Published in final edited form as:

J Affect Disord. 2018 February ; 227: 824–833. doi:10.1016/j.jad.2017.11.084.

Worry amplifies theory-of-mind reasoning for negatively valenced social stimuli in generalized anxiety disorder

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Abstract

Background: Theory-of-mind (ToM) is the ability to accurately infer others' thoughts and feelings. In generalized anxiety disorder (GAD), cognitive and emotion regulation theories allude to the plausibility that ToM is conditional on the degree of individuals' state worry, a hallmark symptom. GAD and state worry may interact to predict ToM constructs. However, no experiments have directly tested such interactional hypotheses, and used ToM as a framework to advance understanding of social cognition in GAD. This study therefore aimed to address this gap.

Methods: 171 participants (69 GAD, 102 Controls) were randomly assigned to either a Worry or Relaxation induction and completed well-validated ToM decoding (Reading the Mind in the Eyes Test) and reasoning (Movie for the Assessment of Social Cognition) tasks.

Results: GAD status significantly interacted with state worry to predict accuracy of overall reasoning, cognitive-reasoning, positive-reasoning, and negative-reasoning ToM. Worry, as opposed to relaxation, led sufferers of GAD to display more accurate overall reasoning and cognitive-reasoning ToM than controls, especially for negative signals. Participants with GAD who worried, but not relaxed, were also significantly better than the norm at interpreting *negative* signals. These findings remained after controlling for gender, executive function, social anxiety, and depressive symptoms. For other ToM abilities, mean scores of persons with and without GAD who either worried or relaxed were normative.

Limitations: The ToM reasoning measure lacked self-reference, and these preliminary findings warrant replication.

Conclusions: Theoretical implications, such as the state worry-contingent nature of ToM in GAD, and clinical implications are discussed.

Keywords

Generalized anxiety disorder; Theory-of-mind; Anxiety disorders; Cognition; Cognitive behavioral therapy

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1. Introduction

Theory-of-mind (ToM) refers to the ability to accurately infer others' internal states such as intentions and emotions that drive observable behaviors (Premack and Woodruff, 1978). Two components, decoding (social perceptual) and reasoning (social cognitive), are embodied within ToM (Sabbagh, 2004). *Decoding* involves deciphering others' tangible social information (e.g., eye gaze; Samson, 2009). *Reasoning* ToM is subdivided into affective and cognitive components. Whereas *Affective-reasoning* ToM is the ability to identify and draw accurate inferences of others' feeling states, *Cognitive-reasoning* ToM is the capacity to precisely deduce others' intentions and beliefs. This includes predicting characters' actions based on inferences about their false beliefs, or discerning jokes from sarcasm. Lesion and neuroimaging studies have supported the decoding and reasoning components of ToM, showing that they entail distinct neural networks.

Whereas static tasks such as reading the mind in the eyes test (RMET; Baron-Cohen et al., 2001) assess ToM decoding, ecologically valid paradigms such as the movie for assessment of social cognition (MASC; Dziobek et al., 2006) measure ToM reasoning. Importantly, ToM decoding focuses on merely one aspect of social cognition (e.g., visual emotion detection using only the eyes) to detect emotion whereas ToM reasoning integrates multiple channels of interpersonal data (i.e., video unfolding with auditory, visual, and interactive facial and body movement) to understand others' emotions, intentions, and behaviors. Thus, although decoding and reasoning take into account some overlapping information, ToM reasoning, a higher-order cognitive process, builds on basic ToM decoding skills and combines both bottom-up mind-reading of information from dynamic environmental changes, as well as top-down schema-driven processing based on knowledge of a person's experiences and belief systems.

With respect to psychopathology, ToM deficits manifest in the form of either *over-attributing* mental states (e.g., excessive ToM in social anxiety disorder; Hezel and McNally, 2014) or making *inadequate* mental state inferences (e.g., autism spectrum disorders; Baron-Cohen et al., 2001). To our knowledge, no studies have explicitly investigated ToM in generalized anxiety disorder (GAD), a condition where excessive and uncontrollable worry is the hallmark symptom. Nonetheless, some indirect evidence may speak to this. Interpersonal problems have been linked to its etiology and maintenance (Newman and Erickson, 2010). For example, persons with GAD were more likely than controls to either under- or over-estimate their impact and hostile behaviors on others (Erickson and Newman, 2007). In addition, although trait worry was associated with self-reported affiliative tendencies, it predicted impacting significant others in unaffiliative ways (Erickson et al., 2016). However, support for no ToM impairment includes evidence that those with GAD were similar to controls in social competence, and involvement (Scharfstein et al., 2011). Similarly, a meta-analysis found unimpaired emotion recognition in GAD (Plana et al., 2014). Thus, there is broad evidence for and against persons with GAD having intact ToM reasoning and decoding capacities.

At the same time, indirect evidence alludes to inferior ToM decoding relative to affective-reasoning capacities in those with GAD. For instance, across cultures, trait anxiety showed

no significant link to comprehension of an array of emotional faces on static photographs, which mimics ToM decoding measures (Baron-Cohen et al., 2001; Cooper et al., 2008; Surcinelli et al., 2006; Yoon et al., 2016). Likewise, individuals with GAD (vs. healthy controls) were similar on attentional processing of facial emotions in response to stationary spatial cueing tasks (Yiend et al., 2015) akin to ToM decoding measures. On the other hand, meta-analytical evidence highlighted that those with GAD had the highest attention toward visual social stimuli when such stimuli were presented in a verbal-linguistic, dynamic, and ecological manner (comparable to ToM reasoning tasks) as opposed static images (Goodwin et al., 2017). Other evidence of enhanced affective-reasoning in GAD is that compared to non-anxious persons, GAD analogues reported enhanced empathy for others' pain (Peasley et al., 1994). Such empathy was also illustrated in Erickson and Newman (2007), when persons with GAD showed stronger sad responses than controls to sad emotional disclosures by confederates. Empathy refers to the propensity to reflexively emulate and synchronize postures, expressions, or vocalizations, and thus, connect emotionally and viscerally with others' experiences (Hatfield et al., 1993). Elevated empathy could signify heightened affective-reasoning ToM accuracy (Tibi-Elhanany and Shamay-Tsoory, 2011). Affective-reasoning ToM may thus be stronger in individuals with GAD than controls (Shamay-Tsoory et al., 2009).

Moreover, evidence demonstrates that cognitive-reasoning ToM may be unique in GAD. Compared to controls, those with GAD showed enhanced amygdala-precuneus (Strawn et al., 2012) and amygdala-PFC (Makovac et al., 2016) connectivity. Importantly, these neural linkages were associated with ToM reasoning relative to decoding (Sabbagh, 2004). Persons with GAD also had elevated bilateral connectivity between the amygdala and executive control networks (e.g., ventromedial prefrontal cortex [vm-PFC]) which was not observed in controls (Etkin et al., 2009). Such tight amygdala-frontoparietal network coupling may indicate a habit of recruiting the cognitive control system as a form of vigilance for comprehending others' motives and intentions, similar to cognitive-reasoning ToM.

Nonetheless, people with GAD worry more chronically than their less severe counterparts. Thus, when simply comparing those with and without GAD, it is difficult to know whether differences found within and across studies were due to inherently present processes regardless of participants' worried versus relaxed state or were instead due to current elevated levels of state worry enhancing their tendency toward vigilance. It is possible that state worry versus relaxation among persons with GAD could heighten attunement to various emotions and other more complex cues related to ToM reasoning abilities. In fact, several theorists have postulated that worry in GAD may function to understand and respond to others' interpersonal needs and vulnerabilities (Borkovec and Newman, 1998; Erickson et al., 2016). Moreover, the hypervigilance model of anxiety (Eysenck et al., 2007) assumes that worry in GAD enhances motivation to assuage anxiety, particularly in response to socially relevant material. Worry in GAD is also a cognitive-elaborative process (Borkovec and Inz, 1990), which could heighten the ability to be attuned to others' thought processes (Brothers and Ring, 1992). Worry in GAD may thus facilitate precise reading of emotions and intentions underlying others' observable actions. However, this conjecture has not been tested directly.

Indirect evidence for this speculation is derived from accounts of chronic worriers showing more rapid detection of emotional expressions following priming of a fearful image, as opposed to benign stimuli (Olatunji et al., 2011). Fear resembles state worry. If these assumptions are true, attunement of persons with GAD to their social environment and ToM reasoning skills may be sharpened when they engage in an acute state of worry. In addition, worry in GAD was correlated with the notion that one cares deeply about others' affairs (Hebert et al., 2014), and may thus motivate accurate comprehension of others' motives. This is consistent with heightened attention to ambiguous aspects of their social environment as a result of state worry in persons with GAD (Hirsch et al., 2009). Taken together, compared to relaxation, state worry may intensify cognitive and affective reasoning ToM in those with GAD more strongly than non-anxious controls. Thus, we conjecture that persons with GAD may have keen ToM reasoning skills when engaged in worry.

Negative versus positive context may also influence ToM reasoning. Indeed, the cognitive model (Hirsch and Mathews, 2012) asserts that pathological worry in GAD is intrinsically linked to the proclivity to attend to and difficulty disengaging from negative social material. A predilection to process environmental threats is theorized to be evolutionarily adaptive (Öhman, 2007) and is thus relevant to all people, but is more pronounced in individuals with GAD when worried (Bar-Haim et al., 2007). Across a diversity of paradigms, worry led individuals with GAD to show vigilance toward social threats (Bar-Haim et al., 2007). However, lower state worry was linked to the propensity to naturally attend to positive social features and interpret ambiguous social signals in a positive light (Frewen et al., 2008). Moreover, relaxation training successfully led to reduction in worry severity, vigilance to social threat (Fonzo et al., 2014), and construing incoming data in negative ways (Hayes et al., 2010). Thus, relaxation, may foster the ability of individuals with GAD to access both positive and negative meanings of the social environment. Taken together, degree of engagement in state worry and relaxation may interact with GAD status to determine ToM reasoning accuracy for negative social signals in particular.

In summary, the foregoing theories and data suggest that effects based solely on GAD status may not reflect the complex reality of ToM processes. Plausible hypotheses of how GAD moderates ToM capacities are likely to be conditional on participants' degree of state worry, which may be controlled by inducing either worry or relaxation in a laboratory setting. To address a knowledge gap, the goal of this experimental study was to test the interactional link between state worry and GAD on ToM reasoning and decoding. Persons with GAD have heightened sensitivity to a diversity of context-specific social cues when worried (Olatunji et al., 2011). As such, we hypothesized that GAD and state worry would interact to facilitate greater awareness of social cues, resulting in higher *global ToM reasoning*. However, we predicted no effects of GAD or worry on *decoding* accuracy, as studies that used static context-absent ToM-like tasks (e.g., Yoon et al., 2016) found no link with GAD diagnostic status. Although hypothesizing null effects poses certain risks (e.g., biased results; Bloeser et al., 2015, p. 335), we based our hypotheses on both theory and data. Second, we predicted based on research on worry and empathy that persons with GAD would demonstrate heightened ToM *affective-reasoning* accuracy when worried compared to relaxation and compared to controls. Third, we predicted that GAD status and state worry would operate in tandem to predict better *cognitive-reasoning* ToM than controls based on

various models of GAD and fMRI data regarding those with GAD when worried. Fourth, since state worry intensifies focus on threats (Hirsch et al., 2009), we expected that worry would lead the GAD group to be more accurate than controls for negative aspects of social interactions. Similar to findings for depressive realism (Alloy and Abramson, 1979), worry in GAD and its associated vigilance could hence lead to heightened accuracy for negative information in ToM reasoning. However, we expected that relaxation would lead controls and persons with GAD to show non-significantly different and intact ToM decoding and reasoning for positive social stimuli.

2. Methods

2.1. Overall design

A 2 (Group: GAD, non-anxious Controls) by 2 (Condition: Worry, Relaxation) between-group block design was employed to explore the differential effects of worry on ToM reasoning and decoding. Cell size was determined *a priori* by a power analysis based on a between-group medium effect size ($d = .50$). Assuming $\alpha = .05$ (two-tailed), 30 participants per condition ensured power of .80 for detecting between-group differences (Neter et al., 1990). In the relaxation condition, 53 were Controls, whereas 38 met criteria for GAD. In the worry condition, 49 were Controls, whereas 31 had GAD.

2.2. Participants

One-hundred-and-seventy-one undergraduates (138 females; $M_{age} = 18.96$ years, $SD = 1.16$ years) participated in exchange for course credit. Ethnic distribution was 80.70% Caucasian, 5.85% African American, 2.92% Hispanic, .58% Middle Eastern, and 9.94% Asian. Based on the Generalized Anxiety Disorder Questionnaire-IV (scored above the 5.7 cutoff on the GAD-Q-IV ($M = 7.53$, $SD = 1.54$); Newman et al., 2002) and Mini International Neuropsychiatric Interview (i.e., full clinical diagnosis of GAD was made based on the MINI; Sheehan et al., 1997), 69 people met criteria for GAD, and 102 were non-GAD controls. Demographic and comorbidity data are reported in Tables 1 and 2 respectively.

2.3. Clinical interview and self-report measures

Aside from the clinical interview and ToM measures, we also assessed for social anxiety (Hezel and McNally, 2014), depression (Harkness et al., 2010), and executive function (Zobel et al., 2010) and controlled these variables in our analyses given their documented links with ToM.

2.3.1. Mini international neuropsychiatric interview (MINI; Sheehan et al., 1997)—The MINI is based on the DSM-IV (American Psychiatric Association, 2013) and International Classification of Diseases - 10th Edition (ICD-10) and has been validated against the Composite International Diagnostic Interview (CIDI; Robins et al., 1988) and Structured Clinical Interview for DSM Disorders (SCID; First et al., 1997). It is a brief but accurate structured interview designed to be used by para-professionals. Inter-rater agreement was $\kappa = .70$ for GAD and ranged from .50 (simple phobia) to .90 (anorexia) for other disorders. Sheehan et al. (1998) showed the sensitivity of the MINI to be .70 for all

diagnoses but dysthymia (.62) and obsessive-compulsive disorder (.67), whereas specificities were .85 for all diagnoses. The MINI was administered by trained undergraduates, supervised by a doctoral-level licensed clinical psychologist. Each interview was observed in-session by a second rater to independently evaluate whether participants met diagnostic criteria. Reliability was good across all mental disorders (Cohen's kappa: $\kappa = .93, p < .001$) and GAD diagnosis in particular ($\kappa = .97, p < .001$).

2.3.2. Generalized anxiety disorder questionnaire (GADQ-IV; Newman et al., 2002)—This 14-item measure was used to screen for DSM-IV and DSM-5-defined GAD (American Psychiatric Association, 2013). A cut-off score of 5.7, used in this study, leads to specificity and sensitivity of .89 and .83 respectively (Newman et al., 2002). Internal consistency ($\alpha = .94$ in the original study; $\alpha = .90$ in the current study) and retest reliability of .92 were good. Also, the scale has good convergent and discriminant validity, and k agreement of .67 with a structured interview.

2.3.3. Penn state worry questionnaire - past week (PSWQ-PW; Stöber and Bittencourt, 1998)—The PSWQ-PW is a 15-item measure of an individual's frequency and intensity of pathological worry over the past week. It was adapted from the original 16-item PSWQ, which measures *trait* worry, in contrast to *state* worry (Meyer et al., 1990). It is rated on a 7-point Likert scale from 'never' to 'almost always'. Scores range from 0 to 90, with higher scores signifying more worry. It has good internal consistency, ranging from .84 to .93 (.95 in this study) over a four-week assessment period (Stöber and Bittencourt, 1998), as well as convergent validity with the past-week version of the Worry Domains Questionnaire (WDQ; Tallis et al., 1992).

2.3.4. Social phobia diagnostic questionnaire (SPDQ; Newman et al., 2003)—This 25-item measure of DSM-IV-TR-defined social anxiety disorder (SAD) has a sensitivity and specificity of .82 and .85 respectively when compared with a structured interview. It has excellent internal consistency ($\alpha = .92$ in the original study; .95 in the current study) and good 2-week retest reliability ($\kappa = .63$). It also has strong convergent validity with the Social Interaction Anxiety Scale (SIAS; Mattick and Clarke, 1998; point-biserial $r = .64$), and demonstrated discriminant validity with the PSWQ ($r = .32$), GADQ-IV ($r = .29$), and other psychopathology measures (Newman et al., 2003).

2.3.5. Beck depression inventory-II (BDI-II; Beck et al., 1996)—This 21-item self-report measure taps into depressive symptom severity. For each item, individuals endorse the most suitable of four statements of greater intensity (0–3), based on the past two weeks. The total score ranges from 0 to 63. It has excellent internal consistency ($\alpha = .92$ –.93; .94 in the current sample) and good validity (Beck et al., 1996).

2.4. Theory-of-mind and executive function measures

2.4.1. Reading the mind in the eyes test (RMET; Baron-Cohen et al., 2001) - ToM decoding—The RMET is a sophisticated ToM decoding task that requires people to recognize others' thoughts and emotions with the eyes only. Each of the 18 pictures is 15 cm by 6 cm and depicts faces only from the middle of the nose to just above the eyebrows.

Participants select one of four words (one target and three foils), which most accurately describe the individual's mental state or emotion in the photograph (e.g., decisive, bored) (one point per correct response). Location of the target answer is counterbalanced and all words are equally spaced from the center. Higher scores indicate better ToM decoding (score range 0–18). It has acceptable internal consistency (Cronbach's $\alpha = .61$; Vellante et al., 2013) and excellent retest reliability (intra-class correlation coefficient of .83; Vellante et al., 2013). RMET options are either positive or negative in valence (cf. Hezel and McNally, 2014).

2.4.2. Movie for the assessment of social cognition (MASC; Dziobek et al., 2006) - ToM reasoning—The MASC assesses ToM reasoning via a 15-min video about four people at a dinner gathering. Characters demonstrate stable traits throughout the movie (e.g., extraverted, timid, selfish) and confront different social scenarios that trigger varied mental states, emotions, and responses (e.g., disgust, anger, jealousy, sarcasm). Intimacy level between characters differ, as they are either friends or strangers. The movie was paused during 45 preset times and participants were questioned regarding characters' intentions, thoughts, and feelings. The MASC encompasses perspectives of social cognition such as faux pas, irony, humor, and first- and second-order false beliefs (for more details see Dziobek et al. (2006)).

Questions followed a multiple-choice format. Answers were classified into four categories: (1) "correct ToM": correct mental states inferred, (2) "no ToM": no mental states inferred (i.e., physical causation), (3) "less ToM": mental states inferred inadequately, and (4) "excessive ToM": high degrees of mental states inferred. To illustrate, Cliff is the first guest to arrive at Sandra's party. They both seem to be enjoying their conversation as Cliff talks about his holiday in Sweden. Upon his arrival, Michael tries to seize Sandra's attention and purposefully exclude Cliff. Sandra starts to feel irritated with Michael, looks briefly at Cliff and then asks Michael if he has ever been to Sweden. The video pauses and participants answer: "Why is Sandra asking this?" "To integrate Cliff," is the correct response. Incorrect responses are "She liked the Sweden topic better than the current one." (no ToM), "To compare the two." (excessive ToM), and "To hear whether Michael also has something to say about Sweden." (less ToM). The MASC has internal consistency (Cronbach's $\alpha = .84$), inter-rater reliability (Cohen's $\kappa = .99$), retest reliability ($r = .97$; Dziobek et al., 2006), and strong convergent validity with other social cognition measures (Dziobek et al., 2006).

Four composite scores, each reflecting one category, were calculated. The sum of correct responses reflected ToM reasoning accuracy. Using predefined categories developed by others, items were sub-divided into cognitive- and affective-reasoning ToM. Example items were "What is (the person) feeling?" (i.e., affective-reasoning ToM; 18 items) and "What is (the person) thinking/ What is (the person's) intention?" (i.e., cognitive-reasoning ToM; 27 items; cf. Wilbertz et al., 2010). In this study, Cronbach's α of the MASC's total scale, affective-reasoning, and cognitive-reasoning scales were .84, .75, and .87 respectively. Six people also independently rated valence of the 180 responses (45 questions $\times$ 4 response selections) as either negative, neutral, or positive. The number of options rated as negatively, neutrally, and positively, valenced were 83, 28, and 69 respectively. There was agreement on 177 of the 180 items, resulting in $\kappa = .99$.

2.4.3. Wisconsin card sorting test (WCST; Heaton et al., 1993)—A

computerized WCST measured executive function (EF) reflected by participants' cognitive flexibility to modify certain criteria using realistic constraints of the matching rule based on shape, number, or color (i.e., when receiving feedback about wrong answers). Using an unspecified matching rule, participants matched stimulus cards to one of four principal cards. The test ends when participants make 60 attempts. Several indices may be obtained from this EF measure: number of categories completed, perseverative errors, and correct responses. For our purposes, results were computed based on the number of correct responses.¹ The computerized WCST has shown good convergent validity with other neuropsychological assessments and test-retest reliability (Kongs et al., 2000).

2.5. Manipulation check measure

2.5.1. Worry and relaxation (Fisher and Newman, 2013)—Participants rated on two 9-point Likert scales their degree of worry and relaxation (1 = *not at all* to 9 = *as much as possible*) before and after the experimental worry or relaxation induction.

2.6. Procedure

Participants provided informed consent as approved by the institutional review board. They were first interviewed using the MINI then completed the measures of demographics, GADQ-IV, PSWQ, BDI-II, and SPDQ. The computer then prompted them to rate their extent of current worry and relaxation. Subsequently, they were randomly assigned to either worry or relax using an Excel algorithm; at no point in time were research personnel able to anticipate the assignment. Instructions for the worry induction were as follows: "Think about your most worrisome topic. Please worry about this topic as intensely as you can, in the way that you usually worry, until you are asked to stop worrying. If at any point your mind wanders off track, simply refocus your thoughts back to your worry topic." Instructions for the relaxation induction were as follows: "Shift to breathing from your stomach rather than from your chest. Allow your stomach to rise and fall without expanding your chest. Also, slow your breathing down to a rate slower than usual but not so slow that it is unpleasant or uncomfortable. You might do this by counting from one to three as you breathe in evenly and then again as you evenly exhale. If at any point your mind wanders, simply refocus your thoughts back to your breathing." Instructions were practiced for three minutes and accord with previous studies (e.g., Borkovec and Inz, 1990). Participants again rated their degree of worry and relaxation post-induction. Then, following others (e.g., Hezel and McNally, 2014), they completed RMET, MASC and WCST in that order. Worry or relaxation inductions were conducted three times prior to the RMET, MASC, and WCST so that impact of experimental inductions did not fade as participants progressed further in the study. These tasks took about 120 min to complete and were done on a computer faced away from the examiner to minimize anxiety about being observed.

¹When we used other EF indices (number of categories completed or perseverative errors) as a covariate in the multivariate models examined in this study, we obtained a similar pattern of results in terms of magnitude and direction for all the models.

2.7. Data analytic plan

All analyses used SPSS (Statistical Package for Social Sciences, Version 20.0). Skewness and kurtosis fell within ± 1 , suggesting normal distribution of the data. Outliers, defined as scores ± 3 standard deviations (SDs) above or below the mean, were absent. χ^2 tests compared differences in gender, race, and diagnoses (cf. Tables 1 and 2). For manipulation checks, multilevel modeling was conducted. This was because repeated measures of state worry and relaxation were nested within persons, and individuals' pre- and post-induction scores were likely to mutually influence one another (i.e., violating assumption of independence of errors) (Raudenbush and Bryk, 2002). Next, we conducted a series of 2×2 ANOVAs with Group (GAD, Control) and Condition (Worry, Relaxation) on accuracy of ToM decoding and reasoning (Hypothesis 1), cognitive-reasoning and affective-reasoning ToM (Hypotheses 2 and 3), as well as negative and positive social stimuli (Hypotheses 4 and 5). All ToM accuracy scores were based on percentages of correct responses. ToM reasoning errors (excessive, less, and no ToM) were coded in terms of absolute scores. Dummy codes were assigned to group (0 = Control; 1 = GAD) and condition (0 = Relax; 1 = Worry). Significant interaction effects were followed by a series of t -tests to clarify the pattern of means. Analyses of covariance (ANCOVAs) were conducted to test robustness of any significant finding by adjusting for the following theoretically and empirically-based covariates: gender (Baron-Cohen et al., 2001), executive function (Zobel et al., 2010), social anxiety (e.g., Hezel and McNally, 2014), and depression (Harkness et al., 2010) (Table 3). Statistically significant univariate findings were considered robust if they remained significant after controlling for these covariates. No ANCOVAs presented with issues of multicollinearity, as reflected by values of tolerance greater than .20 and variance inflation factors of less than 4 for all predictors (Aiken and West, 1991). All p values were based on two-tailed tests. Cohen's d effect sizes were calculated using the following formulas: $\frac{2t}{\sqrt{(df)}}$ or $2\sqrt{\frac{F}{(df)}}$ (i.e., small = .20, medium = .50, large = .80; Cohen, 1992; Dunlap et al., 1996; Dunst et al., 2004). For the ANOVA-derived F -tests, we also calculated the partial eta squared (η_p^2) effect size (i.e., proportion of the effect plus error variance that is due to the effect; Fritz et al., 2012). Although unequal cell sizes do not affect parameter estimates for multilevel modeling (Maas and Hox, 2005), it may introduce concerns for ANOVAs regarding unequal variances. We thus verified that Levene's tests of equality of error variances were statistically non-significant ($p > .05$), reflecting similar variances across groups. For significant findings, we also compared our computed item averages from the RMET or MASC to norms (item means and SD of controls) provided by the test developers (Baron-Cohen et al., 2001; Dziobek et al., 2006). For this, we converted means into standardized z -scores. Means that were significantly different from the norms were reflected by values that surpassed the $z = \pm 1.96$ critical value.

3. Results

3.1. Manipulation checks

As indicated by significant condition $\times$ time interaction effects, worry induction led to sharper increases in levels of self-reported worry compared to relaxation prior to administration of the RMET [$\beta = 2.95$, standard error (SE) = .26, $F(1, 340) = 53.78$, $p < .$

0001, $d = .80$], MASC [$\beta = 2.99$, $SE = .31$, $F(1, 340) = F(1, 340) = 27.12$, $p < .0001$, $d = .56$], and WCST [$\beta = 2.87$, $SE = .23$, $F(1, 340) = 33.91$, $p < .0001$, $d = .63$]. Similarly, significant condition $\times$ time interaction effects reflected that the relaxation induction predicted steeper increases in self-reported relaxation relative to worry before the RMET [$\beta = -1.79$, $SE = .31$, $F(1, 340) = 29.29$, $p < .0001$, $d = -.59$], MASC [$\beta = -1.77$, $SE = -.59$, $F(1, 340) = 13.08$, $p < .0001$, $d = -.39$], and WCST [$\beta = -1.76$, $SE = .29$, $F(1, 340) = 15.72$, $p < .0001$, $d = -.43$] were administered. Taken together, analyses indicated that the manipulations worked.

Hypothesis 1: State worry (vs. relaxation) would result in the GAD group demonstrating more accurate *global ToM reasoning*, but not decoding.

However, among healthy controls, we expected no significant differential effects of state worry versus relaxation.—A significant group $\times$ condition interaction

emerged for ToM reasoning [moderate effect size; $F(1, 167) = 8.20$, $p = .0047$, $\eta_p^2 = .047$] but not decoding [$F(1, 167) = 2.25$, $p = .14$, $\eta_p^2 = .013$].² In the context of worry, ToM reasoning was significantly more accurate among the GAD group ($M = 78.76$) relative to controls ($M = 74.31$) [$t(169) = 2.45$, $p = .014$, $d = .56$]. However, after relaxation, those with GAD ($M = 74.61$) and controls ($M = 76.78$) did not differ in ToM reasoning accuracy [$t(169) = -1.49$, $p = .14$, $d = -.32$]. Furthermore, compared to relaxation, worry led to *higher* ToM reasoning accuracy among the GAD ($M_{\text{WORRY}} = 78.76$ versus $M_{\text{RELAX}} = 74.61$) [$t(169) = 2.56$, $p = .013$, $d = .64$] but not the control group ($M_{\text{WORRY}} = 74.31$ versus $M_{\text{RELAX}} = 76.78$) [$t(169) = -.98$, $p = .33$, $d = -.20$]. However, ToM reasoning accuracy scores of all groups were not significantly above the norms [GAD participants: worry (+ .815 SD), relax (+ .096 SD); Controls: worry (+ .044 SD), relax (+ .001 SD)]. Hypothesis 1 was fully supported (see Fig. 1).

Hypothesis 2: State worry but not relaxation would lead to stronger performance on *affective-reasoning ToM accuracy* in those with GAD.

However, among healthy controls, we expected no significant differential effects of state worry versus relaxation.—The group $\times$ condition interaction effect on

affective-reasoning ToM accuracy was marginally significant [$F(1, 167) = 3.34$, $p = .069$, $\eta_p^2 = .019$] (Fig. 2). Those with GAD were non-significantly different than controls in affective-reasoning ToM following relaxation ($M_{\text{GAD}} = 71.86$ versus $M_{\text{CONTROL}} = 74.22$) [$t(169) = -1.14$, $p = .26$, $d = -.24$] and worry ($M_{\text{GAD}} = 73.30$ versus $M_{\text{CONTROL}} = 69.80$) [$t(169) = 1.43$, $p = .16$, $d = .33$], lending no support to Hypothesis 2. Whereas state worry and relaxation showed no significant differential impact on ability of participants with GAD to reason about others' emotions ($M_{\text{WORRY}} = 73.30$ versus $M_{\text{RELAX}} = 71.86$) [$t(169) = .70$, $p = .49$, $d = .17$], controls were marginally significantly better at affective-reasoning ToM following *relaxation* than worry ($M_{\text{WORRY}} = 69.81$ versus $M_{\text{RELAX}} = 74.22$) [$t(169) = -1.77$, $p = .08$, $d = -.36$]. All groups scored non-significantly below the norms on affective-reasoning ToM [GAD group: worry (-.40 SD), relax (-.69 SD); Control group: worry (-.90 SD), relax (-.29 SD)]. However, controls' affective-reasoning ToM was closest to the norm

²Upon examining ToM reasoning accuracy on positive social stimuli as the outcome, the group $\times$ condition interaction effect became marginally significant, but in similar direction after adjusting for the four covariates [$F(1, 159) = 3.89$, $p = .050$, $\eta_p^2 = .024$, $d = .31$].

when they relaxed. Thus, although controls showed more accurate affective-reasoning ToM after relaxation compared to worry, their scores were normative.

Hypothesis 3: State worry, but not relaxation, would lead persons with GAD to be more accurate than non-anxious controls for *cognitive-reasoning ToM*.

However, among healthy controls, we expected no significant differential effects of state worry versus relaxation.—We observed a significant group $\times$

condition interaction effect on cognitive-reasoning ToM accuracy [$F(1, 167) = 4.80, p = .030, \eta_p^2 = .028$] (Fig. 3).³ Participants with GAD were significantly more accurate than controls after worry ($M_{\text{GAD}} = 82.07$ versus $M_{\text{CONTROL}} = 77.38$) [$t(169) = 2.05, p = .044, d = .47$] but not relaxation ($M_{\text{GAD}} = 76.87$ versus $M_{\text{CONTROL}} = 78.63$) [$t(169) = -.93, p = .35, d = -.20$]. Compared to relaxation, worry enhanced cognitive-reasoning ToM among GAD participants ($M_{\text{WORRY}} = 82.07$ versus $M_{\text{RELAX}} = 76.87$) [$t(169) = 2.11, p = .039, d = .53$] but not non-anxious controls ($M_{\text{WORRY}} = 77.38$ versus $M_{\text{RELAX}} = 78.63$) [$t(169) = .016, p = .99, d = .0032$]. All groups scored non-significantly above the norms on cognitive-reasoning ToM [GAD participants: worry (+ 1.11 SD), relax (+ .27 SD); Control group: worry (+ .404 SD), relax (+ .400 SD)]. Hypothesis 3 was thus fully supported.

Hypothesis 4: State worry, but not relaxation, would cause persons with GAD to have better ToM reasoning and decoding for *negative social stimuli* than controls. However, among healthy controls, we expected no significant differential effects of state worry versus relaxation.—For ToM accuracy on

negative social stimuli, analyses yielded a significant group $\times$ condition interaction effect on ToM reasoning [$F(1, 167) = 7.24, p = .0079, \eta_p^2 = .042$] but not decoding [$F(1, 167) = 1.48, p = .23, \eta_p^2 = .009$] (Fig. 4).⁴ Compared to relaxation, ToM reasoning on negative social stimuli was significantly better following *worry* among those with GAD ($M_{\text{WORRY}} = 41.28$ versus $M_{\text{RELAX}} = 38.49$) [$t(169) = 2.66, p = .01, d = .66$] but not controls ($M_{\text{WORRY}} = 38.29$ versus $M_{\text{RELAX}} = 39.40$) [$t(169) = .48, p = .63, d = .097$]. Relative to controls, those with GAD had better ToM reasoning for negative stimuli following worry ($M_{\text{GAD}} = 41.28$ versus $M_{\text{CONTROL}} = 38.29$) [$t(169) = 2.88, p = .0051, d = .65$] but not relaxation ($M_{\text{GAD}} = 38.49$ versus $M_{\text{CONTROL}} = 39.40$) [$t(169) = -.92, p = .36, d = -.20$]. All participants' ToM reasoning accuracy for negative social signals was above the norms [GAD participants: worry (+ 2.72 SD), relax (+ 1.67); Non-anxious controls: worry (+ 1.77 SD), relax (+ 1.95 SD)]. However, the GAD group who worried was the only group that showed ToM reasoning accuracy on negative stimuli that was significantly above the norm. Thus, Hypothesis 4 was supported for ToM reasoning but not decoding.

Hypothesis 5: State relaxation would lead controls and persons with GAD to show non-significantly different and intact ToM decoding and reasoning for *positive social stimuli*.—For ToM accuracy of *positively* valenced social stimuli, there

was a group $\times$ condition interaction for ToM reasoning [$F(1, 167) = 4.73, p = .031, \eta_p^2 = .$

³The group condition effect predicting ToM reasoning accuracy on *negative* stimuli remained statistically significant in the same direction after controlling for the four covariates [$F(1, 159) = 5.89, p = .016, \eta_p^2 = .036, d = .38$].

⁴Similarly, in determining cognitive ToM accuracy, the group $\times$ condition interaction effect was marginally significant and in the same direction after controlling for the four covariates [$F(1, 159) = 3.76, p = .054, \eta_p^2 = .024$].

028] but not decoding [$F(1, 167) = 1.20, p = .27, \eta_p^2 = .007$] (Fig. 5).⁵ Worry or relaxation yielded similar ToM reasoning for positively valenced social stimuli among the GAD group ($M_{\text{WORRY}} = 38.03$ versus $M_{\text{RELAX}} = 36.36$) [$t(169) = 1.49, p = .22, d = .37$] and non-anxious controls ($M_{\text{WORRY}} = 36.49$ versus $M_{\text{RELAX}} = 38.17$) [$t(169) = -1.24, p = .22, d = -.25$]. Following worry induction, no significant differences were noted between those with GAD ($M = 38.03$) and controls ($M = 36.49$) [$t(169) = 1.23, p = .22, d = .28$]. However, after relaxation, controls ($M = 38.17$) were marginally significantly better than those with GAD ($M = 36.49$) at ToM reasoning for positive stimuli [$t(169) = -1.93, p = .057, d = -.41$]. ToM reasoning accuracy for positive material was non-significantly above the norm for all groups [GAD group: worry (+ 1.44 SD), relax (+ .99 SD); Control group: worry (+ .85 SD), relax (+ 1.53 SD)]. However, compared to the GAD group, controls excelled in positive-reasoning ToM when they relaxed, instead of worried, partially supporting Hypothesis 5.

3.2. Secondary analyses of ToM reasoning errors

Analyses revealed no significant group $\times$ condition interaction effects on excessive ToM [$F(1, 167) = 1.55, p = .22, \eta_p^2 = .009$], less ToM [$F(1, 167) = 1.25, p = .27, \eta_p^2 = .007$] and no ToM [$F(1, 167) = 2.35, p = .13, \eta_p^2 = .014$]. No main group and condition effects were also observed for these three types of ToM reasoning errors (all $p > .05$).

4. Discussion

Overall, our data showed that GAD and state worry synergistically interacted to amplify accuracy for overall reasoning, cognitive-reasoning, and negative-reasoning, but not affective-reasoning ToM. Among controls, however, state relaxation led to more accurate affective-reasoning ToM than worry as well as better positive-reasoning ToM than the GAD group. Compared to the general population norm, overall reasoning, cognitive-reasoning, affective-reasoning, and positive-reasoning ToM of the GAD and control groups who worried or relaxed were normative. However, the GAD, but not control group who *worried*, as opposed to relaxed, were more accurate on *negative* ToM reasoning than controls and this was, on average, significantly *above* the norm. Importantly, this pattern of findings remained after controlling for multiple covariates, which raises our level of confidence in the findings herein. The overall pattern of results reflects that instead of being an enduring trait-like entity, ToM in both GAD and non-GAD control groups are momentarily impacted by state worry/relaxation. Data from this novel study provide fertile ground for theoretical development of the understudied phenomena of ToM in GAD.

Why were GAD individuals in a state of worry more accurate at various types of ToM reasoning than controls, whereas there were no differences between these groups in response to relaxation? The fact that worry enhanced the skill of individuals with GAD to attend to cues and accurately infer the internal states of the film's characters on overall reasoning, cognitive-reasoning, and negative-reasoning may be linked to the verbal-cognitive nature of worry (Carter et al., 1986). Perhaps worry did not impact ToM reasoning in controls because in those without GAD, worry is characterized by more imagery than verbal-cognitive

⁵The interaction effect remained significant in a similar magnitude and direction after accounting for gender, executive function, depressive, and social anxiety symptoms [$F(1, 159) = 6.78, p = .010, \eta_p^2 = .041$; refer to Table 3].

thought (Borkovec and Inz, 1990). Furthermore, functional neuroimaging (fMRI) studies consistently showed that worry induction activated the anterior cingulate cortex (ACC) and medial PFC more strongly and persistently in those with GAD than controls (Andreescu et al., 2015; Paulesu et al., 2010). These areas have been implicated in social cognitive/reasoning, as opposed to social perceptual/decoding ToM (Frith and Frith, 2006), hence also accounting for our null findings on ToM decoding. In the GAD group, worry, once triggered, tends to be a self-perpetuating process cognitively (Pratt et al., 1997) and neurologically (Paulesu et al., 2010). Further, in persons with GAD, state relaxation (vs. worry) may have restrained their inclination to cognitively abstract and elaborate on the agents' intentions in verbal-linguistic ways.

Why did state worry versus relaxation not significantly interact with GAD status to differentially impact ToM decoding, as it did for overall reasoning and cognitive-reasoning ToM? One possible explanation may be based on the nature of the paradigms. ToM decoding was measured with the RMET - a series of static pictures of people's eyes only. This task was devoid of contextual cues. The MASC, however, provides a wealth of social data which includes facial expressions, gestures, voice tone, speech rate, and body language. It has a meta-representational component unlike the eyes test. State worry may have facilitated hypervigilance to the multidimensional aspects of the social interactions unfolding within the movie in participants with GAD. Relaxation, however, led individuals with GAD to be less vigilant, but still as attentive as controls and the general population, to the dynamic social scenarios in the video. Also, individuals with GAD made better use of these contextual hints than controls when engaged in worry. Plausibly, in GAD, worry functions to pick up intentions and beliefs more pointedly than controls and other forms of anxiety disorders. This interpretation is supported by studies showing that chronic worriers were better than controls in accuracy and speed on social cognition tests that provided some form of context such as fear priming (Olatunji et al., 2011), negative emotional disclosures (Erickson and Newman, 2007), or background intensity (Bui et al., 2017). Future research could test this idea by modifying static ToM decoding tasks to include contextual cues.

Although worry induces negative mood and has been linked to heightened empathy in GAD (Peasley et al., 1994), it had no differential impact on affective-reasoning ToM in persons with and without GAD. In GAD, endorsing heightened empathy, care, and affiliation for others on self-reports (Davis, 1983; Erickson et al., 2016; Hebert et al., 2014; Peasley et al., 1994) or expressing more sadness in response to others' disclosures (Erickson and Newman, 2007) did not translate to the predicted superior affective-reasoning ToM on the MASC. However, our findings are consistent with a meta-analysis which found intact emotion recognition in GAD (Plana et al., 2014). Similarly, across cultures, worry showed no significant link to comprehension of an array of emotional faces (Baron-Cohen et al., 2001; Cooper et al., 2008; Surcinelli et al., 2006; Yoon et al., 2016). Comparable affective-reasoning ToM among those with and without GAD when worried is also consistent with fMRI studies showing that worry bore no relationship with amygdala activity (Blair et al., 2008), which is reliably linked to affective-reasoning ToM (Abu-Akel and Shamay-Tsoory, 2011). Future fMRI studies could test the foregoing theories by observing whether combined GAD and worry predicted stronger cognitive-reasoning ToM network activation compared to controls, while simultaneously showing unperturbed affective-reasoning ToM activation.

Additionally, why were healthy controls better on affective- and positive-reasoning ToM items when they relaxed as opposed to worried? We interpret these results to suggest that for healthy controls, state relaxation, rather than worry, freed up attentional resources to process more of the emotional aspects of the social interactions in the film. Also, this may be due to the fact that emotion regulation strategies such as relaxation come more naturally to healthy controls than sufferers of GAD. Future research may test these hypotheses by including measures of attention, emotion regulation, and discomfort arising from engagement in worry and relaxation within experimental contexts.

Last, why was the GAD group highly accurate with reasoning about negative social signals when they worried, and controls more correct with positive social stimuli upon relaxing? First, worry, which elicits and sustains negative mood states (Newman et al., 2013), intensifies the propensity to focus on potential threats (Williams et al., 2014). Worry activated neural correlates of ToM cognitive-reasoning (cf. ACC, mPFC; Andreescu et al., 2011; Paulesu et al., 2010) as opposed to affective-reasoning and decoding more sharply in those with GAD. Once triggered, viewing the rich tapestry of signals unfolding as the story plot progressed may have reinforced proclivities of participants with GAD to focus on negative material. As brain networks connected to cognitive control were activated during state worry, individuals with GAD showed superior higher-level ToM analytical abilities (reasoning), and normative surface-level recognition (decoding), for negative items. Therefore, ToM reasoning, but not decoding, for negative material was magnified specifically when state worry interacted with GAD status. Future neuroimaging studies are needed to test these notions.

Although state worry in GAD enhanced accuracy for negative social material, is it necessarily beneficial? Does a hypersensitivity to negative subtle complex social cues confer adaptive benefits in terms of curtailing interpersonal risks or resolving social issues? Superior negative ToM reasoning accuracy in persons with GAD during a state of worry parallels the idea of depressive realism, wherein clinically depressed people judge contingencies more precisely than their non-depressed counterparts (Alloy and Abramson, 1979). In the realm of ToM, Wolkenstein et al. (2011) found that chronically depressed patients were more accurate than controls on negative social stimuli. However, the consequence of such realism for both GAD and depressed individuals is persistent and maladaptive negative mood states which interfere with everyday interpersonal functioning and diminish quality of life. In GAD, such attentional tendencies toward negativity may contribute to relationship problems in the real world (Newman and Erickson, 2010). Thus, GAD sufferers may benefit from cognitive restructuring strategies which assist them to attend *holistically* to both positive and negative aspects of social scenarios (Fonzo et al., 2014).

Clinically, our findings suggest that educating patients with GAD about the interpersonal and emotional costs of engaging in instances of worry within psychotherapy sessions may be fruitful. In chronic depression, the Cognitive Behavioral Analysis of Psychotherapy (CBASP) (McCullough et al., 2011) was designed to target ToM reasoning by instructing patients to continually reflect on the impact of their behaviors in interpersonal interactions. A similar strategy was used by Newman et al. (2011) in their integrative therapy for GAD.

In the same vein, treating clinicians should raise patients' awareness of the consequences of their *abnormally accurate negative*-reasoning ToM when engaging in worry relative to relaxation. Therapists may subsequently explore how worry adversely affects their social interactions. Using functional analytic principles, psychoeducation focused on how worry serves to avoid negative emotional contrasts, generates negative mood states (Newman et al., 2013), and diverts attention away from fully engaging in and enjoying social interactions is likely to be beneficial. Targeting negative-reasoning ToM in GAD would thus entail the need to measurably reduce frequent instances of worry so that patients do not unnecessarily create undue distress linked to their precise inferences of unfavorable social interactions. Future studies of specific treatments or its components (e.g., exposure therapy, relaxation training, cognitive restructuring) may inquire on whether substantial reductions in negative-reasoning ToM functions as a treatment *mechanism* in cognitive-behavioral (Newman and Fisher, 2013) and interpersonally-oriented therapies for GAD (Newman et al., 2011).

Several limitations of this study deserve mention. The present sample was limited to non-treatment-seeking college students. Nonetheless, participants underwent a standardized clinical interview to determine whether they met criteria for GAD, with excellent interrater agreement. Second, the MASC is a well-validated assessment of ToM reasoning that mimics real-life environments relative to other ToM measures (e.g., eyes test). However, it focused on contrived story narratives and protagonists. The lack of self-reference in the MASC hence restricts the generalizability of the data germane to a person's real life. Future research on ToM in GAD should be extended to other clinical populations and use ToM tasks with greater self-relevance and self-reference. Third, our findings are preliminary and warrant replication. Fourth, future studies should rectify task order effects potentially present herein by counterbalancing the measures. Currently, this presents as a limitation of the entire field as counterbalancing is not practiced among clinical ToM researchers whom we modelled our methods after (e.g., Hezel and McNally, 2014; Sharp et al., 2013; Wolkenstein et al., 2011). Last, it is unclear whether worry or relaxation per se drove the observed effects. We attempted to offset this limitation by comparing all means to normative groups. Our finding that worry led to superior negative ToM reasoning compared to norms whereas relaxation led to normative negative ToM reasoning provides some evidence that worry may be driving this effect in people with GAD. Nonetheless, future studies might also include a neutral induction to clarify. The limitations notwithstanding, our findings offer novel contributions to ToM in GAD, an area of research thus far neglected.

Acknowledgement

We are also grateful for the support of our undergraduate research assistants, Emily Forcht, Jenelle A. Richards, Marietta Kocher, Madeleine Lee Miller, Juliana Rose Caricato, and Kandace Tania Schaffer, for facilitating the data collection process.

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Fig. 1.

Group $\times$ Condition statistically significant interaction predicting accuracy of ToM reasoning on the MASC. *Note.* MASC = movie for the assessment of social cognition; ToM = theory-of-mind; Regression statistics for two-way interaction effect: $b = .98$, $SE = .34$, $t = 2.86$, $p = .0047$, $d = .44$.

Fig. 2.

Group $\times$ Condition interaction marginally significantly predicting for accuracy of ToM reasoning of characters' emotions on the MASC. *Note.* MASC = movie for the assessment of social cognition; ToM = theory-of-mind; Regression statistics for two-way interaction effect: $b = .87$, $SE = .47$, $t = 1.83$, $p = .069$, $d = .28$.

Fig. 3.

Group $\times$ Condition statistically significant interaction predicting accuracy of ToM cognitive-reasoning on the MASC. *Note.* MASC = movie for the assessment of social cognition; ToM = theory-of-mind; Regression statistics for two-way interaction effect: $b = .96$, $SE = .44$, $t = 2.19$, $p = .030$, $d = .34$.

Fig. 4.

Group $\times$ Condition statistically interaction predicting accuracy of ToM reasoning for negatively valenced social stimuli on the MASC. *Note.* MASC = movie for the assessment of social cognition; ToM = theory-of-mind; Regression statistics for two-way interaction effect: $b = .58$, $SE = .21$, $t = 2.69$, $p = .0079$, $d = .42$.

Fig. 5. Group $\times$ Condition statistically interaction predicting accuracy of ToM reasoning for positively valenced social stimuli on the MASC. *Note.* MASC = movie for the assessment of social cognition; ToM = theory-of-mind; Regression statistics for two-way interaction effect: $b = .50$, $SE = .23$, $t = 2.18$, $p = .031$, $d = .34$.

Table 1

Descriptive socio-demographic, clinical, and academic characteristics.

	Control		GAD		Statistics	<i>p</i>	<i>d</i>
	<i>M</i> <i>n</i> = 102	(<i>SD</i>)	<i>M</i> <i>n</i> = 69	(<i>SD</i>)			
Age	19.04	(1.19)	18.84	(1.106)	<i>t</i> (169) = 1.10	.27	.17
Females	75	(73.53)	63	(91.30)	$\chi^2(1) = 8.35$	.0039	.45
White Caucasians	74	(72.55)	58	(84.06)	$\chi^2(1) = 3.10$	.078	.27
GPA	3.34	(.56)	3.28	(.60)	<i>t</i> (169) = .62	.54	.095
GADQ-IV total	1.21	(1.09)	7.53	(1.54)	<i>t</i> (169) = -31.42	< .00001	4.83
PSWQ total	44.89	(12.89)	75.32	(11.85)	<i>t</i> (169) = -15.64	< .00001	2.41
BDI-II total	22.25	(3.52)	34.10	(9.68)	<i>t</i> (169) = -9.74	< .00001	1.50
SPDQ total	20.49	(6.19)	30.31	(9.89)	<i>t</i> (169) = -7.33	< .00001	1.13
WCST total	42.89	(8.57)	43.33	(9.10)	<i>t</i> (169) = -.32	.75	.049
MASC	34.07	(3.50)	34.46	(3.26)	<i>t</i> (169) = -.73	.47	.11
RMET	12.36	(2.08)	12.62	(2.31)	<i>t</i> (169) = .97	.33	.15

Note. GPA = grade point average; GADQ-IV = generalized anxiety disorder questionnaire - fourth edition; PSWQ = Penn State worry questionnaire; BDI-II = Beck depression inventory - second version; SPDQ = social phobia diagnostic questionnaire; WCST = Wisconsin card sorting test; MASC = movie for the assessment of social cognition; RMET = reading the mind in the eyes test.

Table 2

Comorbidity with other DSM-IV-TR-defined Axis I disorders.

	<u>Non-GAD</u>		<u>GAD</u>		$\chi^2(1)$	<i>p</i>	<i>d</i>
	<i>n</i>	(%)	<i>n</i>	(%)			
Major Depressive Disorder Current	3	(2.94)	12	(17.39)	10.74	.001	.52
Major Depressive Disorder Lifetime	1	(.98)	6	(8.70)	6.24	.012	.39
Hypomanic Episode	7	(6.86)	16	(23.19)	9.42	.002	.48
Panic Disorder Lifetime	6	(5.88)	19	(27.54)	15.46	.00008	.63
Agoraphobia without Panic Disorder	3	(2.94)	14	(20.29)	13.84	.0002	.59
Social Phobia	4	(3.92)	12	(17.39)	8.81	.003	.47
Obsessive Compulsive Disorder	0	(.00)	4	(5.80)	6.06	.014	.38
Substance Abuse/Dependence	10	(9.80)	11	(15.94)	1.44	.23	.18
Bulimia Nervosa	2	(1.96)	4	(5.80)	1.79	.18	.21

Note. DSM-IV-TR = diagnostic and statistical manual - fourth version - text revised.

Table 3

Multiple linear regression model predicting for accuracy on MASC.

	<i>b</i>	(<i>SE</i>)	<i>t</i>	<i>p</i>	<i>d</i>
Intercept	75.53	(4.19)	18.04	< .001	
Group	-.17	(.31)	-.56	.58	.09
Condition	-2.82	(1.79)	-1.57	.12	.25
Group × Condition	.93	(.36)	2.60	.01	.41
Gender	-1.07	(1.55)	-.69	.49	.11
Executive function	.11	(.07)	1.62	.11	.26
Social anxiety severity	-.01	(.09)	-.16	.87	.03
Depression severity	-.08	(.11)	-.72	.47	.11

Note. MASC = movie for the assessment of social cognition; Executive function was measured using the Wisconsin card sorting test; Social anxiety was measured using the social phobia diagnostic questionnaire; Depression was measured using the Beck depression inventory - second version.