Looking through tinted glasses: Depression and social anxiety are related to both interpretation biases and inflexible negative interpretations

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Abstract

Interpretation bias is often theorized to play a critical role in depression and social anxiety. To date, it remains unknown how interpretation bias exerts its toxic effects. Interpretation inflexibility may be an important determinant of how distorted interpretations affect emotional well-being. This study investigated interpretation bias and inflexibility in relation to depression severity and social anxiety. Participants (N=212) completed a novel cognitive task which simultaneously measured bias and inflexibility in the interpretation of unfolding ambiguous situations. Depression severity was associated with increased negative and decreased positive interpretation biases. Social anxiety was associated with increased negative interpretation bias. Critically, both symptom types were related to reduced revision of negative interpretations by disconfirmatory positive information. These findings suggest that individuals with more severe depression or social anxiety make more biased and inflexible interpretations. Future work examining cognitive risk for depression and anxiety could benefit from examining both these factors.

Keywords: interpretation inflexibility; interpretation bias; depression; social anxiety

Introduction

Everyday life is replete with ambiguous social situations. For example, while giving a presentation you might notice someone in the audience frowning and wonder, "Was it because he disliked what I said, or because he had fought with his partner earlier that day?" At dinner following your presentation, you might have heard the people at the next table laughing when you sat down and thought, "Were they making fun of me, or simply sharing a more benign joke between friends?". As these potential musings imply, ambiguity in the social sphere is often resolved via interpretation. People need to interpret ambiguous social situations to make sense of what is happening around them and to understand the implications of these events for their own lives. Interpretation is a semantic process that involves integration of different aspects of a situation to construct mental representations that resolve ambiguity (Blanchette & Richards, 2010). How ambiguity is resolved has important consequences for people's emotional experience (Hirsch, Meeten, Krahé, & Reeder, 2016; Wisco, 2009). When characterized by consistent emotional distortions, interpretations can play an important role in the onset and maintenance of emotional disorders such as depression and social anxiety.

Accordingly, cognitive models propose that depression (D. A. Clark, Beck, & Alford, 1999; Ingram, 1984) and social anxiety (D. M. Clark & Wells, 1995; Rapee & Heimberg, 1997) may be caused in part by a tendency toward inferring more negative and fewer positive interpretations of ambiguous situations. Consistent with this hypothesis, meta-analyses have reported medium to large overall effect sizes for interpretation biases in patients diagnosed with major depression and individuals with elevated depressive symptoms (Everaert, Podina, & Koster, *in press*; Phillips, Hine, & Thorsteinsson, 2010). Interpretation bias in depression is characterized by both increased negative and decreased positive interpretations, and particularly occurs in response to self-referent information (Everaert, Podina, et al., *in press*). Also consistent with this hypothesis, studies have found that socially anxious individuals draw more

negative interpretations when elaborating on ambiguous social information and less positive online interpretations at the time of encountering ambiguous cues (Hirsch et al., 2016).

Importantly, interpretation biases are not mere correlates of depression and social anxiety. Research suggests that interpretation biases causally influence symptoms of these disorders (Hallion & Ruscio, 2011; Menne-Lothmann et al., 2014) and predict their longitudinal course (Creswell & O'Connor, 2011; Rude, Durham-Fowler, Baum, Rooney, & Maestas, 2010). In sum, biases in interpretation of ambiguous stimuli may represent an important transdiagnostic mechanism that cuts across depression and social anxiety.

One critical question, however, remains: How do interpretation biases exert their toxic effects? The impact of interpretation biases on emotional well-being may be influenced by the inflexibility with which these biased interpretations are formed and maintained (Kashdan & Rottenberg, 2010; Stange, Alloy, & Fresco, 2017). Indeed, a tendency towards positive or negative interpretations may not be consistently adaptive or maladaptive. Negative interpretations may motivate people to adjust their behavior to situational demands. A tendency towards positive interpretations may lead people to ignore important aspects of a situation, such as problems at work or difficulties in interpersonal relationships. Whether positive or negative interpretations promote adaptive behavior hinges on the fluctuating demands of the context in which these interpretations are made (Kashdan & Rottenberg, 2010). Independent of the valence of interpretations, the (in)flexible nature of the interpretation process may determine the 'goodness-of-fit' between interpretations and changing situational demands, thereby promoting adaptive responding or increasing risk for psychopathology.

Flexible interpretation of ambiguous information involves taking into account multiple aspects of a situation and integrating novel information as it becomes available. This process balances interpretation with previous and current situational information, and allows someone to effectively match his/her responses to continuously changing situations (Mehu & Scherer,

2015; Stange et al., 2017). By contrast, *inflexible* or *rigid* interpretation involves reduced integration of past and current attributes of an unfolding situation. Inflexible interpretation therefore hampers the revision of initial interpretations when these interpretations are disconfirmed. This reduced sensitivity of interpretation to context may confer risk for depression and social anxiety by jeopardizing adaptation to changing contextual demands and evoking frequent anxiety, sadness, and/or despair across situations (Mehu & Scherer, 2015).

Indeed, research has shown that emotional disorders are characterized by inflexible responses to the environment in a number of psychological processes. Depression and anxiety are related to reduced flexibility in cognitive control (Joormann, 2010; Moran, 2016), causal attributions (Stange et al., 2017), and emotion regulation (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Interestingly, these inflexible psychological processes have been associated with interpretation processes (Everaert, Grahek, Duyck, et al., 2017; Everaert, Grahek, & Koster, 2017; Malooly, Genet, & Siemer, 2013). However, it is still unknown how flexible or inflexible depressed and socially anxious individuals are when interpreting ambiguous information.

The Present Study

The present study therefore sought to extend previous research by simultaneously examining interpretation bias and inflexibility in relation to depression and social anxiety for the first time. To this end, an emotional version of the Bias Against Disconfirmatory Evidence (BADE) task (Woodward, Moritz, Cuttler, & Whitman, 2006) was developed. The BADE task has traditionally been employed to investigate belief revision difficulties in individuals with schizophrenia (Speechley, Ngan, Moritz, & Woodward, 2012) and in the general population (Bronstein & Cannon, *in press*). This research has demonstrated that delusional individuals with schizophrenia have difficulties in adjusting their initial beliefs based on novel disconfirmatory information, suggesting inflexibility in revising beliefs (Sanford, Veckenstedt, Moritz, Balzan,

& Woodward, 2014). The BADE task seems particularly suited to examine interpretation bias and flexibility for two important reasons. First, the BADE task involves repeated measurement of interpretations in response to accumulating information. This enables insight into how interpretations dynamically change as ambiguous situations unfold over time. Second, research has shown that performance on the original BADE task can be broken into two components which relate to interpretation bias and interpretation inflexibility over time (Sanford et al., 2014; Speechley et al., 2012). This task feature enables the simultaneous investigation of interpretation bias and inflexibility. Utilizing an emotional version of the BADE task, this study planned to examine two hypotheses:

Hypothesis 1: Severity of depressive symptoms would be associated with more negative and less positive interpretations (Everaert, Podina, et al., *in press*). With respect to social anxiety, greater symptom levels would be related to more negative interpretations (Hirsch et al., 2016). No predictions were made regarding the relationship between social anxiety and positive interpretations because the lack of a positive bias in social anxiety is typically observed in tasks that measure interpretations online (i.e., at the time when ambiguity is initially encountered) but not in tasks that allow elaboration (for a review, see Hirsch et al., 2016). The emotional BADE task adopts features of both types of tasks: Interpretations are measured when situational ambiguity is initially encountered as well as when disconfirmatory information is provided to update interpretations about the situation (i.e., requiring elaborate processing). It is therefore difficult to predict a priori whether an attenuated positive interpretation bias would be evident in socially anxious individuals' behavior on the emotional BADE task.

Hypothesis 2: Greater depression severity and social anxiety would be related to greater inflexibility in emotional interpretations (Mehu & Scherer, 2015). Higher depression severity and social anxiety levels were expected to be related to inflexibility when negative interpretations are disconfirmed by novel positive information (i.e., inflexibility of negative

interpretations). However, revision of initial positive interpretations in light of novel negative information was expected to be intact (i.e., flexibility of positive interpretations).

Method

Participants and Sampling Strategy

Amazon's Mechanical Turk (MTurk) was used to recruit 212 participants (demographics: see Table 1). MTurk provides an online crowdsourcing platform with access to large and diverse samples suitable for clinical research collecting mental health data (Chandler & Shapiro, 2016). Participation in this study was restricted to MTurk users who were 18 years or older and lived in the United States.

Participants were sampled in three waves completed within weeks of one another. A gradual oversampling strategy was employed to capture sufficient variation in depressive symptom severity. In the first two waves, participants were unselected. In the third wave, participants responded to similar advertisements and their eligibility for the study was determined using the depression module of the Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001). Participants scoring above the clinical cutoff (sum-scores ≥ 10) were specifically recruited in order to sample extreme depression scores. This cutoff has a sensitivity and specificity of 88% for major depression (Kroenke et al., 2001). The obtained range in depression severity enabled this study to investigate putatively depression-related differences in interpretation inflexibility.

Data Quality Measures

Following recommendations for research using crowdsourced samples (Chandler & Shapiro, 2016), several measures were taken to ensure high data quality. First, only MTurk workers with a history of providing good-quality responses (i.e., an acceptance ratio of $\geq$95%) were allowed to participate. Second, two questions were presented during the survey to discriminate attentive from inattentive MTurk workers. These questions were presented at

irregular intervals and participants were required to correctly answer both. Data from participants failing to meet this requirement were not considered in any analyses (n=6). Finally, consistent with previous research, participants (n=3) were also excluded from all analyses if they completed the survey in less than 60% of the projected time (±20 min). With such requirements, research has demonstrated that MTurk data are comparable to those collected in the laboratory (Chandler & Shapiro, 2016).

Interpretation Inflexibility

The emotional BADE task retained the general structure of the original version. As in the original task (Woodward et al., 2006), participants were presented with a series of scenarios. Each scenario contained three statements. After each statement was presented, participants were asked to rate the plausibility of four interpretations of the information in the scenario using a 21-point rating scale from 'poor' (a score of 1) to 'excellent' (a score of 21). The interpretations were presented in randomized order across statements and participants. Across all scenarios, the interpretations could be grouped into three categories (Sanford et al., 2014; Speechley et al., 2012): *Absurd* interpretations (which remained implausible throughout the scenario), *Lure* interpretations (which were initially most plausible but became less plausible after the third statement; two different lures were presented in each scenario), and *True* interpretations (which were initially less plausible than the Lure interpretations but became the most plausible after the third statement).

The major change made to the original task in this adaptation was the replacement of the scenarios with 24 novel ones that describe common interpersonal situations relevant to themes of social failure and rejection. These themes may reflect concerns relevant to depression and social anxiety (D. A. Clark et al., 1999; Rapee & Heimberg, 1997). Scenario development was guided by ambiguous scenarios utilized in prior research on interpretation biases in anxiety and depression (Mathews & Mackintosh, 2000). These scenarios were substantially modified

to create situational descriptions (and corresponding interpretations) that follow the three-statement structure employed by the BADE task. All scenarios were self-referential. Participants were instructed to imagine each situational description as if they could see it through their own eyes.

Two types of scenarios were developed in order to examine whether interpretation inflexibility differed according to the valence of initial interpretations relative to that of the corresponding disconfirmatory evidence. The first scenario type, *disconfirming-the-negative* scenarios, were initially negative (the first statement) but had a positive ending (the third statement). For example, one scenario reads as follows: "The company you are working for needs to lay off many employees. You are called in to see your boss" (statement 1), "Your boss looks unhappy when you enter his office" (statement 2), "Your boss shares how upset he is about having to lay off his employees, and states that he wants you to stay because of your collegiality and achievements" (statement 3). In these scenarios, the two Lure interpretations were negative in valence (e.g., "Your boss wants you to leave the company because you're not as good as the other employees.", "The boss will have to let you go because you're not a great fit with the team.") and the True interpretation was positive in valence (e.g., "The boss wants to keep you in the company because you're one of the better employees.").

The second scenario type, *disconfirming-the-positive* scenarios, were initially positive but had a negative ending. For example: "You are telling a joke you recently heard and you see the other people's expressions change" (statement 1), "Everyone looks at each other when you get to the end of the joke" (statement 2), "Someone interrupts you and says you are not telling the joke the right way" (statement 3). In these scenarios, the two Lure interpretations had a positive valence (e.g., "You hear everyone starting to laugh", "The other people think you have a great sense of humor") and the True interpretation had a negative valence (e.g., "Some people think you can't tell a joke properly"). The two scenario types were presented in randomized

order across participants. Figure S1 in the supplemental materials provides an example of the flow of scenario events in the emotional BADE task.

Depression and Social Anxiety Symptoms

Patient Health Questionnaire – Depression Module (PHQ-9)

The PHQ-9 (Kroenke et al., 2001) is a brief self-report measure designed for detection and monitoring of depression severity. The questionnaire includes 9 items that represent the diagnostic criteria for depression from the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). On each item, the frequency of the symptoms is rated on a four-point scale from 0 (not at all) to 3 (nearly every day). As noted, the PHQ-9 was used as a prescreening measure to select individuals with more severe depressive symptoms during recruitment. The internal consistency of the measure in this study was α=.94.

Beck Depression Inventory-II (BDI-II)

The BDI-II (Beck, Steer, & Brown, 1996) is a widely used 21-item self-report measure of depressive symptom severity experienced across the past two weeks. Individuals indicate the degree to which they have suffered from a certain symptom on a four-point scale from 0 to 3. The BDI-II has overall good reliability and validity (Dozois, Dobson, & Ahnberg, 1998). The BDI-II was used to assess depressive symptom severity in the main part of this study. The internal consistency of the BDI-II in this study was α=.96.

Liebowitz Social Anxiety Scale (LSAS)

The LSAS (Liebowitz, 1987) is a self-report measure to assess anxiety and avoidance of social situations. The questionnaire includes 24 items describing different social situations. Respondents rate the extent to which anxiety and avoidance of social situations affected them during the last week. The anxiety items are rated on a scale from 0 (none) to 3 (severe) and avoidance items are rated on a scale from 0 (never) to 3 (usually). The LSAS has good reliability as well as convergent and discriminant validity (Fresco et al., 2001). This study examined the

relationship of the social anxiety subscale of the LSAS with interpretation bias and inflexibility. The internal consistency of the social anxiety scale in this study was α=.95.

Procedure

All participants gave informed consent in accordance with the Yale University Institutional Review Board. Participants completed a survey which began with demographic questions followed by the emotional BADE task. Participants then completed the BDI-II and the LSAS, which were presented in randomized order. Upon completion of the survey, participants were debriefed and received remuneration (4 USD).

Data Reduction and Analysis

In the *original* BADE task, interpretation plausibility ratings provided after a statement is viewed are averaged across all scenarios. This procedure is repeated for each of the four interpretation types (1 Absurd, 1 Lure-A, 1 Lure-B, 1 True). The resulting 12 average ratings are then subjected to Principal Component Analysis (PCA). PCA is a dimension reduction technique that extracts important information from the variance-covariance structure of a set of variables to represent the information contained in these variables using a smaller set of new composite dimensions, with minimal loss of information. This statistical procedure has been commonly applied to analyze original BADE task data (Sanford et al., 2014; Speechley et al., 2012). In these studies, PCA has reliably yielded two components, which we refer to as 'Evidence Integration Impairment' and 'Positive Response Bias' (Bronstein, Dovidio, & Cannon, 2017; prior studies have also referred to these components as 'Evidence Integration' and 'Conservatism,' respectively). The first component, 'Evidence Integration Impairment', reflects the inability to reject implausible interpretations and integrate disambiguating information. This component quantifies the rigidity or inflexibility of the interpretation process. The second component, 'Positive Response Bias'[1], reflects the degree to which interpretations

[1] Please note that the term 'positive response bias' is the label used in research using the original BADE task (Bronstein & Cannon, in press). It does *not* refer to response biases that influence the responses of participants

that are perceived as plausible are endorsed. This component quantifies biases with respect to the content of the interpretations. For the emotional version of the BADE task, the components of 'Evidence Integration Impairment' and 'Positive Response Bias' will be referred to as 'Interpretation Inflexibility' and 'Interpretation Bias', respectively.

To examine inflexible interpretations in the emotional BADE task, PCA with direct oblimin rotation (i.e., the extracted components were allowed to be correlated) was conducted on the twelve averaged interpretation ratings. This approach was chosen because PCA is a powerful data reduction technique that has been applied in prior research with the original BADE task (Bronstein & Cannon, *in press*; Sanford et al., 2014; Speechley et al., 2012). PCA was conducted separately for disconfirming-the-negative and disconfirming-the-positive scenarios. We expected to find similar PCA solutions as for the original BADE task, with components representing 'Interpretation Inflexibility' and 'Interpretation Bias'. The average interpretation plausibility ratings were derived for the two scenario types in the same way as that described for the original task. Using the components derived from the PCA, multiple regression models tested whether interpretation inflexibility and interpretation bias were related to depression severity and social anxiety.

Results

Descriptive Statistics

Participants' BDI-II scores (M=15.20, SD=14.03) represented almost the full spectrum of symptom severity: 116 respondents reported minimal (range: 0–13), 21 reported mild (range: 14–19), 35 reported moderate (range: 20–28), and 40 reported severe (range: 29–55) depressive symptoms. Significant variation was also found in participants' scores on the anxiety scale of

away from truthful responses. Please also note that 'Positive Response Bias' and 'Evidence Integration Impairment' are sometimes referred to as 'Conservatism' and 'Evidence Integration,' respectively (e.g., Speechley et al., 2012; Sanford et al., 2014).

the LSAS (*M*=25.97, *SD*=16.07, range: 0-65). A correlation of .56 (*p*=.000) was found between the BDI-II and LSAS anxiety scale.

PCA: Extracting 'Interpretation Bias' and 'Interpretation Inflexibility'

Table 2 provides the resulting PCA component loadings for both scenario types.[2] Note that the pattern of the Absurd, Lure, and True interpretation ratings of the emotional BADE scenarios conformed to the pattern typical of those that comprise the original BADE task. The Supplemental Material details statistics supporting the utility of the emotional scenarios for examining interpretation inflexibility in response to disconfirmatory evidence.

Disconfirming-the-negative scenarios. The PCA with direct oblimin rotation yielded a Kaiser-Meyer-Olkin measure (.83) suggesting that sampling was adequate for PCA. Bartlett's test of sphericity, $\chi^2(66)=3264.88$, $p=.000$, indicated that correlations between items were sufficiently large. All values on the diagonal of the anti-image matrix exceeded .50 (range: .74-.91), supporting the inclusion of each average interpretation rating in the PCA. Given these indications of the validity of using PCA to analyze these data, the eigenvalues were examined (all eigenvalues: 5.80, 3.59, 1.19, 0.46, 0.26, 0.20, 0.14, 0.12, 0.08, 0.06, 0.06, 0.04). The scree plot and Kaiser's criterion of one converged on a three-component solution. The first component had a similar loading pattern to that of the 'Evidence Integration Impairment' component repeatedly extracted from original BADE task data (Sanford et al., 2014; Speechley et al., 2012). The component consisted of the plausibility ratings for all Absurd interpretations as well as the ratings for the negative Lures and positive True interpretation following the third statement. This component will be referred to as '*Negative Interpretation Inflexibility*' (NII) because it reflects the inability to reject implausible negative interpretations by integrating disambiguating positive information. The second and third component had a loading pattern similar to the 'Positive Response Bias' component that has also been extracted from original

[2] Note that PCAs conducted on random subsamples of the dataset produced the same three-component solutions, supporting the reliability of these results.

BADE task data (Sanford et al., 2014; Speechley et al., 2012). Both components were therefore thought to also capture the degree to which the content of the interpretations was endorsed. Given the negative valence of the items loading onto the second component, it will be referred to as '*Negative Interpretation Bias*' (NIB). The NIB component consisted of all ratings for Lure interpretations following the first two statements. The third component consisted of all average ratings for True interpretations. Given that these were the only items in the scenarios with a positive valence, it was concluded that this final component reflected '*Positive Interpretation Bias*' (PIB). The NII, NIB, and PIB components accounted for 48.30%, 29.96%, and 9.87% of the total variance, respectively.

Disconfirming-the-positive scenarios. For disconfirming-the-positive scenarios, all values on the diagonal of the anti-image correlations matrix exceeded 0.50 (range: .63-.92) except that for 'True 2' (the rating for the true interpretation following the second statement), which equaled 0.44. Although this suggests a potential sampling issue for this variable, it was ultimately included in the PCA because the Kaiser-Meyer-Olkin measure (.82) indicated adequate sampling adequacy for PCA. Also Bartlett's test of sphericity, $\chi^2(66)=3398.63$, $p=.000$, indicated that correlations between items were sufficiently large for PCA despite the inclusion of average True 2 ratings in the analysis. The scree plot and the analysis of eigenvalues with respect to Kaiser's criterion of one justified retaining three components (all eigenvalues: 6.20, 2.80, 1.53, 0.46, 0.34, 0.18, 0.15, 0.14, 0.07, 0.05, 0.04, 0.03). In combination, these three components explained 87.80% of the variance in average plausibility ratings. Again, the first component was similar to the 'Evidence Integration Impairment' component that has previously been extracted from the original BADE task (Bronstein & Cannon, *in press*). The component was dominated by plausibility ratings for the Absurd interpretations and the ratings for both positive Lure and negative True interpretations following the third statement. This component reflects the inability to reject implausible positive interpretations by integrating disambiguating

negative information, and will be referred to as '*Positive Interpretation Inflexibility*' (PII). The second and third component had an identical pattern of loadings to the 'Positive Response Bias' component of the original BADE task and captured the extent to which the content of interpretations was endorsed. The second component consisted of ratings for Lure interpretations following the first two statements. Given the positive valence of these items, the component will therefore be referred to as '*Positive Interpretation Bias*' (PIB). The final component was comprised of average ratings pertaining to all True items. Given the negative valence of these items, this component will be referred to as '*Negative Interpretation Bias*' (NIB). The PII, PIB, and NIB components accounted for 51.68%, 23.35%, and 12.78% of the total variance, respectively.

Relations Among Depression, Social Anxiety, Interpretation Biases, and Inflexibility

Interpretation biases and inflexibility. Correlations were inspected to examine relations between emotional BADE components. Spearman rho correlations were calculated because Kolmogorov–Smirnov tests revealed that the distribution of interpretation inflexibility scores of the components for disconfirming-the-negative, $D(212)=0.23$, $p=.000$, and disconfirming-the-positive, $D(212)=0.28$, $p=.000$, scenarios did not form a normal curve. Supporting the convergent validity of each scenario type's components, strong correlations were found between NII and PII ($\rho=.73$, $p=.000$), between PIB components ($\rho=.51$, $p=.000$), and between NIB components ($\rho=.61$, $p=.000$). Within scenario types, PIB was not related to interpretation inflexibility (NII: $\rho=.07$, $p=.30$; PII: $\rho=.12$, $p=.08$) and also NIB did not correlate with interpretation inflexibility (NII: $\rho=-.08$, $p=.25$; PII: $\rho=-.04$, $p=.61$), suggesting both constructs are relatively independent. Note that the PCA employed direct oblimin rotation, which permits correlations between components.

Relations with depression and social anxiety. Multiple regression models were tested to examine whether interpretation inflexibility and interpretation biases were uniquely

associated with variation in depression and social anxiety. Per scenario type, regression models were tested separately for depression (BDI-II) and social anxiety (LSAS anxiety) as dependent variables. In each model, negative interpretation bias (NIB), positive interpretation bias (PIB), as well as interpretation inflexibility (NII or PII depending on the scenario type) were simultaneously entered into the regression equation. Assumptions of homoscedasticity and normality of residuals were met for all analyses. Collinearity statistics were within acceptable limits (VIF's<1.21, Tolerance's>.83). Table 3 presents statistics for each tested model.

Disconfirming-the-negative scenarios. The results of the regression on BDI-II scores showed that the three emotional BADE components explained a significant amount of the variance, $F(3, 208)=4.39$, $p=.005$, $R^2=.06$. With respect to Hypothesis 1, the results showed that NIB ($\beta=.19$, $p=.006$) but not PIB ($\beta=-.12$, $p=.105$) was associated with depressive symptom severity. In line with Hypothesis 2, NII ($\beta=.19$, $p=.011$) was significantly associated with depressive symptoms even when NIB and PIB were included in the regression model.

Furthermore, the second regression analysis indicated that NII, NIB, and PIB explained a significant proportion of the variance in LSAS anxiety scores, $F(3, 208)=15.58$, $p=.000$, $R^2=0.18$. Regarding Hypothesis 1, NIB ($\beta=.37$, $p=.000$) was uniquely associated with social anxiety. Note that the PIB ($\beta=-.13$, $p=.055$) component was not associated with social anxiety. Consistent with Hypothesis 2, NII ($\beta=.28$, $p=.000$) was significantly associated with variation in social anxiety levels.

Disconfirming-the-positive scenarios. When regressing BDI-II scores on PII, NIB, and PIB, the results showed that these emotional BADE components explained a significant proportion of the variance, $F(3, 208)=9.92$, $p=.000$, $R^2=0.13$. With regard to Hypothesis 1, the analyses revealed that NIB ($\beta=.22$, $p=.001$) and PIB ($\beta=-.27$, $p=.000$) were uniquely associated with variation in depression levels. In line with Hypothesis 2, PII ($\beta=.11$, $p=.107$) was not significantly associated with depressive symptom severity.

Finally, the results of the regression analysis on LSAS anxiety scores showed that PII, NIB, and PIB also explained a significant amount of the variance, $F(3, 208)=8.31$, $p=.000$, $R^2=0.11$. Regarding Hypothesis 1, it was found that NIB ($\beta=.30$, $p=.000$) was uniquely associated with levels of social anxiety. The PIB ($\beta=-.12$, $p=.070$) component was not associated with social anxiety levels. Consistent with Hypothesis 2, PII ($\beta=.10$, $p=.117$) was not associated with levels of social anxiety.

Depression vs. social anxiety specificity. Post-hoc analyses were conducted to explore the specificity and overlap of depressive symptoms and social anxiety levels in accounting for emotional BADE components. A series of commonality analyses (CA) were conducted for regression models with BDI-II and LSAS anxiety as predictors of each emotional BADE task component (e.g., NII or NIB). For each criterion variable, CA decomposes R^2 into three variance partitions: (1) variance uniquely explained by BDI-II; (2) variance uniquely explained by LSAS anxiety; and (3) variance commonly explained by BDI-II and LSAS anxiety (Marchetti et al., 2017; Nimon, Lewis, Kane, & Haynes, 2008). Table S2 in the supplemental materials provides the results of the CA. For disconfirming-the-negative scenarios, CA revealed that the explained variance in NII and NIB was primarily accounted by LSAS anxiety and the common effect of BDI-II and LSAS anxiety. For disconfirming-the-positive scenarios, the variance explained in NIB was primarily accounted by BDI-II and the common effect of BDI-II and LSAS anxiety. These observations suggest that NII and NIB are related to both depression and social anxiety, through unique and common variance.

Discussion

The results of this study support the hypothesis that depression severity and social anxiety are related to greater inflexibility of emotional interpretations. Inflexibility of negative interpretations in this study was associated with symptoms of depression and anxiety, which is consistent with cognitive models highlighting the importance of interpretation inflexibility in

depression (Mehu & Scherer, 2015). This finding suggests that individuals experiencing more severe depression and social anxiety levels have difficulties using novel positive information to adjust their initial negative interpretations. Interestingly, the analyses also suggested that depression and social anxiety levels commonly explained variance in negative interpretation inflexibility, suggesting that it may represent a transdiagnostic process that could contribute to their comorbidity. Furthermore, as predicted, inflexibility in positive interpretations was not related to individual differences in depression severity or social anxiety. This suggests that individuals with more severe symptoms of depression or social anxiety do not differ from those with fewer symptoms in their ability to revise positive interpretations in the face of novel negative information. In tandem, these findings provide evidence for the context-insensitivity of initial negative interpretations in both depressed and socially anxious individuals.

The results of this study also supported the hypothesis that depression and social anxiety are characterized by interpretation biases (D. A. Clark et al., 1999; D. M. Clark & Wells, 1995; Ingram, 1984; Rapee & Heimberg, 1997). It was found that individuals with more severe symptoms of depression endorsed more negative interpretations and rejected more positive interpretations for disconfirming-the-positive scenarios. In addition, social anxiety was related to greater endorsement of negative interpretations. These findings suggest that negative interpretation bias may represent a transdiagnostic process, which was further supported by the post hoc commonality analyses. These findings are consistent with previous research (Everaert, Podina, et al., *in press*; Hirsch et al., 2016).

Interestingly, this study suggests that interpretation inflexibility and interpretation bias could make independent contributions to depression and social anxiety. Interpretation inflexibility and interpretation bias were not interrelated and accounted for unique variance in depression and social anxiety. This finding is in line with prior work suggesting that attributional style (i.e., tendency to make internal, stable, and global causal attributions) and

attributional flexibility (i.e., variability in the type of attributions) independently contribute to symptoms of depression (Stange et al., 2017). Taken together, these findings suggest that research on anxiety and depression should extend beyond traditional examinations of static emotional interpretations. Interpretation is a dynamic process and studying distortions in this process over time may provide a complementary perspective to further our theoretical understanding of when emotional interpretations promote health or maladaptation (Kashdan & Rottenberg, 2010; Mehu & Scherer, 2015; Stange et al., 2017).

In light of this suggestion, the emotional BADE task developed in this study, which can be used to simultaneously examine interpretation biases and flexibility, is noteworthy. The pattern of interpretation ratings we obtained in the emotional BADE task was broadly consistent with that in the original BADE task, supporting its utility for examining interpretation inflexibility in response to disconfirmatory evidence. For each scenario type, three components (positive interpretation bias, negative interpretation bias, and positive or negative interpretation inflexibility) were derived. These components have similar loading patterns to the components derived from the original BADE task (see Bronstein & Cannon, *in press*; Sanford et al., 2014; Speechley et al., 2012). Further, strong correlations were observed between conceptually similar components across scenario types which supports their convergent validity. These results imply that the emotional BADE task is suitable to quantify emotional biases and inflexibility in interpretation.

The suitability of the emotional BADE task for this purpose is fortunate given that it represents a promising paradigm for future research. For example, this task may prove useful in efforts to identify the cognitive mechanisms involved in inflexible positive and negative interpretations. Flexible interpretation, which is a process that integrates various pieces of information, relies heavily on working memory. It is therefore likely that cognitive control processes which regulate the contents of working memory modulate the interpretation process.

In depression, cognitive control is marked by difficulties removing irrelevant negative material from working memory (Joormann & Gotlib, 2008). Given that prior research linked such difficulties to interpretation bias (Everaert, Grahek, & Koster, 2017), it is likely that cognitive control difficulties also affect interpretation inflexibility. More specifically, difficulties updating working memory contents may cause people to be particularly inflexible when an initial negative interpretation is violated by novel positive information.

The emotional BADE task may also be useful in future research examining interpretation inflexibility in relation to emotion regulation difficulties. Depressive and anxiety disorders are characterized by the habitual use of rumination and less frequent use of positive reappraisal (Aldao et al., 2010). Like interpretation biases (Everaert, Grahek, Duyck, et al., 2017), negative interpretation inflexibility likely partially accounts for this decrease in positive reappraisal (by inducing failure to fully integrate disconfirming positive information) and increase in rumination (by causing negative interpretations to persist even in the presence of positive information). Because this pattern of emotion regulation strategy use increases negative thinking and maintains negative mood states (Joormann, 2010), further examination of how interpretation inflexibility might impact rumination and positive reappraisal is a worthwhile endeavor for future research.

Additionally, the emotional BADE task may be useful in investigating how interpretation flexibility is related to resilience. Theorists have repeatedly emphasized that taking into account different aspects of a situation results in balanced interpretations that allow someone to match his/her responses to the needs of that situation (Mehu & Scherer, 2015; Stange et al., 2017), thereby encouraging resilience. It can therefore be expected that flexibility in both negative and positive interpretations, which may facilitate the integration of information discovered over time into a whole that more accurately reflects the situation at hand, is related

to resilient responses to stressful situations (Kashdan & Rottenberg, 2010). Examining this expectation provides a further avenue for future research.

Future research may also build upon the observed valence-specific inflexibility in emotional interpretations. While this finding suggests that there is no general deficit in interpretation inflexibility related to depression or social anxiety, research should test this hypothesis in the context of self-referential BADE scenarios without emotion-laden content.

Beyond basic research, the emotional BADE task may be useful in applied clinical settings. Interpretation biases are a central target in cognitive-behavioral interventions as well as cognitive training methodologies (D. A. Clark et al., 1999; Hallion & Ruscio, 2011; Menne-Lothmann et al., 2014). When assessing the effectiveness of these interventions, it is important to know not only what people believe (i.e., the content of their interpretations) but also how people revise those beliefs (e.g., via interpretation inflexibility). Given that interpretation bias and inflexibility are independent and have unique associations with depression and social anxiety, both factors may represent indicators of treatment success. It would therefore be interesting to investigate whether the emotional BADE task is useful in predicting treatment outcomes, particularly in cognitive behavioral therapy (which includes thought challenging exercises that may depend on interpretation flexibility) and cognitive training programs (which seek to modify interpretation and attentional bias). Extrapolating from the literature on cognitive training (e.g., Vita et al., 2013), it is plausible that these therapies will be more effective in those with less inflexible and biased interpretations at baseline.

Despite these important implications, several limitations of this study should be acknowledged. First, this study employed a cross-sectional design which precludes conclusions regarding directionality. Multi-wave longitudinal study designs investigating cross-lagged relations are better suited to examine how interpretation inflexibility and biases contribute to depression and social anxiety, and vice versa. Second, this study found relatively small effects

for negative interpretation inflexibility and interpretation biases in relation to depression and social anxiety. In accounting for these small effects, it is possible that third variables (e.g., cognitive control difficulties) would moderate the relationship between interpretation bias/inflexibility and symptoms of psychopathology. For example, depressed people with severe cognitive control difficulties may exhibit more rigid negative interpretations than depressed people with less severe impairments in cognitive control. Of note, the reported significant relations proved reliable as suggested by sensitivity analyses on random subsamples of the original dataset. Finally, this study only partly addressed whether negative interpretation inflexibility and bias are characteristic of social anxiety and/or depression. The commonality analyses examined the ability of unique and shared variance partitions of depression and social anxiety to explain negative interpretation inflexibility and bias. Although the results suggest that depression and social anxiety may have both unique and shared contributions to these outcomes, these results should be interpreted in light of the study's sampling strategy. The study recruited individuals based on their depressive symptoms and the findings may not generalize to individuals recruited based on symptoms of social anxiety disorder. To address the issue of depression vs. anxiety-specificity, future studies could include multiple groups recruited on the presence and absence of clinical symptoms corresponding to each of these disorders.

Conclusion

This study advances knowledge of emotional distortions in interpretation in important ways. Using a novel version of the BADE task, this study observed that depression severity and social anxiety are not only related to interpretation biases but also to negative interpretation inflexibility. More severe depression and social anxiety levels were characterized by inflexibility in revising negative interpretations in the face of disconfirmatory positive information. This finding opens up many exciting lines of research that may engender further understanding the cognitive and emotional distortions present in depression and social anxiety.

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References

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, *30*(2), 217–237. https://doi.org/10.1016/j.cpr.2009.11.004

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Washington, D.C.: American Psychiatric Association.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Corporation.

Blanchette, I., & Richards, A. (2010). The influence of affect on higher level cognition: A review of research on interpretation, judgement, decision making and reasoning. *Cognition & Emotion*, *24*(4), 561–595. https://doi.org/10.1080/02699930903132496

Bronstein, M., & Cannon, T. (*in press*). Bias against disconfirmatory evidence in a large nonclinical sample: Associations with schizotypy and delusional beliefs. *Journal of Experimental Psychopathology*, *8*(1), 1–39. https://doi.org/10.5127/jep.057516

Bronstein, M. V., Dovidio, J. F., & Cannon, T. D. (2017). Both bias against disconfirmatory evidence and political orientation partially explain the relationship between dogmatism and racial prejudice. *Personality and Individual Differences*, *105*, 89–94. https://doi.org/10.1016/j.paid.2016.09.036

Chandler, J., & Shapiro, D. (2016). Conducting clinical research using crowdsourced convenience samples. *Annual Review of Clinical Psychology*, *12*, 53–81. https://doi.org/10.1146/annurev-clinpsy-021815-093623

Clark, D. A., Beck, A. T., & Alford, B. A. (1999). *Scientific foundations of cognitive theory and therapy of depression.* New York: John Wiley & Sons.

Clark, D. M., & Wells, A. A. (1995). A cognitive model of social phobia. In R. G. Heimberg, M. R. Liebowitz, D. A. Hope, & F. R. Schneier (Eds.), *Social Phobia: Diagnosis,*

assessment and treatment (pp. 69–93). New York, NY: Guilford Press.

Creswell, C., & O'Connor, T. G. (2011). Interpretation bias and anxiety in childhood: Stability, specificity and longitudinal associations. *Behavioural and Cognitive Psychotherapy*, *39*(2), 191–204. https://doi.org/10.1017/S1352465810000494

Dozois, D. J. A., Dobson, K. S., & Ahnberg, J. L. (1998). A psychometric evaluation of the Beck Depression Inventory-II. *Psychological Assessment*, *10*(2), 83–89. https://doi.org/10.1037/1040-3590.10.2.83

Everaert, J., Grahek, I., Duyck, W., Buelens, J., Van den Bergh, N., & Koster, E. H. W. (2017). Mapping the interplay among cognitive biases, emotion regulation, and depressive symptoms. *Cognition and Emotion*, *31*(4), 726–735. https://doi.org/10.1080/02699931.2016.1144561

Everaert, J., Grahek, I., & Koster, E. H. W. (2017). Individual differences in cognitive control over emotional material modulate cognitive biases linked to depressive symptoms. *Cognition and Emotion*, *31*(4), 736–746. https://doi.org/10.1080/02699931.2016.1144562

Everaert, J., Podina, I. R., & Koster, E. H. W. (*in press*). A comprehensive meta-analysis of interpretation biases in depression. *Clinical Psychology Review*. https://doi.org/10.1016/j.cpr.2017.09.005

Fresco, D. M., Coles, M. E., Heimberg, R. G., Liebowitz, M. R., Hami, S., Stein, M. B., & Goetz, D. (2001). The Liebowitz Social Anxiety Scale: A comparison of the psychometric properties of self-report and clinician-administered formats. *Psychological Medicine*, *31*(6), 1025–1035. https://doi.org/10.1017/S0033291701004056

Hallion, L. S. S., & Ruscio, A. M. M. (2011). A meta-analysis of the effect of cognitive bias modification on anxiety and depression. *Psychol Bull*, *137*(6), 940–958. https://doi.org/10.1037/a0024355 2011-13412-001 [pii]

Hirsch, C. R., Meeten, F., Krahé, C., & Reeder, C. (2016). Resolving ambiguity in emotional disorders: The nature and role of interpretation biases. *Annual Review of Clinical Psychology*, *12*(1), 281–305. https://doi.org/10.1146/annurev-clinpsy-021815-093436

Ingram, R. E. (1984). Toward an information-processing analysis of depression. *Cognitive Therapy and Research*, *8*(5), 443–477. https://doi.org/10.1007/BF01173284

Joormann, J. (2010). Cognitive inhibition and emotion regulation in depression. *Current Directions in Psychological Science*, *19*(3), 161–166. https://doi.org/10.1177/0963721410370293

Joormann, J., & Gotlib, I. H. (2008). Updating the contents of working memory in depression: interference from irrelevant negative material. *Journal of Abnormal Psychology*, *117*(1), 182–192. https://doi.org/10.1037/0021-843X.117.1.182

Kashdan, T. B., & Rottenberg, J. (2010). Psychological flexibility as a fundamental aspect of health. *Clinical Psychology Review*, *30*(7), 865–878. https://doi.org/10.1016/j.cpr.2010.03.001

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*, *16*(9), 606–13. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11556941

Liebowitz, M. R. (1987). Social phobia. *Modern Problems of Pharmacopsychiatry*, *22*, 141–73. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/2885745

Malooly, A. M., Genet, J. J., & Siemer, M. (2013). Individual differences in reappraisal effectiveness: The role of affective flexibility. *Emotion*, *13*(2), 302–313. https://doi.org/10.1037/a0029980

Marchetti, I., Everaert, J., Dainer-Best, J., Loeys, T., Beevers, C. G., & Koster, E. H. W. (2017). Specificity and overlap of attention and memory biases in depression. *Journal of Affective Disorders*, *225*, 404–412. https://doi.org/10.1016/j.jad.2017.08.037

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety. *Journal of Abnormal Psychology*, *109*(4), 602–615. https://doi.org/10.1037/0021-843X.109.4.602

Mehu, M., & Scherer, K. R. (2015). The appraisal bias model of cognitive vulnerability to depression. *Emotion Review*, *7*(3), 272–279. https://doi.org/10.1177/1754073915575406

Menne-Lothmann, C., Viechtbauer, W., Höhn, P., Kasanova, Z., Haller, S. P., Drukker, M., … Lau, J. Y. F. (2014). How to boost positive interpretations? A meta-analysis of the effectiveness of cognitive bias modification for interpretation. *PLoS ONE*, *9*(6), e100925. https://doi.org/10.1371/journal.pone.0100925

Moran, T. P. (2016). Anxiety and working memory capacity: A meta-analysis and narrative review. *Psychological Bulletin*, *142*(8), 831–864. https://doi.org/10.1037/bul0000051

Nimon, K., Lewis, M., Kane, R., & Haynes, R. M. (2008). An R package to compute commonality coefficients in the multiple regression case: An introduction to the package and a practical example. *Behavior Research Methods*, *40*(2), 457–466. https://doi.org/10.3758/BRM.40.2.457

Phillips, W. J., Hine, D. W., & Thorsteinsson, E. B. (2010). Implicit cognition and depression: A meta-analysis. *Clinical Psychology Review*, *30*(6), 691–709. https://doi.org/10.1016/j.cpr.2010.05.002

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy*, *35*(8), 741–756. https://doi.org/10.1016/S0005-7967(97)00022-3

Rude, S. S., Durham-Fowler, J. A., Baum, E. S., Rooney, S. B., & Maestas, K. L. (2010). Self-report and cognitive processing measures of depressive thinking predict subsequent major depressive disorder. *Cognitive Therapy and Research*, *34*(2), 107–115. https://doi.org/10.1007/s10608-009-9237-y

Sanford, N., Veckenstedt, R., Moritz, S., Balzan, R. P., & Woodward, T. S. (2014). Impaired integration of disambiguating evidence in delusional schizophrenia patients. *Psychological Medicine*, *44*(13), 2729–2738. https://doi.org/10.1017/S0033291714000397

Speechley, W. J., Ngan, E. T. C., Moritz, S., & Woodward, T. S. (2012). Impaired evidence integration and delusions in schizophrenia. *Journal of Experimental Psychopathology*, *3*(1), 1–14. https://doi.org/10.5127/jep.018411

Stange, J. P., Alloy, L. B., & Fresco, D. M. (2017). Inflexibility as a Vulnerability to Depression: A Systematic Qualitative Review. *Clinical Psychology: Science and Practice*, (June). https://doi.org/10.1111/cpsp.12201

Vita, A., Deste, G., De Peri, L., Barlati, S., Poli, R., Cesana, B. M., & Sacchetti, E. (2013). Predictors of cognitive and functional improvement and normalization after cognitive remediation in patients with schizophrenia. *Schizophrenia Research*, *150*(1), 51–57. https://doi.org/10.1016/j.schres.2013.08.011

Wisco, B. E. (2009). Depressive cognition: Self-reference and depth of processing. *Clinical Psychology Review*, *29*(4), 382–392. article. https://doi.org/10.1016/j.cpr.2009.03.003

Woodward, T. S., Moritz, S., Cuttler, C., & Whitman, J. C. (2006). The contribution of a cognitive bias against disconfirmatory evidence (BADE) to delusions in schizophrenia. *Journal of Clinical and Experimental Neuropsychology*, *28*(4), 605–617. https://doi.org/10.1080/13803390590949511

Table 1. *Demographic characteristics*.

Age (*M*)	34.26 (*SD*=10.39)
Gender	*N*
Male	92
Female	120
Race	
White or Caucasian	152
Black or African American	21
Asian	19
Latino/a	12
Native American or Alaska native	2
Other	6
Education	
High school graduate	39
Some college	39
Two-year college graduate	29
Four-year college graduate	84
Some graduate or professional school	4
Graduate or professional school graduate	17

Table 2. *PCA component loadings per scenario type.*

	Disconfirming-the-negative			Disconfirming-the-positive		
	NII	NIB	PIB	PII	PIB	NIB
Absurd S1	**0.74**	0.04	0.33	**0.92**	0.03	0.13
Absurd S2	**0.77**	0.03	0.31	**0.93**	0.02	0.11
Absurd S3	**0.82**	0.03	0.26	**0.93**	0.01	0.11
Lure-A S1	-0.07	**0.93**	0.04	-0.04	**0.96**	0.04
Lure-A S2	0.04	**0.95**	-0.12	**0.45**	**0.71**	-0.04
Lure-A S3	**0.90**	0.11	0.05	**0.94**	0.08	0.03
Lure-B S1	-0.10	**0.94**	0.03	-0.22	**0.95**	0.04
Lure-B S2	0.16	**0.95**	-0.04	0.23	**0.86**	-0.05
Lure-B S3	**0.89**	0.07	0.12	**0.90**	0.15	-0.02
True S1	0.25	-0.10	**0.81**	**0.57**	-0.18	**0.66**
True S2	0.04	-0.03	**0.94**	-0.04	0.09	**0.95**
True S3	**-0.96**	0.18	**0.37**	**-0.85**	0.11	**0.46**

Notes. Pattern matrices are provided; NII=Negative Interpretation Inflexibility; PII=Positive Interpretation Inflexibility; NIB=Negative Interpretation Bias; PIB=Positive Interpretation Bias; S1-S2-S3=Interpretation rating in response to statement 1, 2, and 3; Lure-A=This refers to the first Lure interpretation; Lure-B=This refers to the second Lure interpretation; Component loadings higher than .35 are in bold.

Table 3. *Regression models predicting depression and social anxiety symptoms*.

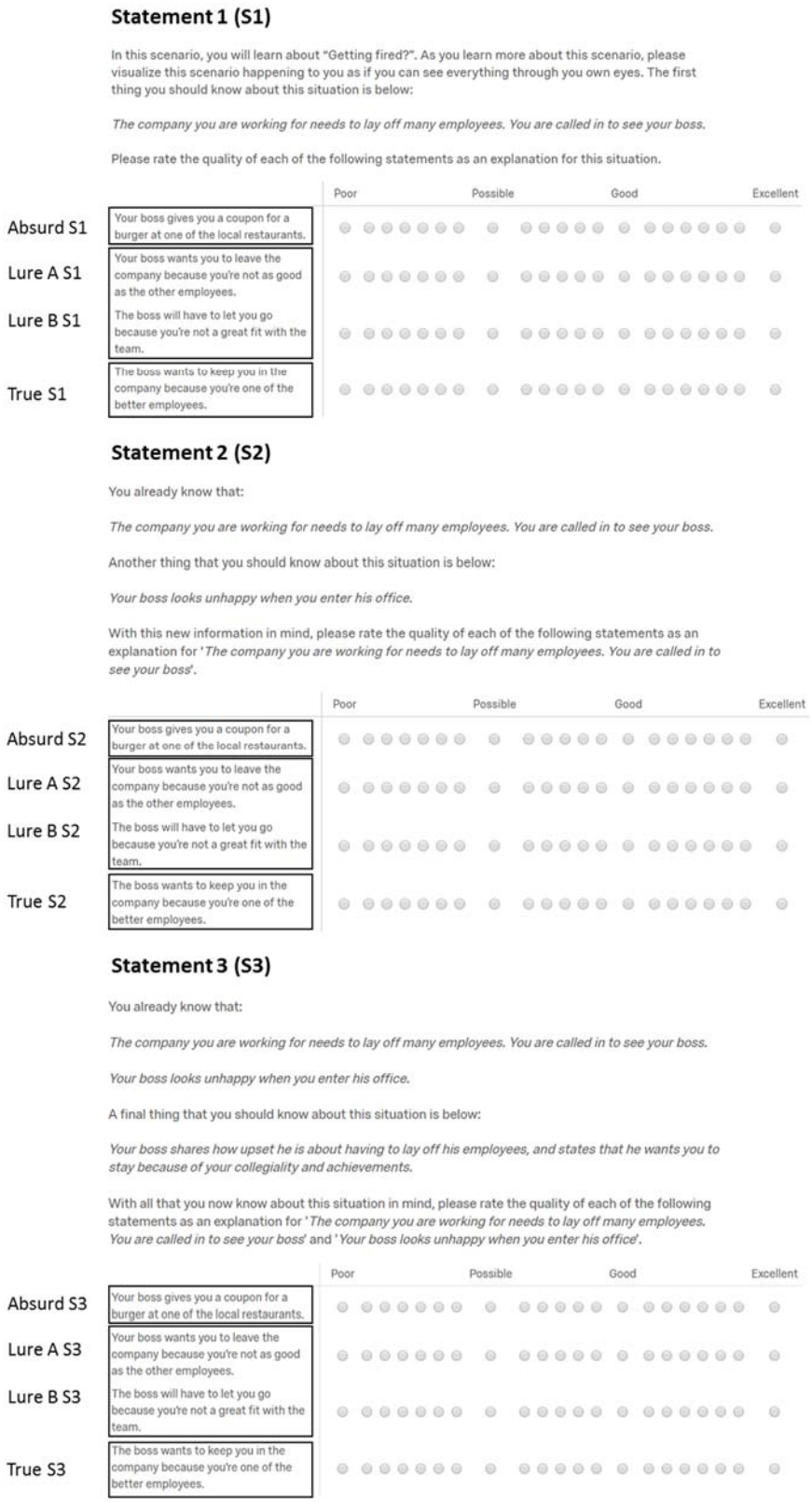
		BDI-II				
		B	SE_b	*β*	*t*	95%-CI
Disconfirming-the negative	Constant	15.20	.94		16.15[c]	13.34; 17.06
	NII	2.70	1.03	.19	2.57[a]	0.62; 4.71
	NIB	2.63	.95	.19	2.75[b]	0.73; 4.47
	PIB	-1.68	1.04	-.12	1.63	-3.74; 0.35
Disconfirming-the positive	Constant	15.20	.91		16.74[c]	13.41; 16.99
	PII	1.50	.93	.11	1.62	-0.31; 3.35
	NIB	3.14	.92	.22	3.43[b]	1.31; 4.92
	PIB	-3.84	.92	-.27	4.15[c]	-5.68; -2.04
		LSAS anxiety				
		B	SE_b	*β*	*t*	95%-CI
Disconfirming-the negative	Constant	25.97	1.00		25.86[c]	23.99; 27.95
	NII	4.51	1.10	.28	4.09[c]	2.34; 6.70
	NIB	5.92	1.01	.37	5.82[c]	3.90; 7.90
	PIB	-2.13	1.10	-.13	1.93	-4.33; 0.03
Disconfirming-the positive	Constant	26.49	1.10		24.06[c]	24.32; 28.66
	PII	2.97	1.88	.10	1.58	-0.75; 6.68
	NIB	4.84	1.06	.30	4.59[c]	2.76; 6.92
	PIB	-1.95	1.07	-.12	1.82	-4.05; 0.16

Notes. [a]$p<.05$; [b]$p<.01$; [c]$p<.001$; NII=Negative Interpretation Inflexibility; PII=Positive Interpretation Inflexibility; NIB=Negative Interpretation Bias; PIB=Positive Interpretation Bias.

Supplemental Material

Section 1: Flow of scenario events

Figure S1 below depicts the flow of scenario events. The figure presents the task instructions for each statement of an emotional BADE scenario. The different types of interpretations are labelled for each statement. Note that the interpretations were presented in randomized order across statements. The task and stimuli are available upon request.



Section 2: Descriptive statistics for emotional BADE interpretation ratings

Table S1 provides descriptive statistics for all average interpretation ratings on the emotional BADE task. As anticipated, the plausibility ratings for the Lure explanations were significantly higher than average True explanation ratings following the first statement for both disconfirming-the-negative scenarios [Lure-A: $t(211)=15.64$, Bonferroni-corrected $p<.001$; Lure-B: $t(211)=15.55$, Bonferroni-corrected $p<.001$] and disconfirming-the-positive scenarios [Lure-A: $t(211)=16.73$, Bonferroni-corrected $p<.001$; Lure-B: $t(211)=19.52$, Bonferroni-corrected $p<.001$]. Also as expected, average ratings for True explanations were significantly higher than those for Lure explanations for both disconfirming-the-negative [Lure-A: $t(211)=32.06$, Bonferroni-corrected $p<.001$; Lure-B: $t(211)=33.95$, Bonferroni-corrected $p<.001$] and disconfirming-the-positive scenarios [Lure-A: $t(211)=32.83$, Bonferroni-corrected $p<.001$; Lure-B: $t(211)=31.37$, Bonferroni-corrected $p<.001$]. This pattern of results is consistent with that in the original BADE task, supporting the utility of the emotional BADE task for examining interpretation inflexibility in response to disconfirmatory evidence.

Table S1. *Descriptive statistics for interpretation ratings.*

	'Disconfirming-the-positive'				'Disconfirming-the-negative'			
	M	*SD*	Min	Max	*M*	*SD*	Min	Max
Absurd 1	3.44	2.98	1.00	15.50	2.95	3.15	1.00	17.17
Absurd 2	2.99	2.85	1.00	15.17	2.65	3.00	1.00	15.00
Absurd 3	2.77	3.13	1.00	17.33	2.47	3.20	1.00	16.58
Lure-A 1	11.10	3.02	1.67	19.92	10.56	2.77	3.67	20.25
Lure-A 2	10.71	2.59	3.75	17.58	8.26	2.41	2.00	15.67
Lure-A 3	4.08	3.13	1.00	15.75	3.06	3.19	1.00	15.33
Lure-B 1	10.98	2.89	2.25	20.67	12.07	3.14	5.75	20.00
Lure-B 2	9.98	2.44	3.92	16.50	9.35	2.34	3.33	16.58
Lure-B 3	3.51	3.03	1.00	15.00	3.94	3.14	1.00	14.58
True 1	6.45	2.85	1.00	17.50	6.00	2.71	1.00	14.75
True 2	7.97	2.34	2.08	16.58	9.59	2.46	2.17	15.33
True 3	17.35	3.39	6.92	21.00	17.61	3.74	1.92	21.00

Note. Similar pattern of ratings were observed for subgroups of individuals reporting high and low scores on the depression (BDI-II) and social anxiety (LSAS anxiety).

Section 3: Commonality analyses

A series of commonality analyses (CA) were conducted for regression models with BDI-II and LSAS anxiety as predictors of the dependent variable (i.e., the NII and NIB emotional BADE components). For each dependent variable, three variance partitions were obtained: (1) the variance uniquely explained by BDI-II; (2) the variance uniquely explained by LSAS anxiety; and (3) the variance that can be explained interchangeably by either BDI-II or LSAS anxiety. The unique partitions reflect the degree of specificity of a predictor. The common partition reflects the degree of overlap of the predictors in accounting for the criterion variable. Table S2 presents the results of the commonality analysis. For *NII*, BDI-II and LSAS anxiety scores accounted for 4.43% of the variance. The CA revealed that LSAS anxiety had the largest unique contribution (60.5%) whereas the unique contribution of BDI-II was small (0.73%). The second largest component was the commonality, that is, the amount of variance explained by the BDI-II or LSAS anxiety (38.70%). For *NIB* in disconfirming-the-negative, BDI-II and LSAS anxiety scores accounted for 11.84% of the variance. The CA revealed that LSAS anxiety had the largest unique contribution (76.51) and BDI-II had only a small unique contribution (0.76%). The commonality was the second largest component LSAS anxiety (22.73%). For *NIB* disconfirming-the-positive, BDI-II and LSAS anxiety scores accounted for 8.81% of the variance. The CA revealed that BDI-II had the largest unique contribution (86.60%) whereas the unique contribution of LSAS anxiety was small (4.71%). The contribution of commonality also was rather small (8.69%).

Table S2. *Results of the commonality analysis.*

Criterion variable	R^2	F (p) model	U_{dep}	U_{anx}	$C_{dep\ or\ anx}$
Disconfirming-the-negative					
NII	4.34	$F(2, 209)=4.74$ ($p=.010$)	0.73%	60.57%	38.70%
NIB	11.84	$F(2, 209)=14.04$ ($p=.000$)	0.76%	76.51%	22.73%
PIB	0.18	$F(2, 209)=0.18$ ($p=.833$)	-	-	-
Disconfirming-the-positive					
PII	1.56	$F(2, 209)=2.67$ ($p=.072$)	-	-	-
PIB	6.29	$F(2, 209)=7.01$ ($p=.054$)	-	-	-
NIB	8.81	$F(2, 209)=7.94$ ($p=.000$)	86.60%	4.71%	8.69%

Notes. R^2 = Total explained variance for the regression model with BDI-II and LSAS anxiety scores as predictors in accounting for the criterion variable. The F (p) column provides F and p values for the tested regression model; U_{dep} =Variance uniquely explained by BDI-II; U_{anx} =Variance uniquely explained by LSAS anxiety; $C_{dep\ or\ anx}$ =Variance that can be explained interchangeably by the BDI-II or LSAS anxiety.