychiatric	Mixed	32 yrs	C - (Swedish Enlistment Battery)	SD	No
63	Yaseen et al. (2014)	161	Psychiatric	Adult	2-6 mo	N, C - (BIS; Suicide Trigger Scale-Framic Hopelessness, Suicide Trigger Scale-Ruminative Flooding)	SA	Yes (Suicide Trigger Scale-Framic Hopelessness-SA) ●
64	Yates et al. (2008)	267	Non-Psychiatric	Youth	17-18 yrs	N - (Wechsler Intelligence Scale for Children-Revised)	NSSI	No

(continued on next page)

Table 1 (continued)

Study no.	Study author(s) & year	n	Sample	Age	Follow-up	Cognitive risk factor(s)	SITB outcomes	Maladaptive cognitions significantly associated with greater SITB outcome?
65	You et al. (2016)	5423	Non-Psychiatric	Mixed	6 mo, 1 yr, 1.5 yrs	N, C - (UPPS Scale)	NSSI	Yes

Notes: Bivariate findings (aside from exceptions noted below) were used to determine whether a maladaptive cognition was significantly associated with SITB. Specific findings for subscales and multivariate analyses tested in each study are in the supplemental table. **Non-psychiatric with Ppath** refers to a non-psychiatric setting for recruitment with a sample that had psychopathology. **Non-psychiatric** refers to a sample not recruited in a psychiatric setting and that did not have psychopathology. **Psychiatric** refers to a psychiatric setting for recruitment (e.g., hospital, inpatient unit). **Follow-up** refers to length of follow-up. Discrete follow-up time points are separated by commas. **N** = Negatively-valenced cognitive risk factor; **S** = SITB-themed cognitive risk factor; **C** = Cognitive deficit; **P** = Positively-valenced cognitive risk factor; **BHS** = Beck Hopelessness Scale; **UPPS Scale** = Urgency, Premeditation, Perseverance, and Sensation Seeking Impulsive Behavior Scale; **BIS** = Barratt Impulsiveness Scale; **RRS** = Ruminative Responses Scale. **SITB** = Self-Injurious Thoughts and Behaviors; **SI** = Suicidal Ideation; **SA** = Suicide Attempt; **SD** = Suicide Death; **SP** = Suicide Plan; **NSSI** = Nonsuicidal self-injury. The final column indicates "Yes" only if higher levels of maladaptive cognitions (e.g., greater SITB-themed cognitive risk factors, negatively-valenced cognitive risk factors, cognitive deficits) significantly predicted higher levels of SITB outcome at $p < .05$ level. Associations described in parentheses after "Yes" indicate that the maladaptive cognition significantly predicted a SITB outcome, while all other maladaptive cognitions did not significantly predict a SITB outcome. *Supplemental Table 1* shows other associations in greater detail.

† Indicates when a study only reported multivariate analyses of the relationship between cognitive risk factor measures listed and SITB.

‡ In Ellis et al. (2016), only multivariate analyses were reported for the relationship between the Life Implicit Association Test and SI.

▲ In Hankin and Abela (2011), only multivariate analyses were reported for the relationship between the Children's Hopelessness Scale and NSSI.

□ In Freeland (2011), only multivariate analyses were reported for the relationship between Zuckerman-Kuhlman Personality Questionnaire - Impulsive/sensation seeking and SI.

● In McLaughlin (2013) - Study 2, only multivariate analyses were reported for the relationship between Brief COPE - Positive Reframing and SI.

◆ In Morrison (2008) - Study 1, only multivariate analyses were reported for the relationship between RRS and SI.

◼ In Yaseen et al. (2014), only multivariate analyses were reported for the relationship between BIS and SA.

factors); and those that involved neither (i.e., cognitive deficits). Very few findings (3%) accounted for SITB-themed cognitive risk factors. Most findings (65%) accounted for negatively-valenced cognitive risk factors, followed by cognitive deficits (28%). Some studies that accounted for negatively-valenced cognitive risk factors also contained findings involving positively-valenced risk factors (4%). There were no studies that solely focused on positively-valenced risk factors.

3.1.1. SITB-themed cognitive risk factors

A preliminary line of research has highlighted the predictive validity of *SITB-themed cognitive risk factors*, defined as biased, automatic processing of SITB-themed information such as death, suicide, or cutting. These studies, described in greater detail below, represent the smallest proportion of the cognitive risk factor literature, and include automatic associations and attentional biases for SITB-themed content.

3.1.1.1. Implicit identification with death, suicide, or cutting. Automatic associations involving SITB-themed content are promising risk factors for suicidal thoughts and behaviors. How closely an individual identifies him/herself with death- and suicide-themed thought content has been shown to be a reliable risk factor for subsequent suicidal ideation (Cha et al., 2018; Ellis, Rufino, & Green, 2016; Glenn et al., 2017) and suicide attempt (Barnes et al., 2017; Nock et al., 2010). This is typically measured via behavioral responses on the *Death Implicit Association Task* and is hereafter referred to as *implicit identification with death*. These effects have been relatively robust, predicting future suicidal ideation and attempt above and beyond negatively-valenced cognitive risk factors (e.g., hopelessness), depression, and prior history of suicidal ideation and attempt (Cha et al., 2018; Ellis et al., 2016; Glenn et al., 2017; Nock et al., 2010). Effect sizes of implicit identification with death predicting SITB outcomes have ranged from large (Cha et al., 2018; Nock et al., 2010) to more modest, the latter being the case especially in clinical samples (e.g., Barnes et al., 2017; Glenn et al., 2017). Participants' mood when completing these measures may be a salient factor, as it was recently found that transient, negative mood may amplify the predictive validity of this cognitive risk factor (Cha et al., 2018).

Those who closely identify with cutting behavior may be at greater risk of subsequent NSSI engagement. *Implicit identification with cutting* (i.e., stronger implicit association between the concepts of 'self' and 'cutting' on the *Self-Injury Implicit Association Test*) has been tested as a potential risk factor for NSSI. While initial cross-sectional work demonstrated large and robust baseline differences between those with and without NSSI history (Cha et al., 2017; Glenn et al., 2016; Glenn & Klonsky, 2011; Nock & Banaji, 2007), prospective findings have been mixed. There have also been more modest results in clinical samples (Cha et al., 2017). It remains possible that other clinical risk factors (e.g., severity of NSSI, BPD features) mediate the association between implicit identification with cutting and future NSSI (Glenn & Klonsky, 2011).

3.1.1.2. Attentional bias toward suicide. Another example of a SITB-themed cognitive risk factor is attentional bias toward suicide. Difficulty disengaging from suicide- and death-related thought content has been proposed to perpetuate suicidal ideation and potentially accelerate the transition to suicidal behaviors (Wenzel & Beck, 2008). Indeed, biased processing of suicide- and death-themed words during the Suicide Stroop task has been shown to predict greater risk of future suicidal ideation and suicide attempt (Cha, Najmi, Park, Finn, & Nock, 2010; Chung & Jeglic, 2017). This attentional bias has been shown to be specific to SITB-themed content, as responses toward negatively-valenced words have not been predictive within those same studies. While these suicide Stroop studies report only modest predictive validity, attentional bias toward suicide is a notably robust predictor of suicidal ideation and suicide attempt when controlling for negative cognitions (e.g., hopelessness) and depressive symptoms. Of

note, one potential concern with the Suicide Stroop task is its poor reliability (Wilson et al., 2018), which may help account for some examples of mixed and/or null findings within cross-sectional studies (e.g., Chung & Jeglic, 2016; Richard-Devantoy et al., 2016; Wilson et al., 2018).

3.1.1.3. Summary. Preliminary evidence suggests that SITB-themed cognitions, especially implicit identification with death, are robust predictors of suicidal thoughts and behaviors after controlling for other prominent risk factors. A unique feature of this category of risk factors is that they are solely captured via behavioral assessments (i.e., computer-based, reaction-time tests). They have the potential to yield large effects, but more research is needed to determine if such effects can be generalized to clinical populations.

3.1.2. Negatively-valenced cognitive risk factors

Negatively-valenced cognitive risk factors are the most frequently assessed cognitive risk factor in the SITB literature. These include the experience of negatively-valenced thought content, as well as the biased processing of negative information. These are described in greater detail below.

3.1.2.1. Negative thought content. Negative cognitions about oneself, the future, and the world feature prominently in the depression and suicide literature (Beck, 1991; Wenzel & Beck, 2008). This category of cognitive risk factors includes *hopelessness* (i.e., negative perceptions about the self, the world, and the future; Beck, Weissman, Lester, & Trexler, 1974), *automatic negative thoughts* (i.e., negative thoughts that rapidly emerge and are not subject to conscious control; Beck, 1991), and *dysfunctional attitudes* (i.e., consistent, negative beliefs about the self, the world, and the future; Weissman & Beck, 1978). To date, these cognitive risk factors have been studied using self-report measures reflecting the frequency or intensity of negative thought content (e.g., Beck Hopelessness Scale; Dysfunctional Attitudes Scale; Automatic Thoughts Questionnaire; Hollon & Kendall, 1980; Weissman & Beck, 1978), and have been shown to predict suicidal ideation (e.g., Chioqueta & Stiles, 2007a; Chioqueta & Stiles, 2007b; Handley et al., 2016; Hiramura, Shono, Tanaka, Nagata, & Kitamura, 2008; Miranda, Gallagher, Bauchner, Vaysman, & Marroquín, 2012; Mustanski & Liu, 2013; Panagioti, Gooding, & Tarriner, 2015; Tsypes & Gibb, 2016). Despite several examples of these negatively-valenced cognitive risk factors predicting suicidal ideation above and beyond depressive symptoms (e.g., Chioqueta & Stiles, 2007a; Chioqueta & Stiles, 2007b; Tsypes & Gibb, 2016), those same studies reveal small to modest effect sizes. In addition, select studies reveal no prospective prediction of suicidal ideation, even in the absence of covariates (e.g., Miller, 2015; Morrison, 2008). As these constructs are often conceptualized through a vulnerability-stress model (e.g., Abela & Sullivan, 2003; Gibb & Coles, 2005), the potential moderating role of stress should be further explored. An additional consideration is not only the presence of negative thought content, but also the absence of positive thought content. Specifically, the *inability* to generate positive future events (vs. negative future events) has been shown to predict subsequent suicidal ideation, even when controlling for other negatively-valenced cognitive risk factors such as hopelessness and entrapment (McLaughlin, 2013; O'Connor, Fraser, Whyte, MacHale, & Masterton, 2008).

Negative thought content extends to maladaptive interpretations of oneself in relation to others. According to the *Interpersonal Psychological Theory of Suicide* (Joiner, 2005), both *perceived burdensomeness* (i.e., perception that one is a burden on others in their life) and *thwarted belongingness* (i.e., perception that one is alienated from others and does not belong) increase the likelihood of suicidal ideation. Findings among adults show that perceived burdensomeness and thwarted belongingness are proximal and robust risk factors for suicidal ideation, such that they mediate the effect of negative attributional style and depressive symptoms on suicidal ideation (Kleiman, Law, & Anestis, 2014a;

Kleiman, Riskind, Stange, Hamilton, & Alloy, 2014b). Of note, these constructs may not play as proximal a role among youth; prospective associations between thwarted belongingness and suicidal ideation among adolescents have been shown to be mediated by depressive symptoms (Miller, Esposito-Smythers, & Leichtweis, 2016). To date, these constructs have been assessed only using self-report measures.

3.1.2.2. Negative information processing biases. Beyond the experience of negative thought content, individuals may process negatively-valenced information in ways that perpetuate risk of suicide and self-injury. In the context of negative life events, certain individuals may employ maladaptive cognitive and behavioral strategies leading to depressogenic beliefs. The experience of *defeat* refers to perceptions of failed struggle during stressful life situations, whereas *entrapment* refers to perception of failed escape from these situations (Gilbert & Allan, 1998). These cognitive risk factors have been examined in relation to suicidal ideation and have been shown to precede this and other SITB outcomes (e.g., suicide attempt) after controlling for hopelessness (O'Connor, Smyth, Ferguson, Ryan, & Williams, 2013; Panagioti et al., 2015). Entrapment is often a more robust predictor of suicidal ideation than defeat, suggesting its potential role as a mediating cognitive process (McLaughlin, 2013; O'Connor et al., 2013). This is aligned with the *Integrated Motivational Volitional Model of Suicide* (O'Connor, 2011), which proposes that defeat precedes entrapment, which, in turn, precedes suicidal ideation.

Styles of processing negatively-valenced information have also been examined in relation to NSSI. These include *negative attributional style* (i.e., tendency to interpret the cause of negative events as being internal, stable, and global in nature; Abramson, Metalsky, & Alloy, 1989) and related cognitive constructs (e.g., cognitive reappraisal deficits; Tatnell, Kelada, Hasking, & Martin, 2014; Voon, Hasking, & Martin, 2014a; Voon, Hasking, & Martin, 2014b). This recent literature is limited to youth and yields mixed conclusions. On the one hand, several studies have shown a significant and robust association between these specific constructs and NSSI over time, controlling for depressive symptoms and hopelessness (Barrocas, Giletta, Hankin, Prinstein, & Abela, 2015; Guerry & Prinstein, 2009; Hankin & Abela, 2011). Moreover, that negative attributional style has been linked with both onset (Hankin & Abela, 2011) and recurrence (Barrocas et al., 2015; Guerry & Prinstein, 2009) over time of NSSI, suggests it may be a relatively constant risk factor. On the other hand, the magnitude of effects when examining even these bivariate associations is fairly modest. There has been stronger evidence when examining the interaction between attributional style and negative life events (e.g., Guerry & Prinstein, 2009), corroborating the vulnerability-stress conceptualization of this cognitive risk factor.

Individuals may respond to and process negative internal experiences in maladaptive ways as well. *Rumination* (i.e., the tendency to focus on the causes, meanings, and consequences of one's negative affect and depressogenic symptoms; Nolen-Hoeksema, 1991) has often been shown to predict subsequent suicidal ideation (McLaughlin, 2013; Miller et al., 2016; O'Connor & Noyce, 2008) and NSSI (Selby, Franklin, Carson-Wong, & Rizvi, 2013). It has, in some cases, predicted suicidal ideation controlling for relevant covariates such as depressive symptoms and history of suicidal ideation (O'Connor & Noyce, 2008); others have shown rumination is not as robust a predictor as negatively-valenced thought content (e.g., entrapment; McLaughlin, 2013) or negative self-referent encoding (Burke et al., 2016). Researchers have increasingly explored whether specific subtypes of rumination may be more predictive than others. Findings are mixed, such that some studies report stronger effects for the brooding subtype of rumination (O'Connor & Noyce, 2008), whereas others report the predictive validity of both brooding and reflection subtypes (Miranda & Nolen-Hoeksema, 2007).

3.1.2.3. Summary. Much of the cognitive risk factor literature has been

dedicated to the study of negatively-valenced cognitive risk factors. Negative thought content and negative information processing biases frequently predict SITB outcomes above and beyond other common and conceptually overlapping risk factors, such as depression, although the overall effects are modest. In contrast to SITB-themed cognitive risk factors, most negatively-valenced cognitive risk factors are measured via self-report.

3.1.3. Cognitive deficits

Cognitive deficits are not characterized by thematic thought content or negative valence, and account for a smaller proportion of the cognitive risk factor literature than negatively-valenced cognitive risk factors. These deficits, further described below, fall under the domains of executive functioning, impulsivity, and intelligence. This review complements prior cross-sectional work on frequently examined cognitive deficits for SITBs (e.g., executive attention, memory; Keilp et al., 2013; Richard-Devantoy et al., 2014).

3.1.3.1. Executive functioning. Specific features of executive functioning, such as cognitive inflexibility (i.e., difficulty shifting between tasks, operations, or sets), have been prospectively examined in reference to suicidal ideation in recent years. Miranda and colleagues demonstrated that greater cognitive inflexibility (via perseverative errors on the Wisconsin Card Sorting Test) predicts subsequent suicidal ideation (Miranda et al., 2012; Miranda et al., 2013). Executive functioning may play a significant yet distal role, as its association with suicidal ideation has been shown to be mediated by negatively-valenced cognitive processes (e.g., recent brooding rumination; Miranda et al., 2013). These findings reveal small to moderate effect sizes, though in combination with other risk factors (e.g., suicide attempt history) yields larger effects (Miranda et al., 2012). To date, associations between other features of executive functioning and suicide attempt have been examined cross-sectionally and have revealed mixed findings, with some demonstrating significant associations with history or lethality of suicide attempt (e.g., Bartfai, Winborg, Nordström, & Åsberg, 1990; Keilp et al., 2013; McGirr, Dombrowski, Butters, Clark, & Szanto, 2012).

3.1.3.2. Impulsivity. Impulsivity is a multifaceted construct whose components (e.g., behavioral disinhibition, risky decision-making, delay discounting) can be captured by an array of behavioral and self-report measures. Studies examining how these discrete components relate to SITB outcomes are limited to cross-sectional investigations (Glenn & Klonsky, 2010; Janis & Nock, 2009). The present review reveals that in the past 10 years, prospective studies examining impulsivity and SITB outcomes have solely explored trait impulsivity, which is assumed to reflect personality features and is captured via self-report (e.g., *Barratt Impulsiveness Scale*, *UPPS Impulsive Behavior Scale*; Patton, Stanford, & Barratt, 1995; Whiteside & Lynam, 2001). Research in this area has revealed a consistently modest magnitude of effects. While existing prospective findings are detailed below, we note the absence of testing the prospective predictive validity of behavioral measures, which may capture more observable, discrete components of impulsivity (e.g., delay discounting, stop-signal task; Kirby, Petry, & Bickel, 1999; Logan & Cowan, 1984).

Distinct features of trait impulsivity — whether from the Five Factor Model of Personality structure (e.g., self-reported sensation seeking, perseverance, positive urgency; Whiteside & Lynam, 2001) or alternative personality structures (e.g., non-planning impulsiveness, motor impulsiveness, attentional impulsiveness; Patton et al., 1995) — have not been shown to prospectively predict either NSSI (Glenn & Klonsky, 2011; Nicolai, 2015; Riley, Combs, Jordan, & Smith, 2015) or suicidal ideation or attempt (Liu & Mustanski, 2012; Yaseen et al., 2014). There are two exceptions. One study demonstrated a weak yet significant association between premeditation/planning (i.e., tendency to act without thinking) and NSSI over time (You, Deng, Lin, & Leung, 2016). The second, perhaps more notable exception concerns negative urgency

(i.e., the tendency to act rashly in the context of negative emotions), which has been shown to modestly predict the onset and recurrence of NSSI (Black & Mildred, 2013; Riley et al., 2015; You et al., 2016). Finally, trait impulsivity as a whole (e.g., total self-report score) has not been shown to prospectively predict NSSI (Garisch & Wilson, 2016; Giletta, Burk, Scholte, Engels, & Prinstein, 2013; Nicolai, 2015) and only modestly predicts future suicidal ideation or suicide attempt (e.g., Brent et al., 2015; Giletta et al., 2013; Liu & Mustanski, 2012).

3.1.3.3. Intelligence. Intelligence and SITB outcomes have most often been studied in large, adult-based samples. These studies tend to reveal a modest and inverse relationship, such that those with low IQ are at greater risk of subsequent suicide attempt and death (Osler, Andersen, & Nordentoft, 2008; Sörberg, Allebeck, Melin, Gunnell, & Hemmingsson, 2013). How or why this association exists remains poorly understood, but it has in part been attributed to psychiatric diagnoses and subsequently low socioeconomic status (Osler et al., 2008; Sörberg et al., 2013). This inverse relationship between intelligence and SITB outcomes does not generalize to all populations. Directionality has been shown to reverse or be nonsignificant among select clinical presentations (e.g., schizophrenia; Pluck et al., 2013; Webb, Långström, Runeson, Lichtenstein, & Fazel, 2011) and younger populations (Chang et al., 2014; Rattaz, Michelon, & Baghdadli, 2015; Yates, Carlson, & Egeland, 2008). Additional nuances warrant consideration. For instance, intelligence may have differential effects on suicidal ideation, suicide attempt, and NSSI. Chang et al. (2014) found that higher IQ is associated with suicidal ideation but not suicide attempt among boys, and is not associated with either outcome among girls. Interestingly, IQ remains positively associated with NSSI regardless of gender (Chang et al., 2014). Regardless of directionality, the general association between intelligence and suicidal thoughts and behaviors has been shown to be modest.

3.1.3.4. Summary. Research prospectively examining whether cognitive deficits predict SITB outcomes has been limited. These cognitive deficits vary, and are captured through both behavioral and self-report measures. Evidence thus far suggests that cognitive deficits may play a more distal role in relation to SITB outcomes, such that they may be mediated by more proximal psychological processes (e.g., negatively-valenced cognitive risk factors) or moderated by demographic characteristics (e.g., gender).

3.2. Treatment studies

Beyond exploring whether these cognitions *predict* future SITBs, an equally urgent question is whether intervening on these cognitions *mitigates* SITB risk. Our review yielded a total of 44 treatment RCTs pertaining to this question. Most treatment approaches (80%) featured in these studies drew from cognitive behavioral principles (e.g., cognitive behavior therapy, dialectical behavior therapy, cognitive processing therapy), with a minority pertaining to some combination with pharmacotherapy or pharmacotherapy-alone (18%) or other psychotherapies (e.g. psychodynamic; 2%). These RCTs assessed either *indirect interventions* on cognition that were informed, at least partly, by existing cognitive theories of psychopathology (e.g., cognitive behavioral therapy; CBT), but did not directly measure potential cognitive processes affected by such treatment (48%); or they assessed *direct interventions* on cognition, by repeatedly measuring at least one cognitive risk factor and SITB outcome throughout the RCT (52%). A summary of findings pertaining to each treatment approach is provided below. Of note, treatment effects primarily refer to the impact on patients' suicidal ideation, since the majority (77%) of RCTs focused on this SITB outcome. Select cases of suicide attempt and NSSI outcomes are mentioned when applicable.

3.2.1. Indirect intervention on cognitive risk factors

Some studies featured interventions informed by cognitive theories of psychopathology. Our search yielded RCTs assessing CBT or CBT-informed treatments (e.g., Bateman, Hansen, Trukington, & Kingdon, 2007; Bryan et al., 2016; Goldstein et al., 2015; Ward-Ciesielski, 2015) that measured SITB outcomes over time. Since these treatment modalities at least in part draw from cognitive theories of psychopathology, they are intended to target many of the aforementioned, negatively-valenced cognitive risk factors. While most of these treatments feature individual, in-person psychotherapy, others feature adaptations to other formats (e.g., family-based; Asarnow et al., 2011; De Groot et al., 2007), delivery methods (e.g., self-guided via internet; Van Spijker, Majo, Smit, van Straten, & Kerkhof, 2012), and combinations with other treatments (e.g., selective serotonin reuptake inhibitors; Goodyer et al., 2007; March, Silva, Curry, et al., 2009; Vitiello et al., 2011).

Among these RCTs, surprisingly few studies demonstrated systematic reduction in suicidal ideation as a function of treatment (Bateman et al., 2007; Davidson, Brown, James, Kirk, & Richardson, 2014; Goldstein et al., 2015; Van Spijker et al., 2012). The most common pattern in this literature was a general decline in suicidal ideation across treatment conditions, regardless of modality (e.g., dialectical behavior therapy vs. relaxation therapy, selective serotonin reuptake inhibitor + CBT vs. selective serotonin reuptake inhibitor-only; Goodyer et al., 2007; Ward-Ciesielski, 2015; Wilkinson, Dubicka, Kelvin, Roberts, & Goodyer, 2009) or format (individual vs. group cognitive processing therapy, CBT with parents and adolescents vs. CBT with adolescents-only; Resick et al., 2017; Spirito et al., 2015). While this pattern is promising, clinically speaking, it raises the question of exactly how or why this improvement in suicidal ideation occurs, and whether this generalizes to other SITB outcomes such as suicide attempt.

3.2.2. Direct intervention on cognitive risk factors

RCTs that repeatedly measured both cognition and SITB outcomes across time most often focused on negatively-valenced cognitive risk factors, paired with repeated assessment of suicidal ideation. These studies primarily showed that CBT-informed psychotherapies mitigate hopelessness (Cottraux et al., 2009; Gradus, Suvak, Wisco, Marx, & Resick, 2013; Handley et al., 2013; Simpson, Tate, Whiting, & Cotter, 2011; Tarrier et al., 2014), dysfunctional attitudes (Lipinski, 2015), and automatic negative thoughts (Wagner, Horn, & Maercker, 2014), as well as perceived burdensomeness and thwarted belongingness (Hill, 2015). While less frequently assessed, deficits cognitive flexibility, memory, attention, and language have also been measured in RCTs. These studies have shown that both pharmacological and psychotherapies (e.g., CBT; paroxetine) are capable of improving general domains of cognition compared to their respective comparison condition (Gorlyn et al., 2015; Peters, 2010). Interesting and emerging work highlights the potential utility of ketamine treatment on SITB-related cognitions, such that ketamine may weaken the implicit association between ‘death’ and ‘self’ (Price, Nock, Charney, & Mathew, 2009). This did not seem to be the case when formally tested via RCT, though ketamine (vs. midazolam) did weaken similar implicit associations between ‘escape’ and ‘self’-related concepts (Price et al., 2014).

Despite these promising findings and potential mechanisms of treatment change, two concerning patterns emerged. First, change in cognitions seems to occur more often than actual change in suicidal ideation or other SITB outcomes such as suicide attempt (e.g., Cottraux et al., 2009; Gorlyn et al., 2015; Handley et al., 2013; Hill, 2015; Wagner et al., 2014). This pattern reminds us of the complex and, at times, seemingly intractable nature of SITB outcomes. One possible reason for this observation is that it takes less time and effort to change maladaptive cognitions compared to their subsequent clinical outcomes—thereby calling for greater dosage of treatments in their current form. Alternatively, it may be that these treatments do not target a comprehensive enough array of mechanisms to mitigate SITB risk.

While negatively-valenced cognitive processes or cognitive deficits may serve as one important treatment target, broadening the emphasis to other risk factors (e.g., SITB-themed cognitive risk factors, non-cognitive risk factors) may be a critical step. Finally, it may be the case that solely targeting cognitive processes may generally be an ineffective way to mitigate SITB risk. As described below, this last possibility has not been sufficiently tested.

A second pattern is that these RCTs rarely examine whether improvements in cognition correspond with reductions in SITB outcomes. In the very few RCTs where this link was examined (e.g., Gradus et al., 2013; Handley et al., 2013), improvement in negative cognition (e.g., hopelessness) did not correspond with improvement in suicidal ideation. Interestingly, one RCT showed that improvements in memory deficits corresponded with reduced suicidal ideation over the course of paroxetine treatment (vs. bupropion; Gorlyn et al., 2015). All in all, given that such few treatment studies have linked cognitions to SITBs, we offer the reminder that RCT designs not only have the capability to test *whether* treatments reduce SITB outcomes, but also *how* (Kazdin, 2007). In this sense, the question of whether intervening directly on cognitive mechanisms mitigates SITB risk has yet to be adequately explored.

An exciting area of treatment research explores whether cognitive risk factors may moderate intervention effects. Adaptive cognitive processes may enhance treatment effects, whereas baseline maladaptive cognition may mitigate such effects. For instance, higher-order cognitive processes such as problem-solving or executive functioning may moderate patients' response to common psychotherapeutic approaches such as CBT or dialectical behavior therapy. In a rare examination of treatment moderators in the suicide literature, Becker-Weidman and colleagues (2010) demonstrated that distinct features of problem-solving moderated the impact of treatment on suicidal ideation among youth. CBT resulted in a greater decrease in suicidal ideation among adolescents who endorsed high positive and low negative *problem-solving orientations* (i.e., awareness of problems, personal assessment of ability to solve problems, expected effectiveness of attempted solutions). Of note, an interesting consideration is whether, and in which contexts, such higher-order cognitive processes may be helpful or harmful. In another example, Secrist (2014) reported that *figural fluency* (i.e., feature of executive functioning that involves maximizing response production while avoiding response repetition) moderated treatment effects of community-based treatment led by experts on NSSI in the opposite-than-expected direction: those with greater figural fluency (i.e., better executive functioning) engaged in more NSSI. This was not the case within the dialectical behavior therapy group, leading the authors to conclude that dialectical behavior therapy may be a more appropriate treatment for those with higher baseline executive functioning.

3.2.3. Summary

There have been substantial efforts to draw from the cognitive literature to reduce SITB risk. Much of the cognitive literature has informed the design of treatments, namely CBT and associated psychotherapies. These studies largely show reductions in suicidal ideation across time. More work is needed to understand exactly how or why these patterns emerge.

4. Discussion

The present review represents the first attempt to synthesize how distinct features of cognition prospectively predict and mitigate SITB risk. In sum, it is clear that certain features of cognition help predict why people consider, desire, or act toward self-harm and death. But these findings are nuanced, leaving room for further investigation. We conclude by elaborating on some of the most prominent patterns observed in the past decade of research—with most findings pertaining to the prediction and reduction of recurrent suicidal ideation, some

pertaining to suicide attempt and NSSI, and nearly none predicting suicide death. Implications for theory and treatment, as well as directions for future research, are subsequently discussed.

4.1. SITB-themed cognitive risk factors: Promising but preliminary evidence

SITB-themed cognitive risk factors emerged as some of the most robust cognitive risk factors. This was especially true for implicit identification with death predicting suicidal ideation and suicide attempt, and less so with cutting-themed cognitions predicting NSSI. SITB-themed cognitions demonstrated incremental predictive validity above and beyond negatively-valenced cognitive risk factors, suggesting a relatively proximal role in accounting for SITB outcomes. One obvious reason why this may be the case is that SITB-themed cognitions directly pertain to death, suicide, or self-harm. Importantly, while they may share properties with actual SITB outcomes, they remain distinct from SITB outcomes themselves. The tendency to closely identify with death is different from actually desiring to die or kill oneself, for instance.

An additional strength is that SITB-themed cognitive risk factors are captured solely through behavioral measures, rather than via self-report. In this sense, SITB-related cognitions could play a critical role in predicting suicidal thoughts and behaviors. They are uniquely and proximally related to suicidal thoughts and behaviors, while at the same time resistant to many challenges facing suicide risk assessments in their current form (e.g., limited insight into suicidal intent, potential motivation to conceal intent). At the same time, the use of behavioral measures invites additional questions and concerns to address, including whether these behavioral paradigms capture their intended construct. For example, performance on the Death Implicit Association Test could capture either weakened identification with life or stronger identification with death (Harrison, Stritzke, Fay, Ellison, & Hudaib, 2014). Similarly, it remains unclear whether adaptations of the emotional Stroop task (e.g., suicide Stroop task) capture attentional bias or alternative processes (e.g., cognitive avoidance, generic slow-down; Algom, Chajut, & Lev, 2004; De Ruiter & Brosschot, 1994).

While these conclusions are promising, the findings remain preliminary. Continued testing of current and novel SITB-themed cognitive risk factors is strongly encouraged.

4.2. Negatively-valenced cognitive risk factors: Common and robust prediction of SITB outcomes

Negatively-valenced cognitive risk factors, especially negative thought content, were by far the most commonly studied risk factor. This is likely due to the central role of negative affect emphasized by existing suicide theories, whether that is through the proposed influence of hopelessness on suicide via Beck's cognitive models of depression and suicide (Beck, 1979; Wenzel & Beck, 2008) or the *Hopelessness Theory of Suicide* (Abramson et al., 2002), of entrapment and defeat through the *Integrated Motivational-Volitional Model of Suicide* (O'Connor, 2011), or of perceived burdensomeness and thwarted belongingness through the *Interpersonal-Psychological Theory of Suicide* (Joiner, 2005). These negatively-valenced cognitive risk factors have received widespread attention, largely in relation to suicidal ideation, although select risk factors (e.g., attributional bias) have been explored in relation to other SITB outcomes such as NSSI.

In several cases, negatively-valenced cognitive risk factors did not seem otherwise accounted for by negative mood or other symptoms of depression. This suggests that although much of this work derives from the depression literature (Beck, 1979), specific aspects of cognition clearly contribute to SITB risk above and beyond depression itself. Negatively-valenced cognitive processes thereby add incremental value to our understanding of SITB risk. There is also evidence that the wide array of negatively-valenced cognitive risk factors are not synonymous and that each may play a unique, albeit modest, role in predicting SITB

outcomes.

Regarding magnitude of effects, the general association between negatively-valenced cognitive risk factors and SITB outcomes ranges from modest to strong when significant. But this pattern emerges about half of the time, with the other half of the time revealing small effects and null results. This is consistent with a recent meta-analysis (Franklin et al., 2017), concluding that when taking all findings into account, even some of the strongest individual risk factors for suicidal thoughts and behaviors (e.g., prior history of suicidal thoughts and behaviors, family history, internalizing disorders) were modestly predictive on average. The present results do not minimize the importance of negatively-valenced cognitive risk factors, but instead call to attention the complexity of SITB outcomes and the importance of considering the combined (vs. individual) effects of risk factors within and beyond cognition.

4.3. Cognitive deficits: Mixed and potentially distal risk factors

Cognitive deficits have received substantial empirical attention over the past decade, but yield mixed findings and reveal several knowledge gaps. Regarding magnitude of effects, modest findings emerged when examining potential risk factors of executive functioning and impulsivity. And while some cognitive deficits (e.g., related to intelligence) may help predict suicidal behaviors (suicide attempt, suicide death), mixed directionality and distal associations potentially mediated by other risk factors limit their utility at present. Another observation was that cognitive deficits well-established in the cross-sectional suicide literature (e.g., executive attention; Keilp et al., 2013; Keilp, Gorlyn, Oquendo, Burke, & Mann, 2008) have not been prospectively examined within the past decade.⁴ This was also the case with impulsivity, such that behaviorally observable, discrete components of impulsivity have been measured cross-sectionally but not yet prospectively (Glenn & Klonsky, 2010; Janis & Nock, 2009). In this sense, the overall picture of cognitive deficits as *risk factors* (vs. correlates) remains underexplored.

4.4. Implications for theory

The recent body of work has several implications for SITB theories. The present findings suggest that examining negative thought content—a central component of many SITB theories—offers a unique lens on through which to examine SITB outcomes beyond depression. That being said, these risk factors still only modestly explain SITB outcomes. Theories that readily connect negative cognitions with more robust risk factors (e.g., SITB-themed cognitions) may be most promising and informative. The *Cognitive Model of Suicide* (Wenzel & Beck, 2008), for instance, proposes that the interaction between state hopelessness and attentional bias toward suicide leads to a fixation on suicide and escape that accelerates the likelihood of suicidal ideation. A beneficial direction for future research would be to explore how implicit identification with death relates to negative cognitions in the prediction of SITB outcomes. To date, these potential connections have not been empirically tested.

Relatedly, individual theories about SITBs have yet to be integrated or concurrently tested. Most existing theories highlight a sequence and/or combination of contributing factors, and require more comprehensive testing to elucidate complex pathways to SITB outcomes. In addition to examining models in their totality, continued work in this area could shed light on how to integrate distinct theoretical models. For instance, Kleiman et al. (2014a) aimed to bridge the gap in the

⁴ These findings should be considered separately from research on attentional bias toward suicide and death using the Suicide Stroop task (Cha et al., 2010; Chung & Jeglic, 2017), given the differences between the basic Stroop task and the adapted emotional/modified Stroop task (e.g., Algom et al., 2004).

literature by examining an integrated model of the *Hopelessness Theory* and the *Interpersonal-Psychological Theory of Suicide* and found that their integrated model served as a robust predictor of subsequent suicidal ideation. Studies examining the association between multiple theoretical models are needed in order to better understand SITB risk.

4.5. Implications for treatment

Findings from both the risk factor and treatment literature yield three key implications for enhancing SITB interventions. First, treatment approaches are encouraged to even more directly target SITB-themed cognitions. A promising strategy that targets related SITB-themed cognitive processes is *Therapeutic Evaluative Conditioning*, which is designed to reduce maladaptive attributions made about oneself and about self-injury (Franklin et al., 2017). In aiming to decrease negative attributions about oneself and increase negative attributions about self-injury, it has been shown to reduce suicidal and nonsuicidal self-injurious behaviors. While Therapeutic Evaluative Conditioning does not precisely target implicit identification with death (Payne & Lundberg, 2014), its relevance to SITB-themed cognitions suggests that similarly designed paradigms may reduce SITB outcomes in the future.

Second, delivery of cognitively-informed treatments should be paired with the repeated assessment of relevant cognitive processes. Since cognitive behavioral approaches are often applied when treating suicidal and self-injurious individuals, systematically assessing implicated cognitions can enhance understanding of potential mechanisms of treatment change. Identifying the most active ingredients of psychotherapies can inform efforts to streamline and disseminate evidence-based psychotherapies in the future (Kazdin, 2007).

Third, providers are encouraged to consider patients' baseline cognitive abilities when designing a course of treatment. Preliminary research points to the potential moderating effects of baseline cognition on treatment success (e.g., problem-solving abilities, executive functioning; Becker-Weidman et al., 2010; Secrist, 2014). Indeed, the effects of psychotherapeutic treatments for depression have been shown to be moderated by patients' cognitive functioning (e.g., Huibers et al., 2015; Sotsky et al., 1991). Similar efforts within the SITB field may help match self-injurious and suicidal patients with the most optimal treatment approach.

5. Future directions

In response to the aforementioned knowledge gaps, we make the following recommendations to guide future research.

5.1. Examine a broader spectrum of SITB outcomes

We recommend that greater priority be placed on the prediction of and transitions across multiple SITB outcomes. Since nearly all of the present risk factor papers focused on a single SITB outcome—most often, recurrence of suicidal ideation—the field at present cannot adequately address this knowledge gap. There is an urgent need to better understand how individuals progress on the pathway to suicide (e.g., Millner, Lee, & Nock, 2017). Relatedly, future work is encouraged to prioritize onset (vs. recurrence) of SITB outcomes, as well as the prediction of suicide attempt and suicide death.

Studies that would most directly fulfill this recommendation are those that directly compare different SITB groups (e.g., suicide ideators who do vs. do not go on to attempt suicide). Expanding the study of SITB outcomes may be challenging, as ideally this would involve very large sample sizes to capture outcomes with lower base rates (e.g., suicide attempt). But it remains achievable with more modest samples sizes by shifting focus toward two population profiles: those who currently have low clinical severity but are known to be at risk for the onset of a SITB outcome (e.g., those with a family history of suicide attempt or death; those with a history of maltreatment or peer victimization),

and those who currently have high clinical severity and may be at elevated risk of attempting suicide or death (e.g., within the post-hospital discharge period; within the first year of suicidal ideation onset). These approaches will help delineate the types of cognitive risk factors that precipitate versus maintain SITB outcomes, and those that predict transition to more severe, life-threatening outcomes, respectively.

5.2. Test for individual differences

We recommend identifying characteristics that may moderate the impact of cognition on SITB outcomes. Inconsistent and modest results in the present literature call for a shift from asking *what* predicts SITB outcomes to *when* and *among whom* prediction is most accurate. We recommend prioritizing three sets of moderators: psychological factors, environmental factors, and demographic factors. Exploring the moderating role of psychological factors would involve understanding which cognitive features interact with one another and with other psychological processes. Since negatively-valenced cognitive risk factors emerged as the most commonly studied cognitive risk factor, exploring the intersection between cognition and affect may be especially worthwhile. Initial studies of cognitive processes (e.g., implicit identification with death, problem-solving) interacting with affective processes (e.g., negative mood, emotion reactivity) have indeed proven to be fruitful (e.g., Cha et al., 2018; Dour, Cha, & Nock, 2011).

Beyond this, exploring the moderating role of environmental factors would complement the diathesis-stress dynamic implied by several suicide theories (Abramson et al., 2002; Wenzel & Beck, 2008). Initial results are promising, where, for instance, negative attributional style has been shown to significantly interact with stressful life events to predict NSSI (e.g., Guerry & Prinstein, 2009). Interactions with environmental factors are not always significant (e.g., Crane et al., 2016), so determining exactly which cognitive risk factors interact with which environmental stressors is an important area for future work.

Finally, testing the moderating role of demographic characteristics could inform the extent to which present findings generalize to diverse populations. Thus far, the most commonly examined demographic characteristic within this literature is gender. For example, Voon et al. (2014b) found that boys with deficits in cognitive reappraisal had an increased risk of engaging in NSSI in mid-adolescence, while this was not the case for girls. Authors propose that this may reflect maturation in emotion regulation coinciding with this period that is delayed in boys. Another study assessing cognitive processes during early- to mid-adolescence found that gender moderated the association between negative self-referent information processing and suicidal ideation, such that this cognitive bias was only predictive of suicidal ideation for early-adolescent girls (Burke et al., 2016). Beyond the potentially moderating role of gender, more work on other demographic characteristics (e.g., age, race, ethnicity, socioeconomic status) is sorely needed.

5.3. Establish a (truly) developmental perspective on cognitive risk factors

There is a paucity of research that examines how the maturation of cognitive processes may affect SITB risk across the lifespan. Drawing foundational knowledge and practices from the developmental literature is a critical step toward investigating how these trajectories may differentially affect risk. The developmental literature informs us that non-linear growth of cognitive and emotional processes may relate to impulsive and risky behavior during adolescence (Galvan, Hare, Voss, Glover, & Casey, 2007). Specifically, Casey and colleagues (2008) found that the limbic system—associated with emotion and drive—rapidly matures during adolescence, whereas the prefrontal cortex—associated with self-control and self-regulation—continues to develop through early adulthood. This non-linear development thereby results in adolescents' underdeveloped ability to regulate their emotions and impulses in a way that is distinct from childhood and adulthood (Casey

et al., 2008).

Adopting methodology from the developmental literature may also help shed light on possible age effects observed within the SITB literature. The developmental literature emphasizes the importance of capturing individual variability and trajectories over time (vs. static snapshots), ideally made possible through longitudinal studies (Casey et al., 2008). Applying this to the SITB literature, study designs that measure cognitive processes multiple times throughout childhood and adolescence may better capture individual variability and development of cognitive abilities in relation to SITB outcomes.

5.4. Examine short-term prediction models

Finally, we recommend adopting methodologies that allow for the short-term (i.e., within a few hours or minutes) prediction of SITB outcomes. This would complement the current literature, which largely addresses whether features of cognition predict SITB outcomes occurring months or years later. Ecological momentary assessment (EMA) study designs (i.e., moment-to-moment and/or daily monitoring of risk factors and SITB outcomes) would be optimal when attempting to understand the short-term temporal association between cognition and SITBs. Preliminary work in this area suggests that unique knowledge can be gained through this approach. For example, Kleiman and colleagues (2017) conducted an EMA study involving negative thought content (e.g., hopelessness, perceived burdensomeness) and suicidal ideation. The results indicated that these negative cognitions frequently and dramatically varied within a span of hours and were, in fact, minimally predictive of short-term changes in suicidal ideation. EMA and real-time monitoring approaches are increasingly feasible through the use of smartphones and emerging technologies (e.g., biosensors), and represent a promising avenue toward identifying proximal risk factors.

6. Limitations

We present this review in light of several caveats. First, although magnitude of effects was discussed, this was based on the authors' reading of individual studies rather than the formal coding of effect sizes. Without such coding or a formal meta-analysis, conclusions about effect sizes should be interpreted with caution. Second, this review only captures recently (2007–2017) explored cognitive risk factors for SITB outcomes. There are notable longitudinal studies published prior to the relevant time frame as well as innovative cross-sectional studies that are not included here.

7. Conclusions

Despite these limitations, the present paper offers numerous strengths. Most notably, it merges the often isolated dialogues around how cognition may be associated with SITB outcomes. By capturing a uniquely broad range of cognitive risk factors, we have identified: (1) areas of cognition most frequently emphasized by the SITB literature, (2) how these cognitive processes are most often assessed, and (3) specific ways to advance this area of research. Continuing the tradition of examining the cognition-SITB link—and taking stock of both its strengths and limitations thus far—is strongly encouraged to help understand and prevent these prevalent, dangerous, and perplexing clinical outcomes.

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Conflicts of interest

None.

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