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Recurrent negative autobiographical memories and mental health

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Abstract

Background: Recurrent symptom-relevant negative autobiographical memories are common in patients with emotional disorders such as anxiety and depression, even among those without a trauma-related diagnosis. Recurrent negative autobiographical memories may also contribute to distress in non-clinical populations.

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Declaration of Competing Interest

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.xjmad.2024.100074.

Methods: To examine the prevalence of recurrent negative autobiographical memories and associated psychological features, we recruited a student sample ($n = 101$) and a treatment-seeking sample of patients with emotional disorders ($n = 123$). We hypothesized that recurrent negative autobiographical memories would be associated with higher levels of psychological symptoms and rumination. We also conducted exploratory analyses of participants' most bothersome memory.

Results: In each sample, individuals who endorsed recurrent negative autobiographical memories had significantly higher depression, anxiety, and stress symptoms as well as greater rumination. In the treatment-seeking sample, where memories also had to be identified by patients as symptom-relevant, those who endorsed memories also had significantly higher clinician-rated symptom severity for their primary diagnosis. The majority of participants in each sample endorsed moderate or greater re-experiencing (sample 1: 79 %, sample 2: 66 %) and avoidance symptoms (sample 1: 78 %, sample 2: 58 %) related to their most bothersome memory.

Conclusion: Recurrent negative autobiographical memories relate to mental health symptoms in both clinical and non-clinical samples. Further research should explore whether targeting such memories reduces distress or improves wellbeing in these populations.

Keywords

Autobiographical; Memory; Anxiety; Depression; Emotional disorders

1. Introduction

An individual got divorced two years ago, and since then, they have been feeling depressed and anxious and experiencing recurrent memories of a particularly bad fight with their partner. Another experienced a panic attack while flying across country last year and similarly endorses upsetting recurrent memories of this attack when preparing for upcoming work trips and worsening of their fear of flying since that event. Given that these events do not meet the DSM-5-TR [1] criteria for trauma, and they occurred over 6 months ago, these individuals would not be diagnosed with posttraumatic stress disorder (PTSD) nor an adjustment disorder. Instead, their current symptoms of depression and anxiety may result in diagnosis of a depressive or anxiety disorder. But what about the recurrent memories they are experiencing? Do these patients differ from others who cannot recall an event associated with the onset or worsening of their symptoms? Should these memories be directly targeted in treatment? Although memories such as these are not a prerequisite for any diagnosis, they may still play a role in the etiology and/or maintenance of emotional disorders [2-4]. Further, understanding the characteristics and impact of such memories, could assist with treatment targeting and development.

Given the high prevalence rates of emotional disorders [5-8] and the non-response rates to current evidence-based treatments [9,10], there is a need to identify transdiagnostic factors that could influence treatment response and possibly be used to personalize treatment [11,12]. Recurrent (i.e., thought about frequently), symptom-relevant negative autobiographical memories (SNAMs²) could be one such factor [2-4, 13]. Examples

²NAMs = Negative Autobiographical Memories; SNAMs = Symptom-Relevant Negative Autobiographical Memories

of SNAMs include memories of social humiliation in social anxiety disorder (SAD) [14,15], negative encounters with a feared stimulus in specific phobia [16,17], memories of contamination experiences in obsessive compulsive disorder (OCD) [18,19], and personal losses or setbacks in depression [2,20]. Some SNAM-focused techniques are described within evidence-based treatments (e.g., restructuring of early memories; [21]), however, they are not integral to those treatments. In contrast, targeting SNAMs is more central to some newer treatments, such as imagery rescripting [22]. More research on the prevalence, characteristics, and impact of SNAMs could help inform existing treatment strategies and the development of new strategies.

Evidence suggests that SNAMs are highly prevalent across emotional disorders and associated with distress and other psychological symptoms [2-4,13]. For example, SNAMs of negative social events are reported by 89–94 % of adults with SAD, and when studies qualify that memories of these events must also be experienced as intrusive, rates of 53–97 % are still reported [14,15,23-31]. Intrusive autobiographical memories are also common in specific phobia (38–67 %) [16,32] and depression (90–96 %) [33,34]. Further, some studies of individuals with SAD [35,36] and panic disorder [36] found that these individuals report more distress at the time of SNAM events than healthy individuals with similar experiences. The impact, however, is not just relegated to the moment the event is lived. Memories of these types of events contain more negative affective content in anxiety patients relative to comparison samples [30,37,38]. Additionally, many studies have found that patients' memories are associated with greater distress and negative emotions upon recall [2,28,30,36,37], and some [28,37,39], but not all [40-43], studies have found a link between SNAMs and symptom severity. Further, despite these memories not meeting the DSM definition of trauma, they often lead to PTSD-like symptoms of intrusive thoughts, avoidance, and thoughts of self/other blame [14,15,44]. For example, one study [14] found that 1/3 of patients with SAD who reported socially "traumatic" events, would be diagnosed with PTSD if these events were considered traumas (i.e., meeting DSM criterion A). Further, recurrent negative autobiographical memories (NAMs) have also been observed in non-clinical community samples and shown to be associated with posttraumatic stress (PTS) symptoms [45]. Additionally, although there is research to suggest that having depression or anxiety may make individuals more apt to recall negative autobiographical events [3,46], there is some initial evidence to suggest that intrusive SNAMs predict symptoms over time above and beyond current symptoms [47-49] and that treatments that target SNAMs lead to symptom improvement [22]. These latter findings make it less likely that SNAMs are simply an epiphenomenon of having anxiety or depression, although further research in this area is needed.

Many studies in this domain have limited the scope of investigations of NAM/SNAMs, thereby limiting a clear understanding of the full impact of these memories on emotional functioning. For example, many studies restrict participants to reporting specific types of events (e.g., bullying in SAD, conditioning events in specific phobia), rather than allowing participants to self-identify events they find bothersome and/or believe are related to their symptoms. Broader assessment may allow for better characterization of the types of NAM/SNAMs that contribute to distress and might be beneficial to target in treatment. Additionally, prior studies have mainly focused on single diagnoses (e.g., SAD; see

exception [36]) or symptom dimension (e.g., SAD symptoms), despite a larger effort to examine transdiagnostic factors that could influence treatment outcome [50,51]. Lastly, few studies have examined whether there is a relationship between reporting such memories and rumination, a trait that is associated with symptoms of emotional disorders and may also relate to whether individuals are likely to dwell on past negative life events [52-54]. Better understanding the link between the presence and characteristics of NAM/SNAMs and symptom severity and rumination may help clarify the potential value of addressing such memories in treatment.

The current studies examine the prevalence of recurrent NAMs in a student sample (Study 1) and recurrent SNAMs in a treatment-seeking sample of patients with emotional disorders (Study 2). We hypothesize a priori that endorsement of such memories will be associated with higher symptom severity and rumination. We also explore the characteristics (e.g., vividness, distress at the time of the memory event) and impact (e.g., memory-related current distress and PTS symptoms) of individuals' most bothersome NAMs/SNAMs.

2. Material and Methods

All procedures were performed in compliance with relevant laws and institutional guidelines, approved by the appropriate institutional review board (Study 1: New York University #2016-2, 11/27/18; Study 2: Boston University #5012E, 2/4/19), and carried out in accordance with The Code of Ethics of the World Medical Association. These studies were not pre-registered.

2.1. Study 1

2.1.1. Participants—Undergraduate students ($n = 101$) at New York University were recruited via Sona Systems between February and March of 2019. Criteria for entry were fluency in English and completion of the survey through the key memory question (described below).

2.1.2. Procedures and Assessments—Participants provided informed consent or assent (with parental consent) prior to completing the study assessments anonymously via Qualtrics in the order listed below. After study completion, participants were granted course credit.

2.1.2.1. Demographics and psychological symptoms. Participants completed a demographics questionnaire followed by the Depression Anxiety Stress Scale-21 (DASS-21), which has been shown to be valid and reliable in non-clinical and clinical populations [55,56]. Participants self-reported lifetime mental health diagnoses and current treatment engagement. Participants also completed the Ruminative Responses Scale (RRS-10) a validated measure of rumination comprised of two subscales: 1) brooding, which is thought to capture dwelling on problems and 2) reflection, which is thought to capture contemplation [57-59].

2.1.2.2. Recurrent NAMs questionnaire. Next, participants completed a questionnaire that the authors designed to assess recurrent NAMs [60], beginning with the key memory

question: “Do you have any memories of specific negative experiences that you have thought about at least 3 times in the past 6 months?” If participants endorsed such recurrent NAMs, they were asked how many they had and to identify their most bothersome NAM. Subsequently, they were asked to write a brief narrative and answer follow-up questions about their most bothersome NAM.

2.1.2.2.1. Most bothersome NAM characteristics.: Participants were asked the age at which the NAM event occurred. They were asked to rate their distress at the time of the event or immediately after (whichever was highest) on a scale from 0 (not at all) to 10 (severely), vividness of their NAM on a scale from 0 (no image at all) to 10 (extremely vivid), and the frequency at which they think about the NAM.

2.1.2.2.2. Most bothersome NAM impact.: Participants were asked to provide a rating of distress associated with the NAM at the time of recall (0–10 as above). To assess for NAM-related psychological symptoms, participants were asked to complete the event-related items (1–8 and 10) from the past month version of the PTSD Checklist for DSM 5 [61, 62] listed in Table 2. We call these “NAM-related PTS symptoms,” however, it is important to remember that the DSM 5 Criterion A was not met in most of these cases as we were specifically interested in the impact of non-Criterion A events (see Sensitivity Analyses).

2.1.3. Data Preparation and Analysis

2.1.3.1. Associations Between Recurrent NAM Endorsement and Psychological Symptoms.: We compared participants who did and did not endorse recurrent NAMs. Given a significant gender difference between the groups, ANOVAs covarying for gender were used for normally distributed outcomes and Mann Whitney U tests, with follow up analyses only within female participants, were used for non-normally distributed outcomes. Endorsement of recurrent NAMs was examined in relation to self-reported symptom severity (i.e., DASS-21) and rumination (i.e., RRS-10). For both measures, the total score was considered our primary outcome. This is justified for the DASS-21 given the high comorbidity of anxiety, depression, and stress symptoms, and a recent meta-analysis [63] that questions the original 3-factor scale structure. Regarding the RRS-10, given limited research on the relationship between different types of rumination and autobiographical memory recollection [64], and the fact that theoretically both types of rumination (i.e., brooding and reflection) could potentially impact memory consolidation/reconsolidation, we chose the total score as our primary outcome. Subscale scores, however, are also reported. Of note, one participant was missing a response to one item on the DASS-21; the mean of their responses to the other items in that subscale was used for imputation. Analyses were conducted with and without statistical outliers (i.e., data points > 1.5 times the inter-quartile range [IQR]). Effect sizes (*Cohen’s d*) were calculated using Psychometrica [65].

2.1.3.2. Exploratory analyses of most bothersome NAM-related outcomes.: Within the subset of the sample that endorsed NAMs, additional most bothersome NAM-related outcomes were examined. For normally distributed variables, means and standard deviations are presented. For variables not normally distributed based on a Shapiro-Wilks test, medians and IQR are presented. Two independent raters categorized NAM narratives based on the

most central of 13 themes outlined in Fig. S1. The 13 themes were originally derived from an initial review of the memories and discussion amongst the authors. If a NAM met the DSM-5-TR definition of a Criterion A trauma, however, that theme was assigned over all others. Cohen's kappa was .79 indicative of satisfactory interrater reliability, and disagreements were reconciled by a third author. For NAM-related PTS symptoms, any symptoms rated as moderate or higher were considered endorsed [61,62]. A total score as well as re-experiencing (items 1–5), avoidance (items 6–7), and negative alterations in cognition (item 8 & 10) subscale scores were calculated by summing responses.

2.1.3.2.1. Correlations between most bothersome NAM characteristics, impact, and symptoms.: Given non-normal distributions and some ordinal outcomes, we used a nonparametric correlation (Spearman's rho) to examine the strength and significance of the relationship between the various NAM characteristics, impact, and symptom variables. Given prior research on disclosure and PTSD [66,67], we also examined whether participants who told others about their NAM event differed from those who did not regarding NAM-related distress or PTS symptoms. A multiple regression was run to predict DASS-21 scores from NAM-related PTS symptom total score, frequency of thinking about the memory, distress upon recall, distress at the time of the event, and memory vividness. To understand what type of NAM-related PTS symptoms were most predictive of DASS-21 scores, we conducted additional regressions replacing the NAM-related PTS symptom total score with each subscale score (e.g., NAM-related re-experiencing). This was done over including all subscales in the model as these subscales are strongly correlated with each other.

2.1.3.3. Sensitivity analyses.: Because we were especially interested in NAMs not captured by Criterion A trauma specifications, analyses were repeated after excluding individuals with a self-reported trauma-related diagnosis or a NAM narrative that was categorized as a Criterion A trauma if these data were available. Two participants endorsed recurrent NAMs but chose not to write a narrative about their most bothersome NAM; these individuals were not excluded from sensitivity analyses.

2.2. Study 2

2.2.1. Participants—Participants were adults ($n = 162$) seeking diagnostic evaluation and/or treatment at the Boston University Center for Anxiety and Related Disorders (CARD) between April 2019 and December 2021. CARD is an outpatient clinic serving the greater Boston community, specializing in CBT for emotional disorders. Beyond the eligibility criteria described for Study 1, participants had to be suitable for CARD services (i.e., absence of psychotic or bipolar disorders, severe substance use, or severe suicidal thoughts/behaviors) and have completed a diagnostic assessment at CARD that included trauma and stressor-related disorders.

2.2.2. Procedures and assessments—Patients provided informed consent prior to completing the study assessments via Qualtrics in the order listed below. After study completion, participants were compensated \$10.

2.2.2.1. Demographics and psychological symptoms.: In addition to the questionnaires described for Study 1, demographics, diagnoses, and date of intake were extracted from CARD charts. Approval to collect date of intake was only received midway through the study, so some participants are missing this variable. Diagnostic assessments at CARD are conducted by trained MA-level or higher clinicians. Standard practice at CARD is to use the Anxiety and Related Disorders Interview Schedule for DSM-5 [68] for diagnosing, however, on rare occasions this may have been supplemented or replaced by unstructured clinical interviewing. For each diagnosis assigned, a Clinician Severity Rating (CSR) between 0–8 is given representing symptom severity, with 4 and higher typically indicating that clinical threshold for diagnosis.

2.2.2.2. Recurrent SNAMs questionnaire.: We modified the memory questionnaire described above to capture recurrent SNAMs [60]. Participants were first asked what mental health difficulty/ies they are experiencing and then: “*Do you have any memories of specific negative experiences that you believe may be related to your mental health difficulty/difficulties?*” If they said yes, they were asked: “*How many of those memories have you thought about at least 3 times in the past 6 months?*” Participants who answered at least 1 to this second question were categorized as endorsing recurrent SNAMs, asked to choose their most bothersome SNAM, and complete the follow-up questions about it. Additional questions regarding SNAM timing in relation to the onset of mental health difficulties and the Covid-19 pandemic were asked.

2.2.3. Data preparation and analysis—The same methods described for Study 1 were used. In addition to self-reported symptoms, CSRs were also examined as an outcome. For coding of SNAM narratives, Cohen’s kappa was .90. Sensitivity analyses were conducted after excluding individuals with a clinical (CSR ≥ 4) or sub-clinical (CSR < 4) diagnosis of a trauma-related disorder or a SNAM narrative that was categorized as a Criterion A trauma if available. Narratives were only available for 44 % ($n = 45$) of the participants who endorsed a memory due to Title IX restrictions. Title IX is a United States federal law that prohibits discrimination based on sex and sexual misconduct on university campuses. In accordance with Title IX, Boston University employees must report any instance of sexual misconduct to the university. Midway through Study 2, when we determined that information collected through research was subject to this policy, we reconsented participants, provided them with relevant information about Title IX as a limitation to their confidentiality, and gave them the option to have their original memory narrative included in the study or destroyed. Two participants requested their narratives be destroyed and others could not be reached, so their narratives were also destroyed.

3. Results

3.1. Study 1

3.1.1. Sample characteristics—One hundred and one participants completed the study through the key memory question. Significantly more individuals identifying as women (77 %) than men (47 %) reported recurrent NAMs, $p = .022$. Other demographic factors (Table 1) did not differ between those who did and did not report recurrent NAMs, $ps > .162$.

The median DASS-21 scores were in the moderate range for anxiety and normal range for depression and stress symptoms, and rates of mental health diagnoses and treatment were low (Table 1).

3.1.2. Outcomes

3.1.2.1. Prevalence.: Seventy-one percent of participants endorsed recurrent NAMs, the majority (72 %) of which endorsed having between 1 and 3 such NAMs.

3.1.2.2. Associations between recurrent NAMs endorsement and psychological symptoms

3.1.2.2.1. DASS-21.: Participants who reported recurrent NAMs ($n = 72$) scored significantly higher on the DASS-21 than participants who did not ($n = 29$), $U = 698$, $p = .009$, $d = 0.54$. This effect was maintained even after excluding two outliers, $U = 698$, $p = .015$, $d = 0.51$, and also when only examining participants who identified as female ($n = 82$), $U = 397$, $p = .027$, $d = 0.50$ (Fig. 1 and Table S2).

3.1.2.2.2. RRS-10.: Participants who reported recurrent NAMs scored significantly higher on the RRS-10 than participants who did not, $F(1, 98) = 5.74$, $p = .019$, $d = 0.53$. This effect was primarily driven by differences on the reflection subscale, $F(1, 98) = 6.84$, $p = .010$, $d = 0.58$, rather than the brooding subscale, $F(1, 98) = 2.66$, $p = .106$ (Fig. 2; Table S2).

3.1.2.2.3. Self-reported mental health diagnoses/treatment.: The rate of self-reported past mental health diagnosis and current treatment did not differ between participants who did and did not report recurrent NAMs, $ps > .144$.

3.1.2.3. Exploratory analyses of most bothersome NAM-related outcomes.: Of those who endorsed recurrent NAMs ($n = 72$), one did not go on to complete follow up questions about their most bothersome NAM so they are not included in those specific analyses.

3.1.2.3.1. Characteristics.: The participant's age when the NAM event occurred varied from 5.5 to 22 years old (Median = 18; IQR = 2). Based on the participants' reported age at the time of study completion, we were able to approximate the time since the NAM event occurred, which varied between 0 and 14.5 years prior (Median = 1, IQR = 2). Distress at the time of the NAM event or shortly after was rated to be high (Median = 9; IQR = 2), as was NAM vividness (Median = 8; IQR = 2). NAMs were largely about relationship issues/difficult interactions (47 %), followed by academic or work issues (17 %), incidents related to participant mental health (13 %), and Criterion A traumatic events (11 %; Fig. S1). Most participants (66 %) reported that they thought about their most bothersome NAM at least once a week, with smaller portions reporting thinking about it once a month (22 %), or less (11 %).

3.1.2.3.2. Impact.: Median distress upon NAM recall was rated to be moderate (Median = 6, IQR = 3). The NAM was associated with some PTS symptoms over the past month for most participants: 42 % reported 5 or more, 48 % reported 1–4 %, and 10 % did not report any of the 9 NAM-related PTS symptoms assessed, at a level of moderate or

higher. Regarding symptom type, 79 % endorsed at least one NAM-related re-experiencing symptom, 78 % endorsed at least one NAM-related avoidance symptom, and 63 % endorsed at least one NAM-related alteration in cognition at a level of moderate or higher. Other characteristics and impact outcomes are presented in Table 2.

3.1.2.3.3. Correlations between most bothersome NAM characteristics, impact, and symptoms.: A full correlation matrix is presented in Table 3. Participants who had (73 %) and had not (27 %) told other people about their event did not differ in terms of NAM-related PTS symptoms or distress upon recall ($ps > .498$). The multiple regression predicting DASS-21 scores resulted in a significant model, $R^2 = 0.26$, $F(5, 65) = 4.55$, $p = .001$. NAM-related PTS symptoms as the only significant predictor, $B = 1.32$, $SE = .38$, $sr = .14$, $p = .001$. As a reminder, our NAM-related PTS symptoms scale only included memory-related items, not other general PTS symptoms which might be expected to correlate with DASS-21 symptoms. Further analyses revealed that all NAM-related PTS symptom clusters (i.e., NAM-related re-experiencing, $B = 1.85$, $SE = .65$, $sr = .10$, $p = .006$; NAM-related avoidance, $B = 3.62$, $SE = 1.14$, $sr = .12$, $p = .002$; and NAM-related negative alterations in cognition, $B = 2.99$, $SE = 1.39$, $sr = .06$, $p = .035$; Model $ps = .003-.022$) predicted DASS-21 symptoms.

3.1.2.4. Sensitivity analyses.: All analyses were repeated after excluding 9 participants with a trauma diagnosis and/or narrative. For this subsample ($n = 92$), the rate of participants endorsing recurrent NAMs was 68.5 % and all the significant differences between those who did and did not endorse recurrent NAMs, correlations, and regressions were maintained, except the comparison of DASS-21 scores for female participants ($n = 74$) who did and did not endorse recurrent NAMs was reduced to a strong trend, $U = 366.5$, $p = .053$, $d = 0.46$. Effect sizes for differences between those who endorsed recurrent NAMs and those who did not on the DASS-21 and RRS-10 scales were slightly smaller but still in the moderate range. Effect sizes for correlations stayed in the moderate range (Tables S3-S5).

3.2. Study 2

3.2.1. Sample characteristics—Of the participants who signed consent ($n = 162$), 147 completed the questionnaire through the key memory questions. Twenty-four additional participants were excluded due to not having any diagnostic data or not completing an assessment that included trauma and stressor-related disorders, leaving a final sample of 123. Demographic factors (Table 1) did not differ between those who did and did not endorse recurrent SNAMs, $ps > .195$. Median DASS-21 scores were indicative of moderate anxiety and mild stress and depression symptoms. All but one participant was assigned at least one diagnosis and the median number of diagnoses was two (IQR=2). Across primary and co-primary diagnoses, the most common category was anxiety (68 %), followed by depressive (19.5 %), obsessive compulsive and related (13 %), and trauma- and stressor-related disorders (6 %) (Table 1 & S1). Consistent with DASS-21 scores, the median CSR rating was indicative of moderate severity (Median = 5; IQR=1).

3.2.2. Outcomes

3.2.2.1. Prevalence. Eighty-four percent of participants ($n = 103$) endorsed recurrent SNAMs and 16 % ($n = 20$) did not. Of those who endorsed recurrent SNAMs, approximately half (49.5 %) endorsed having between 1 and 3 such SNAMs. The remainder endorsed 4–10 (20.5 %) or over 10 SNAMs (30 %).

3.2.2.2. Associations between recurrent SNAMs endorsement and psychological symptoms

3.2.2.2.1. CSR and DASS-21. Participants who endorsed recurrent SNAMs had significantly higher CSRs for their primary diagnosis/es, $U = 713.5$, $p = .039$, $d = 0.34$, and significantly higher DASS-21 scores, $U = 648.5$, $p = .009$, $d = 0.49$ (Fig. 1; Table S2), than participants who did not endorse recurrent SNAMs. Note, one participant was missing a CSR for their primary diagnosis so they were excluded from that analysis. Results for DASS-21 scores were maintained after removing one outlier from analyses, $U = 648.5$, $p = .010$, $d = 0.48$.

3.2.2.2.2. RRS-10. Participants who endorsed recurrent SNAMs scored significantly higher on the RRS-10 than participants who did not, $t(121) = -2.95$, $p = .004$, $d = 0.72$, an effect that was maintained even with removal of one outlier, $t(120) = -3.38$, $p < .001$, $d = 0.84$. This effect was significant for both the brooding, $U = 629.5$, $p = .006$, $d = 0.51$, and reflection subscales, $U = 652.5$, $p = .009$, $d = 0.48$ (Fig. 2; Table S2). The effect for brooding was also maintained after removing one outlier, $U = 530.5$, $p = .001$, $d = 0.60$.

3.2.2.3. Exploratory analyses of most bothersome SNAM-related outcomes. Of those who endorsed recurrent SNAMs ($n = 103$), 8 did not go on to complete follow up questions about their most bothersome SNAM so they are not included in those specific analyses.

3.2.2.3.1. Characteristics. The participant's age at the time that their most bothersome SNAM event occurred varied from 4 to 37 years of age ($M(SD) = 18.6(7.5)$). About one-third (37 %) of participants who endorsed recurrent SNAMs completed the study during the Covid-19 pandemic (after January 2020), but only two indicated that their most bothersome SNAM event occurred during and was related to the pandemic. For a portion of the sample ($n = 61$), we were able to estimate the time since the most bothersome SNAM event occurred which varied between 0.02 and 51.08 years ago (Median = 7.1, IQR = 13.6). Distress at the time of the SNAM event or shortly after was rated to be high (Median = 9, IQR = 2), as was SNAM vividness (Median = 8, IQR = 2). SNAM narrative themes ($n = 45$) are presented in Fig. S1. Regarding when their SNAM event occurred relative to the start of the patients' mental health difficulties, approximately half reported that it occurred before (47 %), one third after (34 %), and 19 % around the same time. Most participants (58 %) reported that they thought about their most bothersome SNAM at least once a week, with smaller portions reporting thinking about it once a month (24 %), or less (18 %). (Table 2).

3.2.2.3.2. Impact. Current distress upon SNAM recall was rated to be moderate (Median = 6, IQR = 3). The SNAM was associated with some SNAM-related PTS symptoms over the past month for most participants: 34 % reported 5 or more, 50 % reported 1–4 %, and 16 % reported 0 or less.

and 16 % did not report any of the 9 SNAM-related PTS symptoms assessed at a level of moderate or higher. Regarding symptom type, 66 % endorsed at least one SNAM-related re-experiencing symptom, 58 % endorsed at least one SNAM-related avoidance symptom, and 58 % endorsed at least one SNAM-related alteration in cognition symptom at a level of moderate or higher (Table 2).

3.2.2.3.3. Correlations between most bothersome SNAM characteristics, impact, and symptoms.: The same significant correlations observed in our student sample were observed in our clinical sample as well as some additional correlations (Table 4). Participants who did (62 %) and did not (38 %) tell other people about their event did not differ in terms of SNAM-related PTS symptoms or distress upon recall ($p > .536$). Given the large range in time since the SNAM event, we also examined whether time since the event was correlated with SNAM-related PTS symptoms and observed a significant negative correlation indicative of greater SNAM-related PTS symptoms associated with more recent events, $r(59) = -.28, p = .028$. Similar to Study 1, the multiple regression predicting DASS-21 scores resulted in a significant model, $R^2 = 0.13, F(5, 89) = 2.72, p = .025$, with SNAM-related PTS symptoms as the only significant predictor, $B = 0.95, SE = 0.36, sr = .07, p = .010$. Replacing SNAM-related PTS symptoms in the model with each subscale separately revealed that the effect was mainly driven by SNAM-related avoidance (Model $p = .050; B = 2.09, SE = .92, sr = .05, p = .026$) and SNAM-related re-experiencing symptoms (Model $p = .070; B = 1.32, SE = .64, sr = .04, p = .044$).

3.2.2.4. Sensitivity analyses.: We repeated all analyses above after excluding 20 participants with a trauma diagnosis and/or narrative. With this new sample ($n = 103$), the rate of participants endorsing recurrent SNAMs was 82 % ($n = 84$). The significant differences between those who reported recurrent SNAMs and those who did not on the DASS-21 and RRS-10 were maintained and effects were once again in the moderate range. The significant difference between the groups for the CSR was reduced to a trend, $U = 574, p = .081$, with effect size maintained. Most significant correlations reported in Table 4 were maintained and remained moderate. The exceptions were: 1) current distress upon recall was no longer significantly correlated with vividness or DASS-21 and 2) there was no longer a trend between frequency of thinking about the event and vividness. The multiple regression model predicting DASS-21 symptoms was reduced to a trend, $R^2 = 0.13, F(5, 71) = 2.11, p = .075$, with SNAM-related PTS symptoms again as the only significant predictor, $B = 0.78, SE = 0.38, sr = .05, p = .046$. In the follow up models, the effect of SNAM-related avoidance was reduced to a trend (Model $p = .082; B = 1.92, SE = 0.97, sr = .05, p = .053$) and SNAM-related re-experiencing no longer significant ($p > .130$) (Tables S6-S8).

4. Discussion

The current study investigated the prevalence of recurrent NAMs in both a student and a treatment-seeking sample. NAMs identified by the treatment-seeking sample were required to be symptom-relevant based on self-report (i.e., SNAMs). In the student sample, 71 % identified at least one NAM that they had thought about at least three times in the past six months, with 66 % thinking about their most bothersome NAM at least once per week. Eighty-four percent of the treatment-seeking sample identified at least one SNAM that they

had thought about at least three times in the past six months, with 58 % thinking about their most bothersome SNAM at least once per week.

The high rate of SNAMs in our treatment-seeking sample with emotional disorders is consistent with existing literature on SNAMs in anxiety and depression. Indeed, a recent systematic review [13] investigating the prevalence of SNAMs across anxiety-related disorders found rates to fall between 89–100 % among the studies that utilized similar assessment methods to the current method (i.e., assessing for SNAMs from any time in life, rather than a specific time frame) [14,15,17,25,26,28]. The current rates of SNAMs are also similar to those previously seen in depressed individuals [33,34] – for example, 96 % reported by Newby & Moulds (2010) [34]. Studies to date have been limited by recruiting only specific disorders. For example, only SAD and emetophobia were included in the studies [14,15,17,25,26,28] identified from the anxiety-disorder systematic review mentioned above [13]. Studies have also been limited by the type of memory queried about, with depression-focused studies often only asking about intrusive memories [2,33,34] and anxiety-focused studies asking about specific types of memories (e.g., an embarrassing memory; [25]). Thus, the current study adds to this growing body of literature and addresses previous limitations by recruiting a transdiagnostic sample as well as querying for a broader range of memories.

Participants in both samples reported moderate distress upon recall of their most bothersome NAM/SNAM. Additionally, most participants reported their memory to be associated with clinically significant PTS symptoms over the past month. More than 50 % of both samples endorsed at least one PTS symptom in the re-experiencing, avoidance, and negative alternations in cognition clusters at a moderate or greater level, even though most of the reported events did not meet the DSM Criterion A trauma definition. The high rates of distressing SNAM-related PTS symptoms from the past month in our treatment-seeking sample is especially interesting given that most memories occurred years prior (Median = 7.1 years, IQR = 13.6 years), demonstrating that these symptoms are likely persisting over time. These findings relate to previous work showing that stressors that do not meet the DSM criterion A definition of trauma also often lead to PTS symptoms in clinical and non-clinical samples [45]. Indeed, a meta-analysis demonstrated that the difference in PTS symptom severity between individuals who experienced stressors that do and do not meet the DSM criterion A definition is significant, but only represents a small effect [69].

It is somewhat surprising that our student sample reported almost as high rates of PTS symptoms as our treatment-seeking sample, however, we suspect that this is because our student sample reported on more recent events (median time since the memory event = 1 year). Indeed, in the treatment seeking sample where there was more variability in time since the memory event, more recent events were significantly associated with more PTS symptoms, largely consistent with research on trajectories of response to potentially traumatic events [70-72]. It is also possible that the high PTS symptoms in the student sample is related to the student sample reporting as high anxiety and stress symptoms as the treatment-seeking sample. Of note, in both samples, in our regression analyses NAM/SNAM-related PTS symptoms were the only significant predictor of current DASS scores, indicating that these reactions to the events are closely tied to current depression, anxiety,

and stress symptoms and may matter more than other factors such as how frequently one thinks of the memory event, distress upon recall, distress at the time of the event, or memory vividness. These regression results, however, should be interpreted with caution and confirmed as they were exploratory in nature. In sum, not only do recurrent NAM/SNAMs present frequently, but participants in both samples appear to be distressed by the way they are engaging and/or processing these memories.

We also investigated differences in non-memory specific psychological symptoms and rumination between participants who did and did not endorse NAM/SNAMs. In both samples, our findings consistently showed that, as hypothesized, participants who endorsed NAM/SNAMs reported significantly greater DASS-21 and rumination scores than those who did not, reflecting moderate effect sizes ($d = 0.49\text{--}0.72$). The presence of this pattern of memory-related distress and psychological symptoms for both the student and treatment-seeking sample appears to indicate that NAM/SNAMs should be further investigated as a factor that may be related to mental health broadly. Whereas understanding the prevalence and impact of SNAMs for a treatment-seeking sample can help elucidate the role of such memories in symptom maintenance and treatment change, understanding the prevalence and impact of NAMs in a non-clinical sample can help to identify modifiable targets that would alleviate general distress. Indeed, there is a wealth of research that has investigated intervention strategies for non-clinical samples. Some studies have investigated treatments to improve resilience following life adversities [73] and other studies have evaluated the improvement of general wellbeing [74]. If future studies replicate the current one, it may be worthwhile to consider addressing NAMs as a universal target.

Given the cross-sectional nature of the current study, we are unable to assess directionality in the observed relationships between report of recurrent NAM/SNAMs and DASS-21 symptoms or rumination. This prevents us from being able to directly comment on the value of addressing NAM/SNAMs within evidence-based therapy for emotional disorders based on this study alone. For example, we cannot infer that the presence of SNAMs worsens symptoms or rumination or maintains underlying psychological processes. Understanding the directionality of these effects and identifying the extent to which NAMs/SNAMs are involved in the etiology and/or maintenance of symptoms would require longitudinal and/or experimental research. For example, a sample could be followed longitudinally to track the occurrence of NAM/SNAM events or recall of NAM/SNAMs and subsequent symptom/rumination changes, while attempting to experimentally or statistically control for other factors that could drive symptom/rumination changes independently from NAM/SNAMs (e.g., anxiety sensitivity). Longitudinal research of this nature could disentangle potential bidirectional relationships between NAM/SNAM recall and symptoms and determine how often and for whom NAM/SNAMs represent an etiological/maintenance factor versus an inconsequential byproduct of psychological symptoms. Another option is to infer the importance of NAM/SNAMs based on studies that have attempted to modify the way an individual views/relates to a NAM/SNAM and then observes subsequent changes in symptoms [75]. Imagery rescripting is one such technique. Imagery rescripting involves integrating neutral or positive imagery into distressing memories that are related to an individual's emotional disorder or distress [22]. Meta-analyses have shown imagery rescripting to result in large symptom reductions across SAD, OCD, body dysmorphic

disorder, depression, bulimia nervosa, and PTSD; although the amount of evidence for some of these disorders is greater than others [76-78]. The observable symptom benefit from intervening on SNAMs lends support to the hypothesis that they may have a mechanistic role in emotional disorder maintenance/alleviation. Future studies may also assess SNAMs and associated distress/PTS symptoms before and after evidence-based treatment for emotional disorders and then statistically evaluate if change in SNAM-related symptoms mediates treatment outcomes. Considering the literature and our study results together, there appears to be several indications that it is worthwhile to continue studying SNAMs as a potential target in the evidence-based treatment of emotional disorders, however future studies should also attend to these described limitations.

As described, one strength of this study is that we queried for a broader range of memories, and we were thus able to examine themes of participants' most bothersome NAM/SNAMs. We found that most memories across both samples frequently centered on the same theme: with approximately half of participants writing about relationship issues or difficult interpersonal interactions (47 % in Study 1 % and 51 % in Study 2). These findings are similar to that of past depression-focused studies that have found the majority of symptom-relevant memories to be focused on interpersonal themes [20,79-81], potentially in line with interpersonal theories of depression [82]. Our findings suggest that these concerns extend to patients with anxiety-related disorders, as well, and are also characteristic of the student sample.

The current study is not without limitations. First, as discussed, this study is correlational in nature and thus we were unable to assess the directionality of these relationships. Second, we did not have access to memory content for a large portion (56 %) of the treatment-seeking sample and were therefore unable to fully characterize the thematic content of those memories nor were we able to determine if those participants had written about Criterion A traumatic events. Nonetheless, our sensitivity analyses did not substantially change our results for either sample. Third, because most participants in both our student (71 %) and treatment-seeking sample (84 %) endorsed having recurrent NAM/SNAMs, our comparison groups were small. Such imbalance in sample sizes can increase the likelihood of Type 1 error; however, this is only a relative weakness given that our study design enabled us to replicate analyses across two samples, reducing the chances of falsely rejecting our null hypotheses. It is also important to note that these studies were not pre-registered and our overall sample sizes were driven more by logistic constraints than power. Fourth, our analyses of the most-bothersome SNAM/NAM-related characteristics were exploratory and we did not correct for multiple comparisons. They should thus be interpreted with caution and used to guide future confirmatory studies. Finally, although our student sample was diverse in terms of race and our treatment-seeking sample diverse in terms of symptom presentation, both samples were predominantly female identifying, the student sample lacked diversity in terms of age and education level, and the treatment-seeking sample lacked diversity in terms of race. As such, these results may not generalize to the groups that were not included or less represented in our samples and future studies should examine these questions in more diverse samples.

5. Conclusions

Overall, our findings suggest that recurrent NAM/SNAMs are common and significantly associated with several key clinically relevant factors such as symptom severity, rumination, and PTS symptoms within the past month. Our broad inquiry of NAM/SNAMs in transdiagnostic samples extends existing literature that has often focused on specific disorders (e.g., SAD) or particular types of memories (e.g., an embarrassing memory). These studies also add to the relatively limited literature examining PTS symptoms and rumination in relation to NAM/SNAMs. Our findings were consistent across both a student and treatment-seeking sample, suggesting that NAM/SNAMs should be further investigated as a potential universal target for distress even in non-clinical samples. Moreover, given the literature showing that targeting SNAMs with interventions such as imagery rescripting results in symptom improvement, it is worthwhile to continue investigating the relationship of SNAMs to symptom severity and underlying mechanisms within clinical disorders. Given that the current study was correlational in nature, future research should also attend to assessing the directionality of relationships between NAM/SNAMs and DASS-21 symptoms/rumination. Such research will ultimately provide insight on if targeting SNAMs within the evidence-based treatment of emotional disorders improves clinical outcomes and overall wellbeing.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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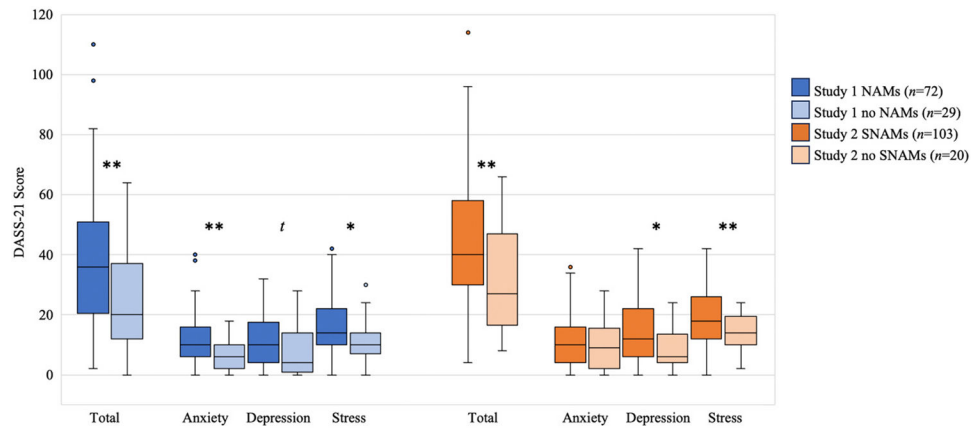
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**Fig. 1.**

Box Plot of DASS-21 Total and Subscale Scores by Recurrent NAM/SNAMs Endorsement: Studies 1 and 2. Note. Box plot of DASS-21 total and subscale scores by recurrent NAM/SNAMs endorsement for studies 1 (blue) and 2 (orange). Box represents first quartile and third quartile with median line presented. Outliers indicated as dots outside of the box plot whiskers. Effects indicated as significant remained significant when analyses were repeated with outliers excluded. DASS-21 = Depression, Anxiety, Stress Scale-21; NAM = Negative Autobiographical Memory; SNAM = Symptom-Relevant Negative Autobiographical Memory. † $p < .08$, * $p < .05$, ** $p < .01$, *** $p < .001$.

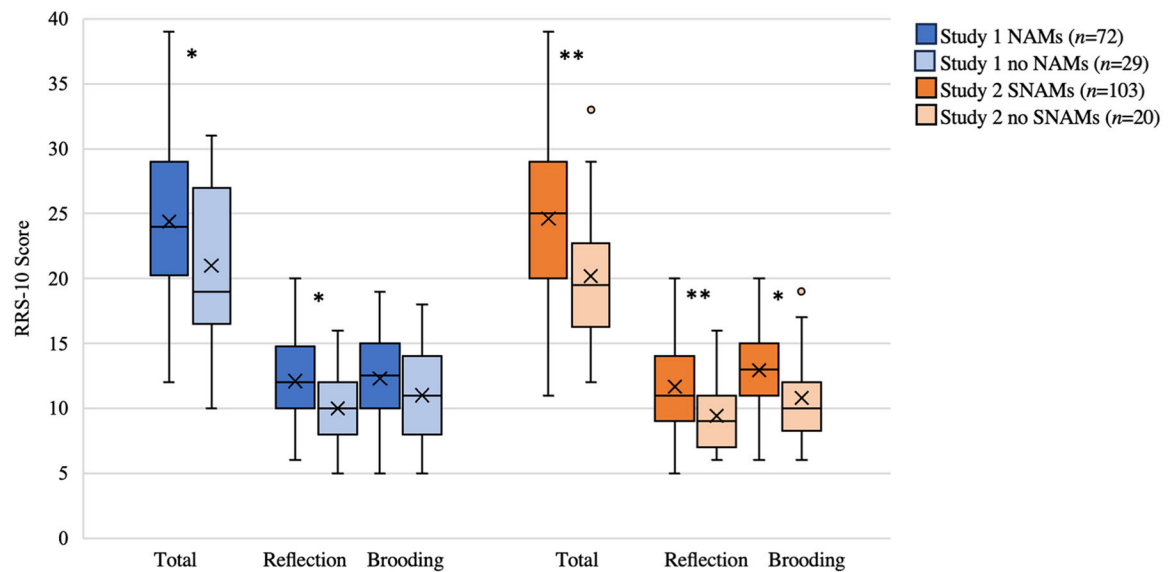


Fig. 2.

Box Plot of RRS-10 Total and Subscale Scores by Recurrent NAM/SNAMS Endorsement: Studies 1 and 2. Note. Box plot of RRS-10 total and subscale scores by recurrent NAM/SNAMS endorsement for studies 1 (blue) and 2 (orange). Box represents first quartile and third quartile with median line and mean (x) presented. Outliers indicated as dots outside of the box plot whiskers. Effects indicated as significant remained significant when analyses were repeated with outliers excluded. NAM = Negative Autobiographical Memory; RRS-10 = Ruminative Responses Scale-10; SNAM = Symptom-Relevant Negative Autobiographical Memory. [†] $p < .08$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 1

Demographic and Psychological Symptom Characteristics: Studies 1 and 2.

Variable	Study 1 (<i>n</i> = 101)	Study 2 (<i>n</i> = 123)
Age at study completion	19.0(2.0)	27.1(9.8) ^a
Days between intake and study	-	-22.0(31.0) ^a
Gender		
• Female/cisgender woman	81 % (82)	70 % (86)
• Male/cisgender man	19 % (19)	25 % (31)
• Other (e.g., non-binary)	0 % (0)	5 % (6)
Race		
• Asian	44 % (44)	7 % (9) ^b
• Black/African American	5 % (5)	7 % (9) ^b
• More than one race	9 % (9)	9 % (11) ^b
• White/Caucasian	35 % (35)	71 % (87) ^b
• Other	7 % (7)	4 % (5) ^b
Ethnicity		
• Hispanic	15 % (15)	80 % (98)
• Non-Hispanic	84 % (85)	18 % (22)
• Other	-	2 % (3)
Education		
• Completed high school or less	15 % (15)	7 % (9) ^c
• Some or completed college	85 % (86)	55 % (67) ^c
• Some or completed graduate school	-	37 % (45) ^c
• Other	-	1 % (1) ^c
DASS-21 Total Score	32.0(31.0)	38.0(30.0)
• Anxiety	10.0(10.0) <i>moderate</i>	10.0(12.0) <i>moderate</i>
• Depression	8.0(14.0) <i>normal</i>	10.0(16.0) <i>mild</i>
• Stress	14.0(12.0) <i>mild</i>	18.0(12.0) <i>mild</i>
RRS-10 Total Score	<i>M(SD)</i> = 23.4(6.1)	<i>M(SD)</i> = 23.9(6.3)
• Brooding	<i>M(SD)</i> = 11.9(3.5)	12.0(5.0)
• Reflection	<i>M(SD)</i> = 11.5(3.4)	11.0(5.0)
Mental health diagnoses ^d	29 % (29) <i>lifetime diagnosis by doctor as self-reported by participants:</i>	99 % (122) <i>current primary/co-primary diagnoses by clinician as reported in clinical chart:</i>
	<ul style="list-style-type: none"> • anxiety disorder: 19 % (19) • depressive disorder: 20 % (20) • obsessive compulsive and related disorders: 5 % (5) • trauma and stressor-related disorders: 2 % (2) • other disorders: 6 % (6) 	<ul style="list-style-type: none"> • anxiety disorder: 68 % (84) • depressive disorder: 19.5 % (24) • obsessive compulsive and related disorders: 13 % (16) • trauma and stressor-related disorders: 6 % (7) • other disorders: 6 % (7)

Variable	Study 1 (n = 101)	Study 2 (n = 123)
	• missing 1 % (1)	

Note. Demographic and psychological characteristics of participants in studies 1 and 2. All values represent *Median (IQR)* or % (*n*) unless otherwise noted. *Median (IQR)* are presented for non-normally distributed data whereas *M(SD)* are presented for normally distributed data. ^aData missing for 42 participants. ^bData missing for 2 participants. ^cData missing for 1 participant. ^dThe student sample responded to the question “Have you ever been diagnosed by a doctor with a mental health condition(s)?” and then if applicable, self-reported mental health diagnoses in a free response box. Responses were categorized by the researchers into four relevant DSM-5 categories or other. Participants could be assigned to multiple categories if they self-reported multiple diagnoses and percentages reflect proportion of the total sample. The clinical sample was diagnosed by mental health professionals and chart data on primary and co-primary diagnoses was used by the researchers to categorize participants into four relevant DSM-5 categories or other. Participants with co-primary diagnoses may show up in two categories and percentages reflect proportion of the total sample. DASS-21 = Depression, Anxiety, Stress Scale-21; RRS-10 = Ruminative Responses Scale-10.

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Table 2

NAM/SNAM Prevalence, Characteristics, and Impact: Studies 1 and 2.

	Study 1 NAMs	Study 2 SNAMs
Prevalence recurrent NAMs/SNAMs	71 % (72/101)	84 % (103/123)
Number of recurrent NAMs/SNAMs		
• 1-3	72 % (52/72)	49.5 % (51/103)
• 4-10	24 % (17/72)	20.5 % (21/103)
• Over 10	4.2 % (3/72)	30 % (31/103)
<i>Most Bothersome NAM/SNAM Characteristics</i>	Study 1 NAMs (n = 71)^a	Study 2 SNAMs (n = 95)^b
Age at time of event <i>years</i>	18.0(2.0)	<i>M(SD)</i> = 18.6(7.5)
Time since memory event <i>years</i>	1.0(2.0)	7.1(13.6) ^c
Distress at time of the event (0-10)	9.0(2.0)	9.0(2.0)
Memory vividness (0-10)	8.0(2.0)	8.0(2.0)
Timing of event in relation to start of mental health difficulties		
• Before	-	47 % (45)
• Same time	-	19 % (18)
• After	-	34 % (32)
Frequency of thinking about the memory		
• More than once a day	14 % (10)	10.5 % (10)
• Once a day	15.5 % (11)	7 % (7)
• Once every few days	22.5 % (16)	23 % (22)
• Once a week	14 % (10)	17 % (16)
• Once a month	22.5 % (16)	24 % (23)
• Once every 2-3 months	8.5 % (6)	10.5 % (10)
• Once every 4-6 months or less	3 % (2)	7 % (7)
<i>Most Bothersome NAM/SNAM Impact</i>	Study 1 NAMs (n = 71)	Study 2 SNAMs (n = 95)
Distress now (0-10)	6.0(3.0)	6.0(3.0)
Rates of NAM-related PTS symptoms endorsed at moderately or higher level over past month ^d		
• Repeated, disturbing, and unwanted memories of the event	56 % (40)	43 % (41)
• Repeated, disturbing dreams of the event	20 % (14)	8 % (8)
• Suddenly feeling or acting as if the event were actually happening again	32 % (23)	18 % (17)
• Feeling very upset when something reminded you of the event	63 % (45)	51 % (48)
• Strong physical reactions when something reminded you of the event	32 % (23)	42 % (40)
• Avoiding memories, thoughts, or feelings related to the event	69 % (49)	48 % (46)
• Avoiding external reminders of the event	62 % (44)	46 % (44)
• Trouble remembering important parts of the event	23 % (16)	18 % (17)
• Blaming yourself or someone else for the event or what happened after it	59 % (42)	54 % (51)
Sum of NAM/SNAM-related PTS symptoms (Possible range: 0-36) ^d	<i>M(SD)</i> = 13.9(7.3)	10.0(12.0)

Note. Characteristics and impact of most bothersome NAM/SNAMs in studies 1 and 2. All values represent *Median (IQR)* or % (*n*) unless otherwise noted. *Median (IQR)* are presented for non-normally distributed data whereas *M(SD)* are presented for normally distributed data.

^aOne participant did not report information about their most bothersome NAM. ^bEight participants did not report information about their most bothersome SNAM. ^cData missing for 34 participants. ^dConsistent with the original PTSD Checklist for DSM-5, participants rated the PTS symptom items on a scale from 0 = “Not at all” to 4 = “Extremely”, with 2 = “Moderately” indicating symptom endorsement. Responses to the 9 items were summed with a possible range of 0-36. NAM = Negative Autobiographical Memory; PTS = Posttraumatic Stress; SNAM = Symptom-relevant Negative Autobiographical Memory.

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Table 3
Correlations Between Most Bothersome NAM Characteristics, Impact, and Symptoms: Study 1 (n = 71).

	DASS-21 Total	Thought frequency	Distress then	Distress now	Vividness
NAM-Related PTS Symptoms Total	$r(69) = .48^{***}$	$r(69) = .26^*$	$r(69) = .14$	$r(69) = .38^{**}$	$r(69) = .09$
DASS-21 Total		$r(69) = .16$	$r(69) = .09$	$r(69) = .33^{**}$	$r(69) = .08$
Thought frequency			$r(69) = -.02$	$r(69) = .18$	$r(69) = -.08$
Distress then				$r(69) = .20$	$r(69) = .31^{**}$
Distress now					$r(69) = .03$

Note. This table presents Spearman's rho correlations between features of participants most bothersome NAM and psychological symptoms. DASS-21 = Depression, Anxiety, Stress Scale-21; NAM = Negative Autobiographical Memory; PTS = Posttraumatic Stress.

* $p < .05$,
** $p < .01$,
*** $p < .001$

Table 4
Correlations Between Most Bothersome SNAM Characteristics, Impact, and Symptoms: Study 2 (n = 95).

	Time since event ^a	CSR	DASS-21 Total	Thought frequency	Distress then	Distress now	Vividness
SNAM-related PTS Symptoms Total	$r(59) = -.28^*$	$r(93) = .10$	$r(93) = .34^{***}$	$r(93) = .47^{***}$	$r(93) = .19^t$	$r(93) = .54^{***}$	$r(93) = .15$
CSR			$r(93) = .24^*$	$r(93) = .06$	$r(93) = .05$	$r(93) = .01$	$r(93) = .12$
DASS-21 Total				$r(93) = .15$	$r(93) = .07$	$r(93) = .22^*$	$r(93) = .14$
Thought frequency					$r(93) = .01$	$r(93) = .27^{**}$	$r(93) = .19^t$
Distress then						$r(93) = .19^t$	$r(93) = .37^{***}$
Distress now							$r(93) = .21^*$

Note. This table presents Spearman's rho correlations between features of participants most bothersome SNAMs and psychological symptoms. ^aData missing for 30 participants. CSR = Clinician Severity Rating; DASS-21 = Depression, Anxiety, Stress Scale-21; PTS = Posttraumatic Stress; SNAM = Symptom-Relevant Negative Autobiographical Memory.

^t $p < .08$,
^{*} $p < .05$,
^{**} $p < .01$,
^{***} $p < .001$.