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Repetitive Thinking in Social Anxiety Disorder: Are Anticipatory Processing and Post-Event Processing Facets of an Underlying Unidimensional Construct?

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Existing literature suggests that anticipatory processing and post-event processing—two repetitive thinking processes linked to social anxiety disorder (SAD)—might be better conceptualized as facets of an underlying unidimensional repetitive thinking construct. The current study tested this by examining potential factor structures underlying anticipatory processing and post-event processing. Baseline data from two randomized controlled trials, consisting of 306 participants with SAD who completed anticipatory processing and post-event processing measures in relation to a speech task, were subjected to confirmatory factor analysis. A bifactor model with a General Repetitive Thinking factor and two group factors corresponding to anticipatory processing and post-event processing best fit with the data. Further analyses indicated an optimal model would include only the General Repetitive Thinking factor (reflecting anticipatory processing and a specific aspect of post-event processing) and Post-event Processing group factor (reflecting another specific aspect of post-event processing that is separable), providing evidence against a unidimensional account of repetitive thinking in SAD. Analyses also indicated that the General Repetitive Thinking factor had moderately large associations with social anxiety and life interference (*r*s = .43 to .47), suggesting its maladaptive nature. The separable Post-event Processing group factor only had small associations with social anxiety (*r*s = .16 to .27) and was not related to life interference (*r* = .11), suggesting it may not, in itself, be a maladaptive process. Future research that further characterises the bifactor model components and tests their utility has the potential to improve the conceptualisation and assessment of repetitive thinking in SAD.

Keywords: social anxiety; anticipatory processing; post-event processing; repetitive thinking; bifactor model

Social anxiety disorder (SAD) is a high-impact disorder given its chronicity, debilitating nature, and burden on the individual and society (Acarturk et al., 2009; Wittchen & Fehm, 2003). Efforts have therefore concentrated on understanding the factors that explain persistence of the disorder and developing strategies to mitigate these factors. Maintenance models of SAD have proposed cognitive and behavioral processes that reinforce maladaptive

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social-evaluative beliefs about the self and social-evaluative situations, resulting in disorder persistence (Clark & Wells, 1995; Rapee & Heimberg, 1997; for a review, see Wong & Rapee, 2016). Two of the maintaining processes in these models are anticipatory processing and post-event processing. Both these processes are repetitive thinking processes, with the former occurring prior to a social-evaluative situation and the latter occurring after such a situation. Both processes involve a negatively biased evaluation of the social-evaluative situation, and also thoughts about previous social failures and negative aspects of the self. Although anticipatory processing and post-event processing have common features from a theoretical perspective, they are considered to be distinct constructs in the literature. There currently has been no empirical evaluation of whether these processes are better conceptualized as two facets of an underlying unidimensional repetitive thinking construct.

Existing research on anticipatory and post-event processing has mainly focused on testing their maintaining role as delineated in models of SAD. For example, correlational research has shown that both processes are associated with trait social anxiety (e.g., Blackie & Kocovski, 2017; Mills, Grant, Lechner, & Judah, 2013; Vassilopoulos, 2004; Wong, 2015) and correlated with each other (Laposa & Rector, 2016; Schreiber, Höfling, Stangier, Bohn, & Steil, 2012; Wong et al., 2017). Experimental research has shown that the induction of each process results in higher levels of social anxiety and more negative cognitive outcomes for socially anxious individuals (e.g., Kocovski, MacKenzie, & Rector, 2011; Mills, Grant, Judah, & White, 2014; Wong & Moulds, 2009; Wong & Moulds, 2011). Moreover, there are reductions in both processes after a course of cognitive-behavioral therapy (CBT; Hedman et al., 2013; McEvoy & Perini, 2009; Price & Anderson, 2011), and higher pretreatment levels of either anticipatory processing or post-event processing predicts a slower rate of decrease in the other repetitive thinking process from pre- to post-CBT (Wong et al., 2017). These empirical findings further highlight the similarities between anticipatory processing and post-event processing, and suggest that the two processes may be interlinked as aspects of an underlying unidimensional repetitive thinking construct.

Other evidence suggesting the link between anticipatory processing and post-event processing are studies that have shown that underlying other forms of repetitive thinking (e.g., worry, rumination) is a single latent transdiagnostic repetitive negative thinking dimension (Ehring et al., 2011; McEvoy, Mahoney, & Moulds, 2010). This latent dimension reflects perseverative mental processing of the negative aspects of one's current, past, or future experiences. There are several advantages of this unidimensional account. First, theoretically, the unidimensional account is more parsimonious than a multidimensional account. Second, the unidimensional account may better map on to broad underlying cognitive deficits (e.g., impaired attentional disengagement from negative information) and neurobiological dysfunctions inherent in mental disorders (e.g., Koster, De Lissnyder, Derakshan, & De Raedt, 2011; see also Research Domain Criteria initiative; Insel et al., 2010), potentially furthering our understanding of the mechanisms contributing to repetitive negative thinking. Third, assessment of a unidimensional process, or targeting a unidimensional process in treatment, is more efficient than assessing or treating multiple processes.

Given the advantages of a unidimensional account, the current study aimed to test whether anticipatory processing and post-event processing can be conceptualized as two facets of an underlying unidimensional repetitive thinking construct. Following previous research (Wong et al., 2017), we utilized an anticipatory version and a post-event version of the negative subscale of the Thoughts Questionnaire (TQ; Edwards, Rapee, & Franklin, 2003) to measure anticipatory processing and post-event processing, respectively. Previous studies have found one factor underlying the negative subscale of the TQ (e.g., Gramer, Schild, & Lurz, 2012). Thus, in a sample of individuals with SAD, several competing factor models were examined and compared using confirmatory factor analysis (CFA): (a) a one-factor model (one factor for both anticipatory processing and post-event processing items), (b) a correlated two-factor model (one factor for anticipatory processing items and one factor for post-event processing items), and (c) a bifactor model (see Reise, 2012; one factor for anticipatory processing items, one factor for post-event processing items, and one General Repetitive Thinking factor for all items). We predicted that the bifactor model, with its ability to account for anticipatory processing and post-event processing dimensions as well as a general repetitive thinking dimension (McEvoy et al., 2010), would demonstrate a superior fit to the data relative to other models. We planned to examine bifactor model indices if the bifactor model emerged as the best fitting model. We also planned exploratory analyses of associations between factor(s) in the best fitting model with symptom and other SAD-related measures.

Method

PARTICIPANTS

The sample for the current study was pooled from two independent samples of individuals with SAD, each recruited for a manualized treatment trial for SAD at the Centre for Emotional Health Clinic (Rapee, Gaston, & Abbott, 2009; Rapee et al., 2013). For both trials, participants were included if they were over 18 years old and had SAD as their most interfering disorder, and excluded if they had suicidal intent, unmanaged substance use, florid psychosis, a recent change in medication type or dosage, or planned to change medication. The current study utilized all individuals with a primary diagnosis of SAD who were assessed for eligibility for one of the treatment trials and who participated in a pretreatment research session (N = 306; 153 female; mean age = 33.62, SD = 10.80). A primary diagnosis of SAD was given by graduate students and clinical psychologists based on the Anxiety Disorders Interview Schedule–IV (ADIS–IV; Di Nardo, Brown, & Barlow, 1994). Reliability analyses for one of the trials (Rapee et al., 2009) has indicated diagnostic procedures used in the clinic yield substantial agreement in the assignment of a SAD diagnosis (κ = .86). Of the 306 participants, 40% had an additional anxiety disorder and 27% had a mood disorder. Furthermore, 68% were born in Australia, 60% were never married, 44% held a bachelor degree or higher, and 44% were employed full-time.

MEASURES AND PROCEDURE

For the main CFAs, we utilized the 14-item Anticipatory version of the negative subscale of the Thoughts Questionnaire (ATQ; Edwards et al., 2003; Wong et al., 2017) and the 14-item Post-event version of the negative subscale of the Thoughts questionnaire (PTQ; Edwards et al., 2003; Wong et al., 2017). The ATQ assessed frequency of anticipatory processing in the week prior to participation in a speech task and the PTQ assessed frequency of post-event processing in the week following participation in the speech task. Items are essentially identical across the ATQ and PTQ except for word tense (e.g., "I will feel like a failure" versus "I felt like a failure"). Previous research has demonstrated the reliability and validity of the ATQ and PTQ (e.g., Cronbach's α = .94 and .96 respectively; expected associations with measures of social anxiety ranging from .37 to .43; Wong et al., 2017). We also used several symptom measures. The 17-item straightforward items of the Social Interaction Anxiety Scale (S-SIAS; Rodebaugh et al., 2011) and the 20-item Social Phobia Scale (SPS; Mattick & Clarke, 1998) assessed social anxiety symptoms. The 21-item short version Depression Anxiety Stress Scales (DASS; Lovibond & Lovibond, 1995) 7-item depression subscale (DASS-D) and 7-item anxiety subscale (DASS-A) assessed depression and general anxiety symptoms. In addition, several SAD-related measures were administered. The 6-item Life Interference Scale (LIS; Rapee et al., 2009) assessed participants' perceived impact of social anxiety on their life. The 17-item Performance Questionnaire (PQ; Rapee & Lim, 1992) assessed participant's own appraisal of their performance on a speech task. The Attentional Focus Questionnaire (AFQ; Abbott & Rapee, 2006) has three subscales (4 items for attention to past experiences, 5 items for attention to physical symptoms, and 5 items for attention to negative evaluation) used to assess maladaptive attentional focus during a speech task, and one subscale (4 items) to assess task focus (i.e., focus on the speech itself). The reliability (Cronbach's α) of all measures in the current study are shown in Table 1.

Procedures for enrollment and inclusion into the treatment trials have been outlined previously (Rapee et al., 2009; Rapee et al., 2013). Procedures directly related to the current study involved participants first completing the ADIS-IV with a clinician and questionnaires (including the S-SIAS, SPS, DASS, LIS). They were then scheduled for a pretreatment research session. One week prior to this session, participants were informed they would be completing a speech task at the session. Participants then attended the session and completed an ATQ. Participants were then instructed to give a video-recorded 3-minute speech on a topic of their own choice and informed their performance would be rated later by two coders. Participants then completed the speech, and then the PQ and AFQ. One week after, participants completed a PTQ. Eligible participants subsequently entered into the relevant treatment trial or were referred on. All procedures were approved by the Macquarie University Human Research Ethics Committee.

ANALYSES

Model Evaluation

CFAs were conducted with the R package "lavaan" (Rosseel, 2012) to test and compare the fit of the competing models to the data. Notably, for the bifactor model, the covariances between factors were fixed to zero (Reise, 2012). The ATQ and PTQ may be thought of as constituting ordinal data since their Likert response scales may reflect unequal distances between response options. Therefore, all CFAs were conducted with the weighted least squares with mean and variance adjusted (WLSMV) estimator. To evaluate model fit, the following fit indices were used (Brown, 2006): the χ^2 statistic (smaller values indicate better fit), the comparative fit index (CFI; values $\geq$ .90 suggest

Table 1
Means, Standard Deviations, and Bivariate Correlations for the Measures

Variable	Range	Mean (*SD*)	Cronbach's α	1	2	3	4	5	6	7	8	9	10
1. S-SIAS	0-68	44.03 (12.25)	.90	-									
2. SPS	0-80	32.23 (14.82)	.90	.57**	-								
3. DASS-D	0-42	17.96 (10.75)	.92	.49**	.37**	-							
4. DASS-A	0-42	14.50 (8.11)	.80	.33**	.59**	.38**	-						
5. LIS	0-48	31.80 (9.47)	.85	.62**	.50**	.53**	.45**	-					
6. PQ	0-68	36.12 (10.91)	.88	-.34**	-.39**	-.18*	-.27**	-.26**	-				
7. AFQ – MAF	0-56	17.76 (11.05)	.91	.37**	.40**	.27**	.32**	.36**	-.56**	-			
8. AFQ – TF	0-16	10.67 (3.15)	.74	.24**	.20**	.16*	.18**	.24**	-.16**	.33**	-		
9. ATQ	0-56	29.72 (13.36)	.95	.40**	.40**	.20**	.30**	.41**	-.47**	.55**	.34**	-	
10. PTQ	0-56	19.46 (13.56)	.96	.33**	.43**	.26**	.28**	.32**	-.55**	.56**	.21**	.49**	-
11. Combined ATQ/PTQ	0-112	49.18 (23.20)	.96	.42**	.48**	.27**	.34**	.42**	-.60**	.64**	.32**	.86**	.86**

Note. Higher scores on all measures indicate greater levels of that construct. Notably higher scores on the PQ indicate a more positive view of one's speech performance. The 7-item DASS-D score and 7-item DASS-A score for each participant was doubled to obtain the full DASS-D and full DASS-A equivalents (see Lovibond & Lovibond, 1995). Combined ATQ/PTQ score is the sum of the ATQ and PTQ. S-SIAS = Straightforward items of the Social Interaction Anxiety Scale; SPS = Social Phobia Scale; DASS-D = Depression Anxiety Stress Scales – Depression subscale; DASS-A = Depression Anxiety Stress Scales – Anxiety subscale; LIS = Life Interference Scale; PQ = Performance Questionnaire; AFQ – MAF = Attentional Focus Questionnaire – Maladaptive Attentional Focus; AFQ – TF = Attentional Focus Questionnaire – Task Focus; ATQ = Anticipatory version of the Thoughts Questionnaire; PTQ = Post-event version of the Thoughts Questionnaire.
$^{*}p < .01$, $^{**}p < .001$.

acceptable fit; values ≥ .95 suggest good fit; higher values indicate better fit), the Tucker-Lewis Index (TLI; values ≥ .90 suggest acceptable fit; values ≥ .95 suggest good fit; higher values indicate better fit), the root mean square error of approximation (RMSEA; values ≤ .08 suggest acceptable fit; values ≤ .05 suggest good fit; lower values indicate better fit), and the standard root mean square residual (SRMR; values ≤ .08 suggest acceptable fit; values ≤ .05 suggest good fit; lower values indicate better fit). A test of the difference in χ^2 was used to examine the difference in fit between competing (nested) models.

Bifactor Model Evaluation

Where the bifactor model showed superior fit to the data compared with the other models, we planned to follow recommendations in the literature (e.g., Rodriguez, Reise, & Haviland, 2016a; Rodriguez, Reise, & Haviland, 2016b) and examine several bifactor model indices to determine whether anticipatory processing and post-event processing can be conceptualized as two facets of an underlying unidimensional repetitive thinking construct. First, for the model-based reliability of summary scores, we planned to determine the degree to which the observed total score (corresponding to all ATQ and PTQ items) can be interpreted as reflecting a General Repetitive Thinking factor by examining Omega (proportion of variance in the observed total score attributable to all sources of common variance) and Omega hierarchical (OmegaH; proportion of variance in the observed total score attributable to a General Repetitive Thinking factor). OmegaH > .80 suggests the total score is an appropriate indicator of a general factor and only trivially affected by multidimensionality due to the group factors (Rodriguez et al., 2016a). We also planned to examine the degree to which an observed subscale score (ATQ or PTQ) can be interpreted as an indicator of the relevant group factor (Anticipatory Processing group factor or Post-event Processing group factor) by examining Omega for the subscale (proportion of variance in the observed subscale score attributable to all sources of common variance) and Omega hierarchical subscale (OmegaHS; proportion of variance in the observed subscale score attributable to a group factor after controlling for the variance due to the General Repetitive Thinking factor). Second, for construct reliability, we planned to determine how well each factor was defined by its indicators (and therefore have stability across studies) by examining Coefficient *H* (proportion of variability in a factor explainable by their indicators). *H* > .80 is used to indicate that a factor is well defined by its indicators and can be appropriately specified in measurement models in structural equation modelling (SEM) contexts (Rodriguez et al., 2016a). Third, we planned to determine the degree to which the data could be represented with a unidimensional measurement model by examining Explained Common Variance (ECV; ratio of variance explained by the General Repetitive Thinking factor divided by the variance explained by the General Repetitive

Thinking factor and the two group factors) and the Proportion of Uncontaminated Correlations (PUC; number of correlations between items from the two group factors, divided by the total number of correlations between items in the factor model). Higher ECV values indicate a stronger general factor and more support for the unidimensionality of a scale's items. Higher PUC values indicate a greater proportion of correlations between items reflecting general factor variance only. When ECV and PUC values are both > .70, a unidimensional measurement model may be adopted, and the factor loadings for a unidimensional model and for the general factor in a bifactor model will not be substantially different (Rodriguez et al., 2016a).

Associations With Symptom and SAD-Related Measures

We planned to use an SEM framework to examine unique associations of the factor(s) of the best fitting model with: a social anxiety related to interactions latent variable (S-SIAS items as indicators), a social anxiety related to performance latent variable (SPS items as indicators), a depression latent variable (DASS-D items as indicators), a general anxiety latent variable (DASS-A items as indicators), a life interference latent variable (LIS items as indicators), a speech performance latent variable (PQ items as indicators), a maladaptive attentional focus latent variable (AFQ maladaptive attentional focus items as indicators), and a task focus latent variable (AFQ task focus items as indicators). We planned to focus on effect size estimates (i.e., standardised parameters) and Bonferroni adjusted 95% confidence intervals (CI), with non-overlapping CIs taken as a statistically significant difference between effect sizes.

Results

PRELIMINARY ANALYSES

Participants had 200 missing data-points out of 39,780 possible (99.5% completion rate). Little's Missing Completely at Random test, $\chi^2(5398) = 5468.54$, $p = .247$, indicated randomness in the missing data. As such, missing values were estimated with the expectation-maximization algorithm. Table 1 shows descriptive statistics and correlations for the measures. ATQ and PTQ item scores approximated normality (skewness < 3, kurtosis < 8).

MODEL EVALUATION

As shown in Table 2, the bifactor model fit the data significantly better than the other models. In addition, three of the four fit indices of the bifactor model were within accepted cut-offs for good model fit (i.e., CFI, TLI, SRMR), while the RMSEA indicated acceptable model fit. We also examined modification indices (MI) for the bifactor model. There were six suggested modifications with MI values > 10 (indicating notable potential modifications) for the bifactor model. Three suggested modifications did not make theoretical sense from a bifactor modeling perspective (i.e., allow an ATQ item to load on to the PEP factor, allow correlated error variances between an ATQ item and a PTQ item). The other three suggested modifications related to correlating error variances of items within either the ATQ or the PTQ. Correlated error variances were suggested for the following item pairs: "I will make a fool of myself" and "I will look stupid" on the ATQ, "I will feel very self-conscious" and "I will feel awkward" on the ATQ, and "I felt very self-conscious" and "I felt awkward" on the PTQ. Analysis of the content of these item pairs suggested that they were not similar enough to warrant the addition of correlated error variances. Based on this evaluation of the MIs, we did not make any modifications to the bifactor model. Standardized factor loadings of the bifactor model are shown in Table 3.

BIFACTOR MODEL INDICES

Bifactor model indices are shown in Table 3. In terms of the reliability of summary scores, it is noteworthy that OmegaH for the General Repetitive Thinking

Table 2
Fit Indices for the Factor Models Tested With CFA and Model Comparisons

Model	*df*	χ^2	CFI	TLI	RMSEA	SRMR	Model fit comparison (χ^2 difference test)
1. One-factor model	350	2857.66***	.869	.858	.153	.182	Model 3 > Model 1 [a], Model 2 > Model 1 [b]
2. Correlated two-factor model	349	779.83***	.977	.976	.064	.056	Model 3 > Model 2 [c]
3. Bifactor model	322	699.99***	.980	.977	.062	.043	

Note. CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = standard root mean square residual.
*$p < .05$, **$p < .01$, ***$p < .001$.
[a] $\chi^2(28) = 2157.67$, $p < .001$.
[b] $\chi^2(1) = 2077.83$, $p < .001$.
[c] $\chi^2(27) = 79.84$, $p < .001$.

Table 3
Standardized Factor Loadings of the Bifactor Model and Bifactor Model Indices

Item/Index	General Repetitive Thinking Factor	Anticipatory Processing Group Factor	Post-event Processing Group Factor
ATQ1: I will feel very anxious	0.692	0.535	
ATQ2: I will make a lot of mistakes	0.766	0.359	
ATQ3: My topic won't be very good	0.575	0.396	
ATQ4: The investigator won't like me	0.743	0.063	
ATQ5: I will look nervous/anxious	0.699	0.395	
ATQ6: My speech will be really bad	0.836	0.286	
ATQ7: I will make a fool of myself	0.832	0.307	
ATQ8: I always do badly at this sort of thing	0.779	0.229	
ATQ9: I will look stupid	0.859	0.228	
ATQ10: I will feel very self-conscious	0.710	0.488	
ATQ11: I will feel like a failure	0.848	-0.038	
ATQ12: I will feel awkward	0.677	0.540	
ATQ13: My heart will pound very fast	0.564	0.280	
ATQ14: I will make a bad impression	0.914	-0.062	
PTQ1: I felt very anxious	0.514		0.694
PTQ2: I made a lot of mistakes	0.471		0.674
PTQ3: My topic wasn't very good	0.270		0.625
PTQ4: The investigator didn't like me	0.515		0.544
PTQ5: I looked nervous/anxious	0.480		0.720
PTQ6: My speech was really bad	0.438		0.762
PTQ7: I made a fool of myself	0.463		0.768
PTQ8: I always do badly at this sort of thing	0.547		0.577
PTQ9: I looked stupid	0.494		0.727
PTQ10: I felt very self-conscious	0.479		0.746
PTQ11: I felt like a failure	0.443		0.738
PTQ12: I felt awkward	0.491		0.754
PTQ13: My heart was pounding very fast	0.428		0.547
PTQ14: I made a bad impression	0.476		0.719
Omega/Omega subscale	.98	.97	.97
OmegaH/OmegaHS	.71	.12	.66
H	.97	.67	.93
ECV	.57	.09	.34
PUC	.52		

Note. ATQ = Anticipatory version of the Thoughts Questionnaire; PTQ = Post-event version of the Thoughts Questionnaire. OmegaH = Omega hierarchical; OmegaHS = Omega hierarchical subscale; H = coefficient H; ECV = Explained common variance; PUC = percent uncontaminated correlations.

total score (.71) was below the .80 cutoff. This indicates that although a General Repetitive Thinking factor explained most of the reliable variance underlying total scores, it did not explain an overwhelming majority of variance, and variance due to group factors needs to be considered. Indeed, comparison of OmegaH and Omega for the General Repetitive Thinking total score suggests that 72% (.71/.98 = .72) of the reliable variance in total scores could be attributed to the General Repetitive Thinking factor. In comparison, 27% (.98–.71) of the reliable variance in total scores could be attributed to the multidimensionality caused by the two group factors. The other noteworthy finding was that OmegaHS for the ATQ subscale score (.12) and the PTQ subscale score (.66) indicated that once reliable variance associated with the General Repetitive Thinking factor was partitioned out, the Anticipatory Processing group factor contributed little unique reliable variance, but there was unique nonnegligible reliable variance explained by the Post-event Processing group factor.

In terms of construct reliability, both the General Repetitive Thinking factor and the Post-event Processing group factor had Coefficient *H* values (.97 and .93, respectively) above the .80 cut-off, indicating they are well-defined by their indicators and are likely to be stable and replicable. In contrast, the Coefficient *H* value of the Anticipatory Processing group factor (.67) was below the .80 cut-off, indicating it is not well-defined by its indicators. This suggests when specifying a measurement model, only the General Repetitive Thinking factor and the Post-event Processing group factor should be considered.

In terms of dimensionality, the ECV (.57) and PUC (.52) for the General Repetitive Thinking factor were both below the criterion of .70, providing evidence against a unidimensional interpretation of the ATQ and PTQ items. That is, multidimensionality due to group factors needs to be taken into account in the interpretation of the ATQ and PTQ. Although the General Repetitive Thinking factor explained over half the common variance (57%), the remaining 43% of the common variance was spread across the two group factors, the majority of which was associated with the Post-event Processing group factor (34%).

ASSOCIATIONS WITH SYMPTOM AND SAD-RELATED MEASURES

The SEM model that examined factors of the bifactor model and their unique associations with symptom and SAD-related factors had satisfactory fit with the data, $\chi^2(6962) = 9416.99$, CFI = .927, TLI = .925, RMSEA = .034, SRMR = .077. Notably, based on the construct reliability results, only the General Repetitive Thinking factor and the Post-event Processing group factor were considered in the model. As shown in Table 4, the Post-event Processing group factor had consistently small positive associations with the symptom factors (.16 to .27), whereas the General Repetitive Thinking factor had a greater range from a small positive association with the Depression factor (.23) to moderately large positive associations with the two Social Anxiety factors (.43 and .45). Notably, the Social Anxiety Interaction factor's association with the General Repetitive Thinking factor (.45) was significantly larger than its association with the Post-event Processing group factor (.16) based on nonoverlapping CIs, although this was not the case for the Social Anxiety Performance factor. The Post-event Processing group factor and the General Repetitive Thinking factor both had moderately large associations with the Speech Performance factor and the Maladaptive Attentional Focus factor, with higher levels on both the former factors linked with more negative speech performance appraisals and more maladaptive attentional focus. Interestingly, both the Life Interference and Task Focus factors had moderately large positive associations with the General Repetitive Thinking factor (.47 and .43, respectively), and these associations were significantly larger than corresponding associations with the Post-event Processing group factor (.11 and .08, respectively) based on nonoverlapping CIs. Indeed, the Post-event Processing group factor had nonsignificant associations with the Life Interference and Task Focus factors.

Discussion

This is the first study to examine whether anticipatory processing and post-event processing in SAD can be conceptualized as two facets of an underlying unidimensional repetitive thinking construct. As predicted, a bifactor model emerged as the best fitting model, suggesting multidimensionality underlying the ATQ and PTQ data. Although multidimensionality is suggested by the bifactor model, a unidimensional interpretation of the ATQ and PTQ is still possible depending on bifactor model indices (Rodriguez et al., 2016b). In our study, these indices indicated that the General Repetitive Thinking factor and Post-event Processing group factor: (a) explained a notable amount of reliable variance respectively in total scores (71%) and PTQ subscale scores (66%; controlling for the General Repetitive Thinking factor), (b) were well-defined by their indicators, and (c) explained

Table 4
Factors of the Bifactor Model and Associations With Symptom and SAD-Related Factors

Variable	Post-event Processing Group Factor Standardised estimate [Bonferroni adjusted 95% CI]	General Repetitive Thinking Factor Standardised estimate [Bonferroni adjusted 95% CI]
Social Anxiety Interaction factor	.16 [.01, .31]*	.45 [.32, .59]***
Social Anxiety Performance factor	.27 [.13, .41]***	.43 [.30, .56]***
Depression factor	.20 [.04, .37]*	.23 [.07, .40]**
General Anxiety factor	.18 [.01, .34]*	.35 [.20, .50]***
Life Interference factor	.11 [-.05, .26]	.47 [.33, .60]***
Speech Performance factor	-.37 [-.51, -.24]***	-.49 [-.61, -.37]***
Maladaptive Attentional Focus factor	.33 [.19, .46]***	.56 [.45, .68]***
Task Focus factor	.08 [-.09, .25]	.43 [.29, .58]***

Note. Higher levels on all factors indicate greater levels of that construct. Notably higher levels on the Speech Performance factor indicates a more positive view of one's speech performance.
$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$.

considerable common variance (57% and 34% respectively). In contrast, bifactor model indices indicated that the Anticipatory Processing group factor explained little reliable variance in ATQ subscale scores (12%; controlling for the General Repetitive Thinking factor), was not well-defined by its indicators, and did not explain much common variance (9%). Taken together, these results suggest a moderately strong General Repetitive Thinking factor and a Post-event Processing group factor but not an Anticipatory Processing group factor underlying the ATQ and PTQ data. That is, our results suggest that repetitive thinking in SAD, at least as assessed by the ATQ and PTQ, is multidimensional. The General Repetitive Thinking factor, which was common to anticipatory processing and an aspect of post-event processing in our study, is likely to have captured the common process of engaging in perseverative negative cognitive content that occurred before and after the speech. In contrast, the Post-event Processing group factor is likely to have captured a separable process involved in the post-mortem following the speech.

The emergence of the bifactor model as the best-fitting model with a moderately strong General Repetitive Thinking factor is consistent with previous literature indicating there may be a common dimension underlying anticipatory processing and post-event processing (e.g., Clark & Wells, 1995; McEvoy et al., 2010). However, our results also indicate that with anticipatory processing and post-event processing unified via a single General Repetitive Thinking factor, an additional Post-event Processing group factor, but not an Anticipatory Processing group factor, would still need to be taken into account to fully capture repetitive thinking in SAD. That is, in addition to a generalized tendency to engage in repetitive thinking in SAD, there is a separable unique aspect of post-event processing that is only evident following a social stressor. From an assessment perspective, our results suggest that measurement of a unidimensional repetitive thinking construct is appropriate prior to social-evaluative situations. Measurement of this general repetitive thinking construct is also appropriate after social-evaluative situations but would require additional assessment of the separable unique aspect of post-event processing.

The factors in the bifactor model were further characterized via an examination with symptom and SAD-related factors. The General Repetitive Thinking factor had a small positive association with depression symptoms and moderately large positive associations with social anxiety and general anxiety symptoms, whereas the Post-event Processing group factor generally had small positive associations with all the symptom types. Both the General Repetitive Thinking factor and Post-event Processing group factor had similar moderately large associations with speech performance appraisals and maladaptive attentional focus. Notably, the General Repetitive Thinking factor was associated with life interference and task focus, whereas the Post-event Processing group factor was not. Overall, the pattern of associations suggests that the General Repetitive Thinking factor is closely linked with social anxiety, involves a general focus on negative elements related to the speech task and some focus on task elements, and is life-interfering. In contrast, the Post-event Processing group factor is more weakly linked to social anxiety, involves a general focus on negative elements related to the speech task, but is not life-interfering. These results suggest that the General Repetitive Thinking factor might reflect more maladaptive aspects of repetitive thinking. Although the Post-event Processing group factor may also be maladaptive because of its links with social anxiety and negative elements of the speech task, an alternative interpretation based on its lack of association with life interference is that the Post-event Processing group factor may reflect more reflective pondering and non-impairing aspects of repetitive thinking. This interpretation of the results is consistent with previous research highlighting maladaptive and adaptive forms of repetitive thinking in SAD (Mills et al., 2013; Vassilopoulos, 2008; Wong & Moulds, 2012), and has important implications for theory, assessment, and treatment. From a theoretical perspective, our interpretation suggests that specifically the maladaptive aspects of anticipatory processing and post-event processing can be unified under a single factor resulting in a more parsimonious account of maladaptive repetitive thinking in SAD. As such, considering that only the General Repetitive Thinking factor is maladaptive, then from a clinical perspective only the General Repetitive Thinking factor would need to be assessed and targeted in treatment. Assessment and treatment of this single factor would be more efficient than assessing and treating anticipatory processing and post-event processing separately. Future research will need to further examine the nature of the factors in the bifactor model, particularly as to their impairing or nonimpairing quality (e.g., replicate bifactor model structure and further test associations between the factors and a measure of life interference or other indicator of impairment).

Limitations of the study should be noted. First, although the ATQ and PTQ measured anticipatory processing and post-event processing by directly assessing the frequency and therefore repetition of specific negative thoughts, there are other measures that assess the process of engaging in anticipatory processing and post-event processing that are not content dependent (e.g., Extended Post-event Processing Questionnaire; Wong, 2015). Future research with these measures before and after social stressors would be informative. Second, to complete the ATQ and PTQ, participants had to recall the frequency of their cognitions in the previous week. A number of previous studies have utilized a 1-week period as the assessment timeframe for anticipatory processing or post-event processing (e.g., Blöte, Miers, Van den Bos, & Westenberg, 2018; Cândea & Szentágotai-Tătar, 2017; Penney & Abbott, 2015). It is possible that memory biases may have influenced participant reports of anticipatory processing or post-event processing in these studies, as well as ATQ and PTQ responses in the current study. However, providing evidence to support the appropriateness of retrospective measures of anticipatory processing and post-event processing over 1 week, studies have shown a significant positive association between prospective daily measures of repetitive thinking processes taken over 1 week (e.g., via experience sampling methodology, daily diaries) and retrospective measures of the same construct (Kircanski, Thompson, Sorenson, Sherdell, & Gotlib, 2015; Penney & Abbott, 2015). Future studies could replicate the results of our study using prospective measures of anticipatory processing and post-event processing. Third, in our CFAs, we treated our ordinal variables appropriately by using the WLSMV estimator, and subsequently tested a bifactor model (amongst other models) and calculated bifactor model indices. This approach is consistent with other studies examining various aspects of psychopathology using bifactor modelling (e.g., Olatunji, Ebesutani, & Kim, 2015; Reise, 2012; Sadri, McEvoy, Pinto, Anderson, & Egan, 2018). However, we note there is a lack of research that has investigated whether bifactor modelling and calculation of bifactor model indices is appropriate for categorical data, and future research will need to examine this issue further. Finally, we measured anticipatory processing and post-event processing in relation to a speech task and future studies should replicate the current study with other social-evaluative situations (e.g., interaction task).

The current study adds to the existing literature by providing evidence to support a bifactor model interpretation of repetitive thinking in SAD. Repetitive thinking among people with SAD appears to reflect a General Repetitive Thinking factor that is maladaptive as well as a separate aspect of post-event processing that does not appear to be overly maladaptive. Future research that further characterises the bifactor model components and tests their utility will have the potential to improve the conceptualization and assessment of repetitive thinking in SAD.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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