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**Measuring state pre-event and post-event rumination in Social Anxiety Disorder:  
Psychometric properties of the Socially Anxious Rumination Questionnaire (SARQ).**

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**Abstract**

Cognitive models have consistently recognised pre-event and post-event rumination as maintaining factors in Social Anxiety Disorder (SAD). This study aimed to investigate the psychometric properties of a state-based measure of pre-event and post-event rumination in SAD: The Socially Anxious Rumination Questionnaire (SARQ), which was formerly known as the Thoughts Questionnaire. In particular, we examined the factor structure, internal consistency, test-retest reliability, construct validity, sensitivity to treatment response, clinical cut-off scores (relative to non-clinical participants), and associated test performance indicators of the SARQ. The sample comprised 505 adults with a principal diagnosis of SAD and 130 non-clinical controls. Pre-event and post-event rumination were assessed in relation to a three-minute impromptu speech. Results indicated single factors for the SARQ: Pre-event and SARQ: Post-event scales, along with excellent internal consistency, good test-retest reliability, sound sensitivity to cognitive-behavioural treatment response, and a clear ability to discriminate between individuals with a principal diagnosis of SAD and non-clinical controls. The findings justify the SARQ's use as a robust and reliable measure of state rumination for individuals with SAD that can be used both before and after encountering a social threat.

*Keywords: Pre-event rumination, post-event rumination, Social Anxiety Disorder, Socially Anxious Rumination Questionnaire*

**Measuring state pre-event and post-event rumination in Social Anxiety Disorder:  
Psychometric properties of the Socially Anxious Rumination Questionnaire (SARQ)**

Social Anxiety Disorder (SAD) is a prevalent mental disorder (Crome et al., 2015) marked by fear of negative social evaluation and associated with high rates of functional impairment (e.g., Patel, Knapp, Henderson, & Baldwin, 2002) and psychiatric comorbidity (e.g., Crome et al., 2015). Cognitive models of SAD (Clark & Wells, 1995; Hofmann, 2007; Rapee & Heimberg, 1997) point to a number of key processes that contribute to and ultimately maintain SAD symptoms; two such processes are pre-event rumination and post-event rumination (Clark & Wells, 1995; Hofmann, 2007; Rapee & Heimberg, 1997). In SAD, rumination refers to intrusive and repetitive negative thoughts about an upcoming social situation (known as pre-event or anticipatory rumination) or past encounter (post-event rumination), with an emphasis on perceived personal mistakes, social incompetence and scrutiny from others (Clark & Wells, 1995). In this paper, we use the term ‘rumination’ as it specifically refers to intrusive and repetitive negative thoughts about an upcoming or recently experienced social event, as opposed to ‘processing’ (commonly in SAD literature: anticipatory processing, post-event processing), which refers to a broader range of cognitive and metacognitive processes (e.g., attentional focus, memory bias, attempts to control thoughts, etc.) in addition to rumination”.

Consistent with cognitive models, research indicates that both pre-event and post-event rumination are positively associated with symptom severity (e.g., Kocovski, Endler, Rector, & Flett, 2005; Mills, Grant, Lechner, & Judah, 2013) and a slower treatment response (Price & Anderson, 2011; Wong et al., 2017) in individuals with SAD. Given these associations, pre-event and post-event rumination warrant significant attention in SAD research. While the last twenty years have witnessed a growing interest in post-event rumination in particular (see Brozovich & Heimberg, 2008 for a review), the literature on

pre-event rumination is more limited, and both pre-event and post-event rumination have received significantly less empirical attention relative to other cognitive and attentional processes in SAD (Modini & Abbott, 2016).

***Measures of pre-event and post-event rumination***

In order to continue to build on the emerging understanding of these processes, the tools we use to measure pre-event and post-event rumination in SAD must be psychometrically sound. So far, attempts to measure pre-event and post-event rumination in SAD have been sparse. The vast majority of rumination scales pertain to depressive rumination or generally anxious rumination (e.g., the Ruminative Response Scale of the Response Styles Questionnaire: Treynor, Gonzalez & Nolen-Hoeksema, 2003; the Anxious Rumination Questionnaire: Rector, Antony, Laposa, Kocovski & Swinson, 2008; the Rumination-Reflection Questionnaire: Trapnell & Campbell, 1999). Given the items in these scales, which reflect either depressogenic or broad threat content, they are not appropriate for measuring pre-event and post-event rumination in SAD, which are diagnostically distinct from other kinds of rumination as they focus more specifically on perceived social shortcomings (Fehm, Schneider, & Hoyer, 2007; Kocovski & Rector, 2008).

Particular to pre-event rumination in SAD, The Anticipatory Processing Questionnaire (APQ: Vassilopoulos, 2004) is an 18-item scale that asks respondents to think of a past social situation and rate (from 1-100) on a visual analogue scale how much they had thought about that situation prior to it happening (i.e., pre-event rumination). The APQ demonstrated good internal consistency (Cronbach's  $\alpha = 0.91$ ) and a significant positive correlation with social anxiety symptoms (Vassilopoulos, 2004). However, as a state measure, the APQ is limited by its reliance on respondents' memory of an undefined past social situation and how much they had thought about it beforehand. Furthermore, the scale

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was validated on a non-clinical student population and as such the extent to which it captures pre-event rumination in a clinical sample of individuals with SAD is unknown. Another measure is the Anticipatory Social Behaviours Questionnaire (ASBQ; Hinrichsen & Clark, 2003), a 12-item scale that asks respondents to rate on a 4-point scale (1 = never, 4 = always) whether they usually engage in various cognitive strategies prior to social situations in general. While the ASBQ was found to have good internal consistency (Cronbach's  $\alpha = 0.88$ ), it only captures these cognitive processes at a trait level, and therefore has limited value in capturing state fluctuations in pre-event rumination.

In regards to post-event rumination, the Post Event Processing Questionnaire (PEPQ; Rachman, Grüter-Andrew, & Shafran, 2000) is a 13-item scale that was developed to measure state post-event processing in SAD and is one of the most frequently used measures of this construct. Several modified versions of this scale with 7, 15 and 17 items have also been developed and validated on non-clinical samples of undergraduate students (Fehm, Hoyer, Schneider, Lindemann, & Klusmann, 2008; Kocovski & Rector, 2007; Wong, 2015). To our knowledge, the only study to have examined the psychometric properties of the PEPQ using a clinical sample of individuals with SAD found that it failed to correlate with measures of trait social anxiety symptoms, correlating instead with measures of state anxiety, depression, general anxiety and stress (McEvoy & Kingsep, 2006). These results suggest that the PEPQ captures more general processes that are less specific to social anxiety, bringing the construct validity of the measure into question. Furthermore, the PEPQ and associated versions require respondents to answer in relation to a non-specific social situation that they experienced over the past few weeks or months. While this may pose advantages in clinical settings, its reliability in research contexts is potentially compromised by its reliance on respondents' memory for past events and the inevitable variability in the kinds of situations recalled.

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The Post-Event Processing Inventory (PEPI: Blackie & Kocovski, 2017) is a self-report measure of post-event processing that includes both state and trait scales (12 items each, with corresponding items reworded for state versus trait purposes). The PEPI has clear advantages in its capacity to assess both state and trait post-event processing, and it appears to have good psychometric properties in relation to a non-clinical student sample (Blackie & Kocovski, 2017) and a community sample with elevated levels of social anxiety symptoms (Blackie & Kocovski, 2019), however it is yet to be validated for individuals diagnosed with SAD.

One additional measure is the Rumination Questionnaire (RQ: Mellings & Alden, 2000), a 5-item scale assessing state post-event rumination in relation to a social interaction task. Respondents are asked to rate on a 7-point scale how much they thought about the interaction. While construct validity was demonstrated through positive associations between social anxiety levels and post-event rumination in a non-clinical population, the small number of items in the RQ limits its detailed assessment of the construct and its psychometric properties are yet to be examined.

### ***The Socially Anxious Rumination Questionnaire (Previously: Thoughts Questionnaire)***

Evidently, there is currently a lack of scientifically sound state-based measures of pre-event and post-event rumination that have been empirically validated within clinical populations. This is problematic because while cognitive models posit that pre-event and post-event rumination maintain SAD, we cannot examine the intricacies of these relationships without accurate and reliable tools of measurement. One promising measure that has been used for several years in experimental research is the negative rumination subscale of the Thoughts Questionnaire (Abbott & Rapee, 2004; Edwards, Rapee & Franklin, 2003), which was developed to assess state pre-event and post-event rumination in relation to a social

threat task and has been widely used for this purpose in a range of previous studies (e.g., Modini & Abbott, 2017; 2018; Modini, Rapee & Abbott, 2018; Modini, Rapee, Costa & Abbott, 2018; Perini, Abbott & Rapee, 2006; Wong et al., 2017; Zou & Abbott, 2012). The Thoughts Questionnaire was ambiguously named to conceal its purpose from respondents. We recently changed its name to the Socially Anxious Rumination Questionnaire (SARQ) such that the title more accurately reflects the construct it is designed to measure.

The SARQ is a single measure (with minor tense changes for the pre-event and post-event rumination scales), which is beneficial because it allows for direct comparison of pre-event and post-event rumination. Additionally, the SARQ is a state-based measure designed to capture ruminative responses as they are occurring in relation to a social threat task, which is helpful in tracking fluctuations in this process over time. Finally, the SARQ is intended to be used in relation to a predetermined social threat, which is empirically advantageous because it allows both the type of social event and temporal distance from the event to be controlled. Despite these advantages and its widespread use in previous empirical studies, the psychometric properties of the SARQ are yet to be thoroughly evaluated.

### *The current study*

The current study aims to extensively evaluate the psychometric properties of the pre-event and post-event versions of the SARQ using a large clinical sample of individuals with SAD, in relation to a 3-minute impromptu speech task. We adhere with Terwee et al.'s (2007) quality criteria for evidence-based evaluation of measurement properties by examining the SARQ's factor structure (using both exploratory and confirmatory factor analyses), internal consistency, test-retest reliability, construct validity, sensitivity to cognitive-behavioural treatment, clinical cut-off scores (relative to non-clinical participants) and associated test performance indicators including sensitivity, specificity and positive and negative predictive



values. We hypothesise that a one-factor solution will emerge for both the pre-event and post-event versions of the SARQ, and that the SARQ will demonstrate strong properties in each of the above domains, rendering it a psychometrically robust state-based measure of pre-event and post-event rumination in individuals with SAD.

## **Method**

### ***Participants***

The sample comprised 635 participants ( $M_{age} = 29.91$  years, 57.10% female). Participants were English-speaking adults ( $\geq 17$  years) with a principal diagnosis of SAD ( $N = 505$ ) and non-clinical controls ( $N = 130$ ). Participants were excluded if they were acutely suicidal or experiencing psychosis. Participants with SAD were recruited from two sites: the Centre for Emotional Health Clinic at Macquarie University (where treatment-seeking individuals presented for assessment and treatment of SAD) and the University of Sydney (where non treatment-seeking undergraduate students were mass-screened for probable social anxiety using the Social Interaction Anxiety Scale (SIAS: Mattick & Clarke, 1998) and received course credit or reimbursement for participation as well as onward referrals). Non-clinical control participants were recruited through two sources: community noticeboards advertising for confident and outgoing individuals who received vouchers for their time and travel expenses, and first year undergraduate psychology students at the University of Sydney who were mass-screened as unlikely to have social anxiety using the SIAS (Mattick & Clarke, 1998) and received course credit for participation. Non-clinical diagnostic status was determined via an in-person semi-structured diagnostic interview. Only participants who provided written consent were included in the study.

### ***Measures***

Rumination: Pre-event and post-event rumination were assessed using the Socially Anxious Rumination Questionnaire (SARQ; Previously the negative rumination subscale of

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the Thoughts Questionnaire: Abbott & Rapee, 2004; Edwards et al., 2003), which was the primary outcome measure for this study and the focus of psychometric investigation. The SARQ: Pre-event and SARQ: Post-event scales measure self-reported pre-event and post-event rumination, respectively, and are identical bar changes in tense (e.g., Item 5: “I will make a fool of myself” on the pre-event scale, versus “I made a fool of myself” on the post-event scale). Given that frequency of negative thoughts is a good indicator of rumination (Papageorgiou & Wells, 2004), participants are asked to rate how frequently they experienced each of 12 negative thoughts about a social threat task over the past week, on a 5-point scale ranging from never (0) to very often (4). Higher scores indicate more frequent rumination.

Historically, the Thoughts Questionnaire has been used to measure state pre-event and post-event rumination in relation to a range of different threat tasks and at varying time points, most typically at one week prior to and one week following a task, but also ranging from one day to one week prior to a task (e.g., Grant & Beck, 2010; Modini & Abbott, 2017; 2018) and ranging from 10 minutes to two weeks following a task (e.g., Blackie & Kocovski, 2016; Brown & Kocovski, 2014; Çek, Sánchez, & Timpano, 2016; Cox & Chen, 2015; Dannahy & Stopa, 2007; Gaydukevych & Kocovski, 2012; Gramer, Schild, & Lurz, 2012; Grant & Beck, 2010; Haccoun, Hildebrandt, Klumb, Nater, & Gomez, 2020; Kocovski, MacKenzie, & Rector, 2011; Makkar & Grisham, 2011; 2013; Zoccola, Dickerson, & Lam, 2012; Zoccola, Dickerson, & Zaldivar, 2008; Zoccola, Quas, & Yim, 2010). Internal consistency remained reliably excellent with Cronbach’s  $\alpha$ ’s ranging from 0.90 to 0.97 in each of the above studies, where reported.

Details regarding item development of the original Thoughts Questionnaire are outlined by Edwards et al. (2003) and Abbott and Rapee (2004). The positive rumination subscale that was previously included in the Thoughts Questionnaire is not included in the SARQ (and has also been excluded in previous studies, e.g., Modini & Abbott, 2018; Rapee

& Abbott, 2007; Wong et al., 2017), since positive rumination was not associated with indicators of social anxiety and did not discriminate individuals with SAD from non-clinical controls (Edwards et al., 2003). Despite Cronbach's alphas indicating excellent internal consistency, two of the original items from the Thoughts Questionnaire ("My topic won't be very good" and "My speech will be really bad") were removed from the SARQ in order to make it a more generic measure that is applicable to a broader range of social threats tasks, such as interaction tasks<sup>1</sup>.

Diagnostic status: The Anxiety and Related Disorders Interview Schedule for DSM-IV (ADIS-IV: Di Nardo, Brown, & Barlow, 1994) and DSM-5 (ADIS-5: Brown & Barlow, 2014) were used to ascertain diagnostic status for both clinical SAD participants and non-clinical controls. The ADIS is a semi-structured diagnostic interview schedule administered by a trained clinician to assist in determining whether an individual meets DSM criteria for an anxiety and/or other disorder(s). Clinical Severity Ratings on a 9-point scale ranging from 0 (none) to 8 (very severe) are recorded to determine principal diagnosis, with scores over 4 indicating that the clinical threshold for a formal DSM diagnosis is met. Comorbid diagnoses are also recorded. Participants in the clinical group with secondary psychiatric comorbidities were included so long as SAD was deemed to be their principal diagnosis.

Self-report symptom measures: Trait social anxiety symptoms were measured using the Social Phobia Scale and the Social Interaction Anxiety Scale (SPS & SIAS: Mattick & Clarke, 1998), two self-report scales (20 items each) that assess fears of social scrutiny and social interaction, respectively (Mattick & Clarke, 1998). The Brief Fear of Negative Evaluation scale (BFNE: Leary, 1983), a 12-item self-report scale that captures fear of negative evaluation by others, was also administered. The SPS, SIAS and BFNE have all demonstrated strong internal consistency, construct validity and responsiveness (Modini,

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<sup>1</sup> Note: For Item 3. "The investigator won't/didn't like me", the word 'investigator' may be substituted for 'observer' or other suitable replacement depending on the context.

Abbott & Hunt, 2015). Internal consistency for these measures for the overall sample ranged from adequate to excellent in the current study (SPS:  $\alpha = 0.94$ ; SIAS:  $\alpha = 0.90$ ; BFNE:  $\alpha = 0.75$ ). The three subscales of the Depression Anxiety and Stress Scales (DASS-21: Lovibond & Lovibond, 1995) have been widely validated in assessing levels of depression, anxiety and stress symptomatology. Internal consistency for the DASS-21 was excellent in the current study ( $\alpha = 0.94$ ). The Depression subscale of the DASS-21 was of particular interest to this study so that participants' levels of depression could be controlled for in subsequent analyses if rumination were correlated across depressive and anxious symptomatology. The State Anxiety Rating scale (SAR: Rapee & Abbott, 2007) and the Speech Performance Questionnaire (SPQ: Rapee & Lim, 1992) are two self-report questionnaires that measure state anxiety levels and state perceived performance, respectively, which were administered in relation to a speech task. In the current study, internal consistency for the SAR scale and the SPQ were excellent (both  $\alpha$ 's = 0.94).

Demographic variables: Background measures of age, gender, relationship status, education, employment, ethnicity and language were collected to determine sample characteristics.

### ***Procedure***

The study was approved by Macquarie University and the University of Sydney Human Research Ethics Committees. The primary outcome data were obtained from a number of previously published studies<sup>2</sup> (Modini & Abbott, 2017, 2018; Norton & Abbott, 2016; Rapee, Abbott, Baillie, & Gaston, 2007; Rapee, Gaston, & Abbott, 2009; Rapee et al., 2013) whose participants presented for assessment at the Centre for Emotional Health Clinic at Macquarie University or the University of Sydney Psychology Clinic. Protocols and eligibility criteria were comparable across studies.

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<sup>2</sup> Note: Rumination data were not necessarily published in the final manuscripts of these papers.

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All participants completed an ADIS-IV/ADIS-5 interview to ascertain diagnostic status, conducted by masters and doctoral level students in clinical psychology under the supervision of experienced clinical psychologists. All diagnostic interviews were recorded, and a randomly selected subset (15%) were coded by an independent rater who was blind to the diagnostic status of participants. Diagnostic interrater reliability was high, with  $k$  (kappa) ranging from 0.86 to 1.00 in each of the trials,  $p < .001$ . The Avoidant Personality Disorder section of the International Personality Disorders Examination for ICD-10 (Loranger, Janca, & Sartorius, 1997) was also administered.

Thereafter, participants completed a battery of trait questionnaires including the SPS, SIAS, BFNE and DASS-21. Participants were then told that they would perform a three-minute impromptu speech in one week's time<sup>3</sup> (social threat task); they then completed a battery of state questionnaires including the SAR scale and the SPQ (Time 1). Participants returned one week later and completed state questionnaires (SARQ: Pre-event, SAR scale and SPQ) immediately before the speech task (Time 2; pre-event rumination). They performed the speech in front of a video camera and completed state questionnaires (SAR scale and SPQ) immediately afterwards (Time 3). One week later, participants completed the SARQ: Post-event (Time 4; post-event rumination).

A subsample of participants with a principal diagnosis of SAD also completed 12 weeks of Cognitive Behavioural Therapy (CBT) treatment for SAD delivered in group format *or* were allocated to a waitlist control *or* a 'stress management' active treatment control condition. The CBT treatment program (previously described by Rapee et al., 2007, 2009, 2013) consisted of standard cognitive behavioural treatment components including cognitive restructuring of unhelpful evaluations through examining evidence, in vivo exposure, hypothesis-testing through behavioural experiments, performance feedback, and elimination

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<sup>3</sup> In one study (Modini & Abbott, 2018), the speech was completed on the fifth day of testing. For all other studies, the speech was completed one week after initial testing.

of safety behaviours and avoidance. The ‘stress management’ active treatment control condition consisted of training in a range of skills including relaxation, problem solving, time management and maintaining a healthy lifestyle. Both treatment groups consisted of 2-hour sessions conducted over 12 weeks. Following the 12-week treatment or control period, the speech task (Times 1 through 4) was repeated to collect post-treatment outcomes.

### ***Statistical analyses***

Statistical analyses used IBM SPSS Statistics 22.0 for Windows (IBM, New York, USA). A standard alpha of 0.05 was chosen for all tests. Chi-square analyses, independent samples *t*-tests and one-way Analyses of Variance (ANOVA) compared those with a primary diagnosis of SAD and non-clinical controls on demographic variables. The subsample of participants with a principal diagnosis of SAD was randomly divided (via a random computer number generator) into two groups in order to examine the factor structure of the SARQ using both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The AMOS v12 program (Arbuckle, 2013) was used to conduct the CFA’s. Cronbach’s alphas were calculated to determine internal consistency. Test-retest reliability for pre-event rumination was examined by comparing SARQ: Pre-event scores at two time points (three days apart) for participants in a waitlist-control (i.e., no intervention) condition, using Pearson’s correlations, intra-class correlations and paired samples *t*-tests. Convergent validity was assessed using Pearson’s correlations between the SARQ and associated trait and state symptom measures, controlling for relevant covariates. Sensitivity to group CBT treatment for SAD was evaluated by comparing SARQ scores for CBT-treated participants against those in a stress management control condition, before and after the 12-week intervention period, using a mixed effects ANOVA. Change in rumination following CBT treatment was also compared with clinician-rated and self-reported change in symptom severity using Pearson’s correlations. Receiver Operating Characteristic (ROC) Curve Analyses were used

to provide guidelines regarding clinical cut-off scores for the SARQ and to examine associated test performance indicators (sensitivity, specificity, and positive and negative predictive values), using the MedCalc program (MedCalc Software, Mariakerke, Belgium).

## Results

### *Demographic variables*

Participants with a principal diagnosis of SAD ( $n = 505$ ) had a mean clinician severity rating of 5.96 ( $SD = 0.98$ ) on the ADIS, corresponding to a ‘severe’ level of SAD overall. Of these individuals, 51% had a secondary diagnosis of another mental disorder (21% Generalised Anxiety Disorder, 16% unipolar depression, and 14% ‘other’). In addition, 37% of those with a principal diagnosis of SAD also met criteria for comorbid Avoidant Personality Disorder. Of the non-clinical control group ( $n = 130$ ), 98% had no diagnosis of a mental disorder, and 2% met criteria only for a Specific Phobia (unrelated to social or performance contexts). These individuals were retained because they did not differ significantly from those without a diagnosis on any of the listed demographic variables or trait or state symptom measures, all  $p$ 's  $> .05$ , and removing them did not impact the results.

The overall sample predominantly consisted of individuals of either White (61%) or Asian descent (30%) whose first language was English (64%). The sample was primarily employed (53%) or studying full-time (30%), and their highest level of completed education was ‘high school or less’ (47%). They were predominantly single or dating (53%) and had no children (79%). Those with a principal diagnosis of SAD did not significantly differ from non-clinical controls on measures of age,  $t(625) = .79, p = .43$ ; gender,  $(\chi^2(1, N = 627) = .34, p = .56$ ; relationship status,  $\chi^2(2, N = 622) = 2.69, p = .26$ ; number of children,  $\chi^2(1, N = 562) = .44, p = .51$ ; level of education,  $\chi^2(3, N = 622) = 5.02, p = .17$ ; employment status,  $\chi^2(2, N = 581) = 5.67, p = .06$ ; ethnicity,  $\chi^2(4, N = 309) = 4.26, p = .37$ ; or language,  $\chi^2(1, N = 174) = .002, p = .97$ . Table 1 displays the mean scores for trait (SIAS, SPS, BFNE, DASS-21) and

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state (SAR, SPQ) symptom measures by group. Those with a primary diagnosis of SAD scored significantly higher than non-clinical controls on all trait and state symptom measures, all  $F$ 's > 131.01, all  $p$ 's < .001.

Table 1. Mean scores on trait and state symptom measures and group differences for participants with a principal diagnosis of SAD and non-clinical controls.

Measure	Clinical SAD Mean (SD)	Non-clinical controls Mean (SD)	Group difference $F$ -value
SIAS	51.73 (12.74)	12.68 (8.19)	1084.94***
SPS	32.12 (14.52)	5.68 (5.94)	408.86****
BFNE	45.59 (9.70)	14.97 (5.85)	548.71***
DASS-21			
Depression	17.57 (10.53)	3.91 (4.04)	207.35***
Anxiety	14.50 (8.48)	2.98 (3.47)	227.50***
Stress	19.82 (9.14)	7.47 (5.50)	214.71***
SAR			
Pre-speech	20.10 (10.01)	4.21 (4.88)	294.99***
Post-speech	20.50 (10.73)	5.18 (6.21)	224.92***
SPQ			
Pre-speech	30.50 (10.76)	49.48 (8.77)	312.19***
Post-speech	34.50 (11.63)	48.21 (9.60)	131.01***

Note: BFNE = Brief Fear of Negative Evaluation, DASS-21 = Depression Anxiety Stress Scales, SAR = State Anxiety Rating, SIAS = Social Interaction Anxiety Scale, SPQ = Speech Performance Questionnaire, SPS = Social Phobia Scale, \*\*\* =  $p < .001$ ; \*\*\*\* =  $p < .0001$ .

***Exploratory Factor Analyses (EFA)***



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Only those participants with a principal diagnosis of SAD were used for the EFA's. Separate EFA's were conducted for the SARQ: Pre-event (n = 196) and SARQ: Post-event (n = 196) using Maximum Likelihood extraction.

*Pre-event rumination:* Examination of eigenvalues indicated a one-factor solution for pre-event rumination, with only one eigenvalue greater than or equal to 1, which was also supported by the Scree plot. The one-factor solution explained 61.17% of the total variance. Factor loadings for the 12 items were all above .58, and as such all items were retained.

*Post-event rumination:* A one-factor solution was also indicated for post-event rumination, also supported by inspection of the Scree plot, explaining 62.97% of the total variance. Factor loadings for all items were above .61; all items were retained. Refer to Table 2 for the factor loadings for each of the 12 items on the pre-event and post-event rumination scales of the SARQ.

Table 2. Results of Exploratory Factor Analyses of the SARQ: Pre-event (n = 196) and SARQ: Post-event (n = 196) measures.

SARQ: Pre-event items	Factor loading	SARQ: Post-event items	Factor loading
1. I will feel very anxious	.77	1. I felt very anxious	.83
2. I will make a lot of mistakes	.81	2. I made a lot of mistakes	.78
3. The investigator won't like me	.65	3. The investigator didn't like me	.69
4. I will look nervous/anxious	.80	4. I looked nervous/anxious	.82
5. I will make a fool of myself	.86	5. I made a fool of myself	.83
6. I always do badly at this sort of thing	.80	6. I always do badly at this sort of thing	.75
7. I will look stupid	.88	7. I looked stupid	.88
8. I will feel very self-conscious	.80	8. I felt very self-conscious	.83
9. I will feel like a failure	.76	9. I felt like a failure	.76
10. I will feel awkward	.80	10. I felt awkward	.84
11. My heart will pound very fast	.58	11. My heart was pounding very fast	.61

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12. I will make a bad impression	.82	12. I made a bad impression	.85
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Note: SARQ: Pre-event = Socially Anxious Rumination Questionnaire: Pre-event rumination, SARQ: Post-event = Socially Anxious Rumination Questionnaire: Post-event rumination.

### ***Confirmatory Factor Analyses (CFA)***

In order to assess the goodness of fit of the one-factor solutions determined by the EFA's, CFA's were conducted for the SARQ: Pre-event and SARQ: Post-event. Only participants with a principal diagnosis of SAD were included in the CFA's. Within-factor correlated errors with covariances of greater than 4.0 were permitted to covary within the model if there was sufficient theoretical rationale for doing so (Brown, 2015).

*Pre-event rumination:* Data from 203 participants (16.92 participants per item on the scale) showed that the single-factor model for pre-event rumination demonstrated a good fit to the data,  $\chi^2/df = 1.60$ , IFI = .98, TLI = .98, CFI = .98; RMSEA = .05; PCLOSE = .35.

*Post-event rumination:* The single-factor solution also demonstrated good fit for post-event rumination (n = 207; 17.25 participants per item on the scale),  $\chi^2/df = 1.32$ , IFI = .99, TLI = .99, CFI = .99; RMSEA = .04; PCLOSE = .74.

### ***Internal consistency***

Cronbach's alphas ( $\alpha$ ) were calculated for the SARQ: Pre-event and SARQ: Post-event for the overall sample as well as for clinical SAD and non-clinical groups separately. Excellent internal consistency was found for both the SARQ: Pre-event (overall sample:  $\alpha = .96$ ; clinicals:  $\alpha = .94$ ; non-clinicals:  $\alpha = .92$ ) and SARQ: Post-event (overall sample:  $\alpha = .96$ ; clinicals:  $\alpha = .95$ ; non-clinicals:  $\alpha = .94$ ).

### ***Group differences***

The minimum possible total score on the SARQ is 0 and the maximum possible score is 48. For the overall sample, total scores ranged from 0 to 47 on the SARQ: Pre-event and from 0 to 46 on the SARQ: Post-event. These were also the ranges of scores for individuals

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with a principal diagnosis of SAD. Total scores for non-clinical controls ranged from 0 to 33 on the SARQ: Pre-event and from 0 to 35 on the SARQ: Post-event. Neither floor nor ceiling effects were present, as defined by Terwee et al. (2007). The mean total scores for each group are displayed in Table 3. As expected, those with a principal diagnosis of SAD scored significantly higher than non-clinical controls on both pre-event,  $F(1, 534) = 332.88, p < .001, \eta_p^2 = .38$ , and post-event rumination,  $F(1, 517) = 105.89, p < .001, \eta_p^2 = .17$ .

Table 3. Mean total scores and standard deviations for the SARQ: Pre-event and SARQ: Post-event for the clinical SAD and non-clinical control groups, by gender.

	Clinical SAD		Non-clinical controls	
	Mean (SD)		Mean (SD)	
	Men	Women	Men	Women
SARQ: Pre-event	23.84 (11.12)	26.32 (11.69)	5.63 (6.30)	5.97 (6.93)
SARQ: Post-event	15.08 (11.19)	18.03 (12.10)	4.88 (6.98)	4.52 (7.39)

Note: SAD = Social Anxiety Disorder, SARQ: Pre-event = Socially Anxious Rumination Questionnaire: Pre-event rumination, SARQ: Post-event = Socially Anxious Rumination Questionnaire: Post-event rumination.

### ***Normality***

Inspection of Q-Q plots for the SARQ: Pre-event and SARQ: Post-event indicated that the data was approximately normally distributed for the combined sample. Frequency histograms indicated a positive skew for both the SARQ: Pre-event and SARQ: Post-event, which is to be expected in light of the large non-clinical sample who predictably engaged in lower levels of pre- and post-event rumination. Furthermore, according to the central limit theorem, the sampling distribution for large sample sizes (i.e.,  $N > 30$  or  $40$ ) is generally normal regardless of the shape of the data, and parametric tests can be reliably used (Ghasemi & Zahediasl, 2012).

***Test-retest reliability***

Test-retest reliability for pre-event rumination was determined by comparing SARQ: Pre-event scores for 25 waitlist-control participants (all with a principal diagnosis of SAD) at two time points: three days prior to the speech and immediately before the speech. The Pearson's correlation between the two time points was large and significant,  $r = .91, p < .001$ , as was the intraclass correlation coefficient,  $ICC = .90, p < .001$ . However, a paired samples  $t$ -test indicated a significant difference between the two time points,  $t(24) = 2.53, p = .02$ , whereby rumination levels were significantly higher immediately before the speech ( $M = 22.00, SD = 12.90$ ) compared to three days earlier ( $M = 19.24, SD = 11.99$ ). Given that the SARQ is a state measure, one would expect it to be sensitive to fluctuating rumination levels, and scores on the SARQ: Pre-event would be expected to increase as the social threat task becomes imminent (i.e., immediately before the speech).

***Construct validity***

Current evidence for construct validity was determined by examining convergent and discriminant validity. To assess convergent validity, pre-event rumination was correlated with baseline trait measures as well as state measures completed immediately *before* the speech task, while post-event rumination was correlated with baseline trait measures and state measures that were completed immediately *after* the speech.

*Convergent validity:* Pre-event rumination was significantly positively correlated with trait symptom measures, including the SIAS,  $r = .67, p < .001$ , SPS,  $r = .64, p < .001$ , and BFNE,  $r = .66, p < .001$ . Pre-event rumination also significantly correlated with state measures of anxiety, SAR:  $r = .81, p < .001$ , and subjective performance ratings, SPQ:  $r = -.78, p < .001$ , such that higher levels of rumination were associated with higher state anxiety and lower self-perceptions of performance. Finally, pre-event rumination significantly correlated with post-event rumination,  $r = .64, p < .001$ . Given that rumination is also a well-

known feature of depression (e.g., Papageorgiou & Wells, 2004), the above correlations were also calculated while controlling for DASS-21 Depression subscale scores, and all remained statistically significant, all  $r$ 's  $> .37$ , all  $p$ 's  $< .001$ . A similar pattern of results was observed for post-event rumination, which significantly correlated with trait symptom measures including the SIAS,  $r = .48$ ,  $p < .001$ , SPS,  $r = .55$ ,  $p < .001$ , and BFNE,  $r = .38$ ,  $p < .001$ . Post-event rumination also correlated with state anxiety, SAR:  $r = .64$ ,  $p < .001$ , and state subjective performance ratings, SPQ:  $r = -.66$ ,  $p < .001$ . Again, these correlations remained significant when controlling for DASS-21 Depression subscale scores, all  $r$ 's  $> .24$ , all  $p$ 's  $< .02$ .

*Discriminant validity:* Gender was not significantly correlated with either pre-event rumination,  $r = .03$ ,  $p = .47$ , or post-event rumination,  $r = .07$ ,  $p = .13$ , and this is consistent with findings in previous studies (Abbott & Rapee, 2004; Hagen, Battista, Couture, Pencer, & Stewart, 2020; Perini et al., 2006).

### ***Sensitivity to CBT treatment***

Sensitivity to CBT treatment was assessed by examining SARQ scores for 233 clinical participants with a principal diagnosis of SAD, before and after a 12-week group CBT program ( $n = 192$ ) compared with a 12-week 'stress management' active treatment control condition ( $n = 41$ ) using a mixed effects ANOVA. The assumptions for a mixed effects ANOVA were tested and met; five outliers were identified; however, they were retained because removing them did not alter the results.

*Pre-event rumination:* Table 4 displays the mean pre-event and post-event rumination scores for each treatment condition at two time points, along with measures of effect size (Cohen's  $d$ ). A mixed effects ANOVA was conducted to assess whether pre-event rumination scores showed significantly greater change from pre- to post-treatment for the CBT treatment condition compared with the stress management condition. Results showed a significant time

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by condition interaction, whereby the reduction in pre-event rumination scores over the 12-week period was greater for those who received CBT treatment than for those receiving stress management,  $F(1, 231) = 16.30, p < .001$ . Reduction in pre-event rumination following CBT was significantly correlated with reduction in clinician-rated symptom severity,  $r = .24, p < .001$ , and self-reported social anxiety symptom severity,  $r = .28, p < .001$ . Interestingly, change in pre-event rumination following CBT was highly correlated with pre-event rumination levels at baseline,  $r = .56, p < .001$ , but not post-event rumination levels at baseline,  $r = .12, p = .09$ , suggesting that CBT had a stronger impact on pre-event rumination for those with higher initial levels of pre-event rumination.

*Post-event rumination:* A mixed effects ANOVA showed a significant time by condition interaction, such that the reduction in post-event rumination scores following the intervention period was significantly greater for those receiving group CBT compared with those receiving stress management,  $F(1, 195) = 4.53, p = .04$ . Decreases in post-event rumination scores after 12 weeks of CBT was significantly correlated with decreases in self-reported social anxiety symptom severity,  $r = .21, p = .004$ , but not changes in clinician-rated symptom severity,  $r = .12, p = .08$ . Finally, change in post-event rumination following CBT was correlated with both pre-event rumination at baseline ( $r = .22, p = .002$ ) and post-event rumination at baseline ( $r = .64, p < .001$ ), indicating that CBT had a stronger impact on post-event rumination for those with higher initial levels of pre-event and post-event rumination. Change in pre-event rumination following CBT was also significantly correlated with change in post-event rumination,  $r = .29, p < .001$ . As can be seen in Table 4, effect sizes for pre-post change were large for CBT but small for the stress management condition.

Table 4. Mean pre-event and post-event rumination scores, standard deviations and effect sizes for the two treatment conditions, before and after the treatment period.

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	SARQ: Pre-event			SARQ: Post-event		
	Pre-treatment	Post-treatment	Cohen's <i>d</i>	Pre-treatment	Post-treatment	Cohen's <i>d</i>
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
CBT treatment	26.46 (11.27)	13.96 (10.10)	1.17	17.35 (12.43)	8.49 (9.82)	.79
Stress management	21.40 (11.68)	16.81 (13.88)	.36	12.66 (10.38)	7.97 (8.78)	.49

Note: CBT = Cognitive Behavioural Therapy, SARQ: Pre-event = Socially Anxious Rumination Questionnaire: Pre-event rumination, SARQ: Post-event = Socially Anxious Rumination Questionnaire: Post-event rumination, SD = standard deviation.

### ***Clinical cut-off scores and test performance indicators***

*Predicting clinically significant SAD:* While the SARQ is not intended to be used for diagnostic purposes, Receiver Operating Characteristic (ROC) Curve Analyses were conducted to provide cut-off scores for clinically significant levels of pre-event and post-event rumination that are consistent with a clinical SAD population, and to examine associated test performance indicators (sensitivity, specificity, positive predictive values [PPV] and negative predictive values [NPV]). The ROC Curve Analyses for pre-event rumination were conducted using a sample of 404 individuals with a principal diagnosis of SAD and 129 non-clinical controls (SAD prevalence rate: 76%), while the sample for post-event rumination comprised 406 clinical SAD participants and 112 non-clinical controls (SAD prevalence rate: 78%). Table 5 displays the results from the ROC Curve Analyses. The identified cut-off scores explained significant area under the curve (AUC), indicating that they showed a strong ability to discriminate between those with a principal diagnosis of SAD and non-clinical controls. Interestingly, the cut-off scores were notably higher for pre-event rumination than for post-event rumination. When the ROC Curve Analyses were conducted a second time using a SAD prevalence rate of 7% to reflect population estimates (Kessler et al., 2005), clinical cut-off scores, AUC values and sensitivity and specificity indicators remained

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the same, while the PPV and NPV changed (pre-event scale: PPV = 41.0, 95% CI [28.3, 55.1], NPV = 98.3, 95% CI [97.9, 98.6]; post-event scale: PPV = 19.2, 95% CI [14.8, 24.6], NPV = 98.2, 95% CI [97.7, 98.6]).

*Predicting comorbid Avoidant Personality Disorder (APD):* Given that a subset of participants with SAD also met criteria for comorbid APD, ROC Curve Analyses were also used to calculate clinical cut-off scores and test performance indicators for predicting comorbid APD in individuals with SAD. These cut-off scores are for predictive purposes and are not intended to be used diagnostically. The results of the ROC Curve Analyses are displayed in Table 5. The current sample comprised participants with SAD only (Pre-event: n = 227; Post-event: n = 237) and participants with both SAD and APD (Pre-event: n = 175; Post-event: n = 167). The prevalence of comorbid APD was 44% in the pre-event sample and 41% in the post-event sample. Results indicated that the SARQ was able to discriminate between those with a comorbid diagnosis of APD and SAD and those with SAD only, as indicated by significant AUC values. Again, cut-off scores were higher for pre-event rumination than for post-event rumination.

Table 5. Clinical cut-off scores, sensitivity, specificity, positive and negative predictive values and area under the curve (AUC) for the SARQ: Pre-event and SARQ: Post-event in distinguishing i) individuals with a principal diagnosis of SAD from non-clinical controls, and ii) individuals with a principal diagnosis of SAD, with and without comorbid APD.

		Cut-off score	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	AUC (95% CI)
SARQ: Pre-event	SAD vs	>15	78.7	91.5	96.7	57.8	.92****
	Non-clinical		(74.4 – 82.6)	(85.3 – 95.7)	(94.2 – 98.1)	(53.0 – 62.5)	(.90 - .94)
SARQ: Post-event	SAD vs	>31	41.7	76.2	57.5	62.9	.58***
	SAD+APD		(34.3 – 49.4)	(70.1 – 81.6)	(50.3 – 64.4)	(59.5 – 66.2)	(.58 - .67)



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SARQ: Post-event	SAD vs	>4	81.8	74.11	92.0	52.9	.83****
	Non-clinical		(77.7 – 85.4)	(65.0 – 81.9)	(89.3 – 94.0)	(47.0 – 58.6)	(.80 - .87)
	SAD vs	>8.7	75.5	38.0	46.2	68.7	.57*
	SAD+APD		(68.2 – 81.8)	(31.8 – 44.5)	(42.9 – 49.4)	(61.6 – 75.0)	(.52 - .62)

Note: AUC = Area under the curve, CI = Confidence Interval, NPV = Negative predictive value, PPV = Positive predictive value, SAD = Principal diagnosis of Social Anxiety Disorder, SAD+APD = Principal diagnosis of Social Anxiety Disorder with comorbid Avoidant Personality Disorder, SARQ: Pre-event = Socially Anxious Rumination Questionnaire: Pre-event rumination, SARQ: Post-event = Socially Anxious Rumination Questionnaire: Post-event rumination, \* =  $p < .05$ , \*\*\* =  $p < .005$ , \*\*\*\* =  $p < .0001$ .

### Discussion

This study aimed to investigate the psychometric properties of the Socially Anxious Rumination Questionnaire (SARQ) using a large clinical sample of individuals with Social Anxiety Disorder (SAD). Consistent with predictions, the results of the exploratory and confirmatory factor analyses indicated that pre-event and post-event rumination are unitary constructs that can be successfully captured by the SARQ in a single, state-based measure. Also, as predicted, we found that the SARQ has excellent internal consistency, good test-retest reliability, strong construct validity, and is sensitive to changes in state pre-event and post-event rumination following group cognitive behavioural therapy. Finally, consistent with hypotheses, we found that the SARQ showed an excellent ability to discriminate between i) individuals with clinical levels of SAD compared to those without a psychological disorder, and ii) those with a principal diagnosis of SAD with and without comorbid APD. The cut-off scores for these clinical thresholds were found to be much higher for pre-event rumination than for post-event rumination.

Taken together, these findings indicate that the SARQ is a psychometrically robust state-based measure of pre-event and post-event rumination in individuals with SAD. While

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most of our findings were as predicted, it is noteworthy that the clinical cut-off scores were considerably higher for the SARQ: Pre-event (SAD clinical cut-off score = 15) compared with the SARQ: Post-event (SAD clinical cut-off score = 4), suggesting that the experience of pre-event rumination is perhaps more common in the general population, while the experience of post-event rumination may be more specific to those experiencing social anxiety. As such, higher levels of pre-event rumination are needed to reach the clinical SAD threshold. Possible explanations for this difference include: i) that the potential threat of future social embarrassment is also salient for non-clinical individuals, however their estimations of the probability and cost of negative outcomes is simply less pronounced than for those with SAD; and/or ii) both groups may, to some extent, hold positive metacognitive beliefs about pre-event rumination (e.g., that it will make them more prepared), which further reinforces rumination in anticipation of a social threat event.

Following the speech, those with SAD are more likely to continue thinking about their perceived negative performance and its potential consequences, while non-clinical individuals seem less inclined to do so. The lower clinical threshold for post-event rumination may reflect the possibility that individuals with SAD perform objectively worse than non-clinical individuals and therefore have more to retrospectively agonise over. However, this explanation is unlikely, since research indicates that objective speech performance ratings are comparable for those with and without SAD (Rapee & Lim, 1992; Voncken & Bogels, 2008). Instead, a more likely explanation is that individuals with SAD appraise their performance more negatively (and inaccurately) compared to non-clinical individuals (Cody & Teachman, 2011; Rapee & Lim, 1992), making them more inclined to ruminate afterwards, as predicted by the Clark and Wells (1995) model of social anxiety. Indeed, it has been shown that the degree of post-event rumination one week after a social event is strongly predicted by the perceived performance following the event (Abbott & Rapee, 2004). Additionally,

individuals with SAD may hold more positive and negative metacognitive beliefs about the helpfulness and controllability of post-event rumination that ultimately serve to maintain the ruminative process, akin to metacognitive models of worry in generalised anxiety disorder (see Wells, 2009). Furthermore, for non-clinical individuals, it is likely that the social threat has passed once the speech is over, meanwhile for individuals with SAD the threat of social rejection (as a consequence of perceived poor performance, etc.) is potentially ongoing even after the event has passed, resulting in a continued tendency to ruminate following the speech. That is, without direct disconfirmation of negative evaluation, probability and cost estimates remain high for individuals with SAD, but perhaps diminish quickly for non-clinical individuals after the event. Regardless, our observed discrepancy between clinical cut-off scores for the SARQ: Pre-event versus the SARQ: Post-event is consistent with existing research positing that pre-event and post-event rumination, while similar, show some important theoretical distinctions (Modini et al., 2018a; 2018b).

The findings of the current study justify the SARQ's use as a valid and reliable measure of state pre-event and post-event rumination in SAD. The availability of a psychometrically sound measure of both pre- and post-event rumination in relation to social threat facilitates the ability of researchers to further explore the processes underlying rumination in SAD, including how rumination interacts with other hypothesised processes to maintain social anxiety symptoms. The SARQ is also a useful tool in clinical settings: i) to identify individuals who show particularly high levels of pre-event or post event rumination (given that these individuals tend to experience more severe symptoms and respond more slowly to treatment); and ii) as a means of assessing change in state pre-event and post-event rumination throughout treatment in relation to exposure to perceived social threat.

Merits of the current study include its use of a large clinical sample of individuals with SAD, the employment of both EFA and CFA in determining the SARQ's factor

structure, and the adherence to the quality criteria outlined by Terwee et al. (2007) for evidence-based evaluation of health questionnaires. Limitations warranting consideration include the need to conduct test-retest reliability analyses for both pre- and post-event rumination, and that the test-retest timeframe for the SARQ: Pre-event was only a three-day interval, allowing the possibility of recall effects. Individuals with SAD existed in larger numbers than non-clinical controls, however this is unlikely to have significantly impacted the results as both groups were sufficiently large that neither lacked power. In assessing the SARQ's sensitivity to evidence-based treatment, the group-delivered CBT treatment condition displayed higher initial levels of pre-event and post-event rumination at baseline than did the stress management condition, despite random allocation. However, the significantly larger reductions in pre-event and post-event rumination following CBT treatment (compared to active treatment control) remains a significant and large effect. It would be useful to extend the current findings in future research to related social threat tasks (such as social interaction tasks), particularly so for pre-event rumination which has been less thoroughly examined using the SARQ compared with post-event rumination. It would also be useful to assess the relationship between the SARQ and general measures of rumination such as the Ruminative Response Scale (RRS) of the Response Styles Questionnaire (RSQ; Treynor et al., 2003).

The SARQ has emerged as a robust and reliable measure of state pre-event and post-event rumination in individuals with SAD. These findings justify its continued use in the endeavour to better understand and treat pre-event and post-event rumination as underlying processes than maintain symptoms of social anxiety disorder.

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