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Authors

Kaplan, Simona C
Morrison, Amanda S
Goldin, Philippe R
et al.

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The Cognitive Distortions Questionnaire (CD-Quest): Validation in a Sample of Adults with Social Anxiety Disorder

Simona C. Kaplan¹ · Amanda S. Morrison² · Philippe R. Goldin³ · Thomas M. Olino¹ · Richard G. Heimberg¹ · James J. Gross²

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Abstract Cognitive distortions are thought to be central to the development and maintenance of anxiety disorders and are a widely acknowledged treatment target in cognitive-behavioral interventions. However, little research has focused on the measurement of cognitive distortions. The Cognitive Distortions Questionnaire (CD-Quest; de Oliveira, *Trial-based cognitive therapy: A manual for clinicians*, Routledge, New York, 2015), a brief, 15-item questionnaire, assesses the frequency and intensity of cognitive distortions. The CD-Quest has been shown to have sound psychometric properties in American, Australian, and Brazilian undergraduate samples and one Turkish-speaking outpatient clinical sample. The current study aimed to provide the first evaluation of the psychometric properties of the English version of the CD-Quest in a clinical sample and the first evaluation of any version of the CD-Quest in a sample of adults diagnosed with social anxiety disorder (SAD). In a sample of treatment-seeking adults with SAD, the CD-Quest demonstrated good convergent validity, discriminant validity, known-groups validity, and treatment sensitivity. It also showed good internal consistency, and

both confirmatory and exploratory factor analyses supported the previously reported unitary factor structure. Findings extend prior research indicating the reliability and validity of the CD-Quest.

Keywords Cognitive distortion · Cognitive error · Assessment · Cognitive model · Social anxiety · Social anxiety disorder

Introduction

Cognitive-behavioral therapy is based on the premise that the way we cognitively represent the world largely determines how we feel and behave (e.g., Beck 1976; Beck et al. 1979). Beck et al.'s (1979) cognitive theory postulates that our cognitions (i.e., the verbal or pictorial contents of our stream of consciousness) derive from schemas—cognitive structures that develop out of prior life experiences—and that these schemas guide how we perceive ourselves, others, and the world around us. When schemas are dysfunctional, they engender distorted cognitions, predisposing certain individuals to experience pathological emotional states. Beck et al. (1979) suggest that negative interpretations of problems and situations lead individuals to believe that they cannot master or overcome their psychological difficulties. Consequently, Beck's cognitive therapy teaches patients to identify, test, and alter their distorted cognitions and dysfunctional schemas. According to Beck's theory, modification of distorted cognitions, and their related attitudes, beliefs, and information processing biases, is a core mechanism leading to symptom reduction (Clark and Beck 2010).

Despite the theoretical prominence of cognitive distortions in the etiology, maintenance, and treatment of anxious

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✉ Richard G. Heimberg
heimberg@temple.edu

¹ Department of Psychology, Temple University, 1701 North 13th Street, Philadelphia, PA 19122-6085, USA

² Department of Psychology, Stanford University, Stanford, CA, USA

³ The Betty Irene Moore School of Nursing, University of California, Davis, CA, USA

and depressive pathology, relatively little work has been directed toward developing a strong, psychometrically sound tool to assess the content and quantity of cognitive distortions. Such a measure could facilitate treatment planning as well as the assessment of progress by measuring changes in cognitive distortions over time. A measure of cognitive distortions would also allow researchers and clinicians to examine differences in patterns of cognitive distortions—in terms of frequency, intensity, and content—across individuals and groups. Further, such a measure would enable researchers to evaluate the relative importance of distinct cognitive distortions in the maintenance of various disorders and consequently refine treatment based on relevant thinking patterns (Morrison et al. 2015).

Various measures have been developed to assess constructs related to cognitive distortions. Such measures include questionnaires assessing negative automatic thoughts (e.g., Anxious Self-Statements Questionnaire, Kendall and Hollon 1989; Automatic Thoughts Questionnaire; Hollon and Kendall 1980). Measures have also been developed that assess automatic thoughts specific to individuals who experience elevated social anxiety (e.g., The Social Thoughts and Beliefs Scale; Turner et al. 2003). Automatic thoughts are thoughts that automatically emerge in, or in anticipation of, anxiety-provoking situations, and they typically contain, but are not the same as cognitive distortions. For instance, one might have the automatic thought, “Everyone is going to hate my speech,” which contains the cognitive distortion *fortune telling*. Psychometrically sound measures of attitudes or schemas, which underlie or precede cognitive distortions, have also been developed (e.g., the Dysfunctional Attitudes Scale, Weissman and Beck 1978). A measure of distorted beliefs related to social anxiety (e.g., “If I don’t get everything right, I’ll be rejected”) has also been developed (Self-Beliefs Related to Social Anxiety Scale; Wong et al. 2013), as well as a measure of unconditional core beliefs about oneself for individuals with SAD (e.g., “I am unlikeable”; Wong et al. 2017). Although the aforementioned measures tap constructs associated with, preceding, and underlying cognitive distortions, they do not assess types, patterns, frequency, or intensity of cognitive distortions.

To our knowledge, only four measures have been developed that attempt to directly assess cognitive distortions: the Cognitive Error Questionnaire—General Form (CEQ; Lefebvre 1981), the Inventory of Cognitive Distortions (ICD; Yurica 2002), the Cognitive Distortions Scale (CDS; Covin et al. 2011), and, the focus of the current paper, the Cognitive Distortions Questionnaire (CD-Quest; de Oliveira 2015). The CEQ and ICD are lacking in psychometric development (see Jager-Hyman et al. 2014; Lefebvre 1981; Smith et al. 1986, for studies on their psychometric properties). The CDS has more empirical support and

has demonstrated good internal consistency, convergent, and discriminant validity in undergraduate and clinical samples (Covin et al. 2011; Özdel et al. 2014). However, although the CDS was developed as a two-factor measure to assess cognitive distortions occurring in interpersonal and achievement domains, it exhibited a one-factor solution (Covin et al. 2011). Thus, there is need for more refined understanding of the psychometric properties of tools used to measure cognitive distortions.

Recent research demonstrating the CD-Quest’s psychometric properties across multiple and diverse samples is providing increasing support for this measure. The CD-Quest was developed simultaneously in English and Portuguese as a tool to be completed by patients over the course of treatment to demonstrate the connections between cognitive distortions and resulting emotions and maladaptive behaviors, as well as to help therapists quantify the frequency and intensity of patients’ cognitive distortions over time (de Oliveira et al. 2015). Each of the 15 items of the CD-Quest assesses the frequency and intensity of a specific cognitive distortion: (1) dichotomous thinking (all-or-nothing, or black-or-white thinking), (2) fortune telling (catastrophizing), (3) discounting the positive, (4) emotional reasoning, (5) labeling, (6) magnification/minimization, (7) selective abstraction (mental filter, tunnel vision), (8) mind reading, (9) overgeneralization, (10) personalization, (11) should statements (“musts,” “ought tos,” and “have tos”), (12) jumping to conclusions (arbitrary inference), (13) blaming others or oneself, (14) what if...? statements, and (15) unfair comparisons.

Research conducted to date examining the CD-Quest has found it to possess good psychometric properties. de Oliveira et al. (2015) assessed the initial psychometric properties of the Brazilian Portuguese version of the measure in a sample of undergraduate students. It showed good internal consistency (Cronbach’s $\alpha = 0.85$) and convergent validity with self-report measures of depression and anxiety ($r = 0.65$, and $r = 0.52$, respectively). Furthermore, the CD-Quest was able to discriminate between those endorsing high depression and anxiety and those without these symptoms. Lastly, a principal components analysis showed that the items can be aggregated as a single component.

Two other psychometric studies have evaluated the CD-Quest in student samples. Morrison et al. (2015) examined the CD-Quest’s psychometric properties in a large undergraduate sample from a public university in the United States. The English version of the CD-Quest showed good internal consistency ($\alpha = 0.88$). An exploratory factor analysis indicated that a one-factor solution best fit the data. The measure also demonstrated good convergent and discriminant validity: the CD-Quest total score correlated significantly with measures of automatic thoughts, anxious and depressive psychopathology, and

general functioning. Furthermore, it was not correlated with the theoretically unrelated constructs of psychopathic traits and vocabulary knowledge. Kostoglou and Pidgeon (2016) examined the English-language version of the CD-Quest in a sample of students at an Australian university. Confirmatory factor analysis supported a unidimensional factor structure. The study suggested good internal consistency ($\alpha = 0.80$). Furthermore, the frequency and intensity subscales were highly correlated, and convergent validity was again demonstrated through correlations of the CD-Quest with measures of automatic thoughts, anxiety, and depression ($r_s > 0.45$). The questionnaire was also able to discriminate between groups of individuals with and without depression, anxiety, and stress symptoms.

Batmaz et al. (2015) conducted the first study examining the psychometric properties of the CD-Quest in a clinical sample. They assessed the Turkish version of the CD-Quest in a mixed psychiatric outpatient sample with mood symptoms. They demonstrated good internal consistency ($\alpha = 0.93$) and satisfactory test–retest reliability over a 4-week period ($r = 0.90$). The CD-Quest also showed good concurrent validity, correlating significantly with another measure of cognitive distortions as well as measures of mood symptoms and negatively biased thinking. Fourteen of the 15 items on the scale were able to discriminate between depressed and nondepressed groups, and all 15 items were able to distinguish anxious from nonanxious groups. Finally, an exploratory principal components factor analysis with an oblique rotation found that all of the items can be aggregated as a single component.

The aim of the current study was to assess the psychometric properties of this relatively new self-report measure of cognitive distortions in a sample of adults seeking treatment for social anxiety disorder (SAD). Researchers who study SAD theorize that maladaptive cognitions play a key role in the development and maintenance of SAD. Clark and Wells' (1995), Rapee and Heimberg's (1997; see also Heimberg et al. 2014), and Hofmann's (2007) cognitive-behavioral models of SAD postulate that socially anxious individuals' excessive focus on dysfunctional cognitions helps maintain their symptoms. These models suggest that dysfunctional cognitions in persons with SAD include the following: distorted perceptions regarding how they appear to others, unrealistically high standards for how they should perform, and unrealistically negative predictions of the outcomes of a discrepancy between what they think their performance *should be* and what they believe it *is*. These models also posit that socially anxious persons are more likely to interpret ambiguous situations as threatening, which leads to negative self-judgment and anxiety (see Wong et al. 2014, for a more thorough comparison of these models and other models of SAD).

Research on the mechanisms and treatment of SAD provide evidence of the important role of cognitive distortions in the maintenance of the disorder. Socially anxious persons tend to rate their performance worse than other people rate it (e.g., Rapee and Lim 1992). In addition, research has consistently found that people with SAD interpret ambiguous situations negatively (Steinman et al. 2014). For instance, in a study in which participants were asked to choose one of three possible interpretations of a scenario, individuals with SAD interpreted ambiguous social scenarios more negatively than nonanxious controls and individuals with obsessive–compulsive disorder, even when positive and neutral interpretations were available (Amir et al. 1998). Thus, it is clear that individuals with SAD engage in various types of distorted thinking assessed by the CD-Quest, including mind-reading (e.g., she thinks I'm stupid), catastrophizing (e.g., If I don't come up with something interesting to say, he'll never want to be my friend), and all-or-nothing thinking (e.g., I stuttered, therefore my speech was a failure), among others. Cognitive-behavioral treatments for SAD (e.g., Hope et al. 2010) commonly train patients to identify the distortions in their negative thoughts and to use this strategy as a step in disputing these thoughts. Given the importance of cognitive distortions in the development and treatment of SAD, we considered it an especially relevant clinical sample in which to evaluate the CD-Quest.

This is the first evaluation of the psychometric properties of the English version of the CD-Quest in a clinical sample, and the first evaluation of any version of the CD-Quest in a sample of adults diagnosed with SAD. We hypothesized that the CD-Quest would correlate significantly with measures of social anxiety, other psychopathology, negative interpretation bias, and general functioning. To assess discriminant validity, we examined measures in our dataset that we thought would be less likely to have a significant positive correlation with the CD-Quest. We hypothesized that the CD-Quest would be less likely to correlate significantly with measures of sleep quality/quantity and attentional control. Although there is reason to think that poor sleep or poor control of attention might be associated with difficulties thinking cohesively, there was less theoretical basis for a prediction of a significant correlation between the CD-Quest and these measures.

We predicted that confirmatory factor analysis would corroborate previous findings indicating a unidimensional factor structure of the CD-Quest. We also hypothesized that CD-Quest scores would be significantly higher in individuals with SAD compared to healthy controls (HCs). We hypothesized that CD-Quest scores would be associated with treatment outcome, such that changes in cognitive distortions from pre- to post-treatment would be related to changes in social anxiety symptoms from pre- to

post-treatment. Finally, we predicted that the CD-Quest would demonstrate treatment sensitivity, such that more severe cognitive distortions at baseline would predict less improvement in SA at post-treatment.

Method

Participants

Participants were 126 patients meeting criteria for a DSM-IV principal diagnosis of generalized SAD (American Psychiatric Association 1994) based on the *Anxiety Disorders Interview Schedule for the DSM-IV-Lifetime version* (ADIS-IV-L; Di Nardo et al. 1994). One hundred eight of these patients took part in a randomized controlled trial (RCT) comparing cognitive-behavioral group therapy (CBGT), mindfulness-based stress reduction (MBSR) and a waitlist control (WL) (Goldin et al. 2016). Data were also collected from 40 HCs.

Of the 114 patients who provided information on age and gender, 54.4% were women. Mean age was 32.74 ± 7.92 (range = 21–56 years). These patients also provided information on race/ethnicity: 40.5% ($n=51$) identified as Caucasian/white, 34.1% ($n=43$) identified as Asian, 7.9% ($n=10$) identified as Hispanic, 0.8% ($n=1$) identified as African American/black, 0.8% ($n=1$) identified as American Indian/Alaskan native, and 6.3% ($n=8$) identified as more than one race/ethnicity. Of the 126 SAD patients and the 40 HCs, 6 patients and 3 HCs did not complete the CD-Quest and were therefore excluded from the present analyses, resulting in a baseline analysis sample of 120 participants with SAD and 37 HCs.

Patients met criteria for generalized SAD if they endorsed greater than moderate fear in 5 or more different social situations on the ADIS-IV-L. In addition, they were required to score over 60 on the Liebowitz Social Anxiety Scale—Self-Report (LSAS-SR; Fresco et al. 2001; Liebowitz 1987), which is the cutoff for generalized SAD as indicated by a receiver operator characteristics analysis of the LSAS-SR (Rytwinski et al. 2009). Participants were excluded from the study if they received pharmacotherapy or psychotherapy during the past year, were enrolled in any MBSR course, participated in long-term meditation retreats, had a history of regular meditation practice, participated in CBT for an anxiety disorder in the last 2 years, or reported history of neurological disorders, cardiovascular disorders, thought disorders, bipolar disorder, or current substance or alcohol abuse/dependence. HCs also completed the ADIS-IV-L and did not meet criteria for any mental disorder assessed therein. All participants provided informed consent in accordance with the Institutional Review Board at Stanford University.

Procedure

Patients were recruited through community listings and clinician referrals. Screening consisted of a telephone interview, followed by an in-person diagnostic interview, the ADIS-IV-L. Self-report questionnaires were completed online, at home, after the administration of the ADIS-IV-L. Participants could complete the questionnaires in more than one sitting so as to limit fatigue. Patients were not compensated for completion of baseline, treatment, or post-treatment assessments; however, therapy was provided for free. Patients completed baseline assessments and then were randomly assigned to CBGT, MBSR, or WL. Patients in the three groups did not significantly differ on demographic variables, Axis I comorbidity, past treatment, or symptom age of onset or duration (see Goldin et al. 2016, for more details regarding recruitment and preliminary analyses). Patients completed post-treatment questionnaires. At post-treatment, individuals in the WL condition were given the option to elect to be randomized to CBGT or MBSR. Both treatments consisted of 12 sessions lasting 2.5 h each conducted in group format. HCs were recruited through community flyers and web listings and were compensated for completion of questionnaires and the diagnostic interview.

Measures

Cognitive Distortions

The *Cognitive Distortions Questionnaire* (CD-Quest; de Oliveira et al. 2014, 2015) consists of 15 items that assess the frequency and intensity of a variety of common cognitive distortions that occurred in the past week. Each item on the CD-Quest presents a category of distorted thinking (e.g., “Discounting the positive”) along with a brief explanation (“I disqualify positive experiences or events insisting that they do not count”) and two example thoughts (“I passed the exam, but I was just lucky.” “Going to college is not a big deal, anyone can do it.”). Respondents are instructed to indicate which cognitive distortions they have experienced in the past week, “how much [they] believed it in the exact moment it occurred” (i.e., intensity), and “how often it occurred during this past week” (i.e., frequency). Frequency options include “No (It did not occur),” “Occasional (1–2 days during the past week),” “Much of the time (3–5 days during the past week),” and “Almost all the time (6–7 days during the past week).” Intensity options include “A little (Up to 30%),” “Much (31–70%),” and “Very much (More than 70%).” Response options were set up in a three-by-three grid that captured both the frequency and intensity dimensions. Each cell in the grid ranged in value from 0 to 5. Respondents were instructed to write an example of a thought if they endorsed a cell with a value of 3 or above.

The CD-Quest can therefore generate three separate scores: frequency, intensity, and total. The CD-Quest has demonstrated good internal consistency ($\alpha=0.80\text{--}0.91$) and convergent validity with measures of anxiety, depression, and automatic thoughts ($r_s>0.45$) (Batmaz et al. 2015; de Oliveira et al. 2015; Kostoglou and Pidgeon 2016; Morrison et al. 2015).

Measures Assessing Convergent Validity

Social Anxiety Measures The *Liebowitz Social Anxiety Scale-Self-Report* (LSAS-SR; Fresco et al. 2001; Liebowitz 1987) was used to assess social anxiety symptom severity. The measure assesses reactions to 24 situations—11 involving social interaction and 13 involving different types of performance. Respondents rate their fear and avoidance of each situation during the past week on a 4-point Likert-type scale ranging from 0 (*none and never*, for fear and avoidance respectively) to 3 (*severe and usually*, respectively). Ratings are summed for a total score (range 0–144). The LSAS-SR has shown good reliability and construct validity (Rytwinski et al. 2009). Its internal consistency was good in this study ($\alpha = 0.92$).

The *Social Interaction Anxiety Scale* (SIAS; Mattick and Clarke 1998) is a 20-item measure of anxiety-related reactions to social interaction in dyads and groups. Items are rated on a 5-point Likert-type scale from 0 (*Not at all characteristic of me*) to 4 (*Extremely characteristic of me*). Example items include “When mixing socially, I am uncomfortable” and “I have difficulty making eye contact with others.” The SIAS has shown good internal consistency ($\alpha = 0.88$) and test–retest reliability ($r > 0.90$) (Mattick and Clarke 1998). Rodebaugh et al. (2007) found that when the SIAS included only the 17 straightforwardly worded items, it was a significantly stronger predictor of criterion measures than the full scale in both undergraduate and clinical samples. The authors suggested using only the straightforward items to calculate the total score, creating a 17-item straightforward SIAS (SIAS-S) score, and we did so here. The SIAS-S has demonstrated excellent internal consistency ($\alpha = 0.93$) and factorial validity, and strong construct validity (Rodebaugh et al. 2007). Internal consistency for the SIAS-S in this study was good ($\alpha = 0.87$).

The *Brief Fear of Negative Evaluation Scale* (BFNE; Leary 1983) is a 12-item measure assessing anxiety and fear about being evaluated negatively (e.g., “I am frequently afraid of other people noticing my shortcomings”). Items are rated on a Likert-type scale from 1 (*not at all*) to 5 (*extremely*). The BFNE has demonstrated good test–retest reliability, internal consistency, and convergent validity (Leary 1983). Research has indicated that the eight straightforwardly worded items of the scale are a better measure of fear of negative evaluation than the reverse scored items

(Rodebaugh et al. 2004; Weeks et al. 2005). The BFNE-straightforward (BFNE-S) has demonstrated good internal consistency and concurrent validity (Rodebaugh et al. 2004), and we used it in this study. Internal consistency for the BFNE-S in this study was good ($\alpha = 0.87$).

The *Subtle Avoidance Frequency Examination* (SAFE; Cuming et al. 2009), a 32-item questionnaire that assesses safety behaviors, or subtle avoidance behaviors related to social anxiety (e.g., “I say ‘It’s hot’ to explain sweating or blushing.”). It has demonstrated good discriminant and construct validity in SAD patients (Cuming et al. 2009). Internal consistency in this study was good ($\alpha = 0.91$).

Personality and Psychopathology Measures The Neuroticism-Extraversion-Openness—Five Factor Inventory (NEO-FFI; McCrae and Costa 1987) was used to assess neuroticism in this study. It is a 60-item measure of the five basic personality factors: extraversion, neuroticism, agreeableness, conscientiousness, and openness. For the purposes of this study, we examined the 12 items that tapped neuroticism only. Example items from the neuroticism subscale include “I often feel inferior to others,” and “when I’m under a great deal of stress, sometimes I feel like I’m going to pieces.” Items are rated on a 5-point Likert-type scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The NEO-FFI has shown appropriate factor structure and good convergent and discriminant validity (McCrae and Costa 1987). Internal consistency for the neuroticism subscale of the NEO-FFI in this study was good ($\alpha = 0.82$).

The *Beck Depression Inventory-II* (BDI-II; Beck et al. 1996) is a 21-item questionnaire that assesses the presence and severity of depressive symptoms. Participants are asked to rate the severity of each symptom (e.g., sadness; loss of interest) over the past 2 weeks on a scale from 0 to 3. Higher scores indicate more severe depressive symptoms. The BDI-II is a widely used instrument and has shown good internal consistency in undergraduate and outpatient clinical populations (e.g., Beck et al. 1996; Storch et al. 2004). Internal consistency in this study was good ($\alpha = 0.92$).

Cognitive Measures The Interpretation Questionnaire: Self-Relevant Version (IQ-SR; Amir et al. 1998) is a 16-item questionnaire used to assess interpretation bias, modeled after Butler and Mathews’ (1983) interpretation questionnaire. Respondents are presented with ambiguous situations (e.g., “You are making a speech to a group of people and your hands are shaking”) and various interpretations (i.e., negative, positive, and neutral) in random order. An example of a negative interpretation is “You think that the people in the audience think you have a problem with intense anxiety.” Respondents are asked to rank the likelihood of each interpretation from 1 (*most likely to come into your mind*)

to 4 (*least likely to come into your mind*) and then they are asked to rate the valence of each interpretation, from -3 (*negative emotionally*) to $+3$ (*positive emotionally*). For the purposes of this study, we examined the ranking of the negative interpretations related to social situations to assess negative interpretation bias in social situations. Thus, a lower score on the total ranking of negative items indicated greater negative interpretation bias. The IQ-SR has shown good internal consistency ($\alpha = 0.85$; Amir et al. 1998). Internal consistency of ranking items for negative interpretations of social situations was good in this sample ($\alpha = 0.79$).

The *Maladaptive Interpersonal Beliefs Scale* (MIBS; Boden et al. 2012) was used to assess core beliefs in this study. The questionnaire measures nine negative beliefs about the self that are relevant to SAD (e.g., “I don’t fit in”). Items are rated on a Likert-type scale ranging from 1 (*Definitely false* or *Strongly disagree*) to 5 (*Definitely true* or *Strongly agree*). The measure has demonstrated good internal consistency ($\alpha > 0.77$; Boden et al. 2012). Internal consistency in this sample was good ($\alpha = 0.79$).

The *Implicit Theories of Emotion Scale* (ITES; Tamir et al. 2007) was used in this study to assess implicit beliefs about emotion. The questionnaire consists of four items that assess personal beliefs about the malleability of one’s own emotions. Two items assess ‘incremental beliefs’ (e.g., “If I want to, I can change the emotions that I have”), and the other two measure ‘entity beliefs’ (e.g., “The truth is, I have very little control over my emotions”). It is important to note that this is an explicit measure of beliefs about emotion; they are called “implicit theories,” however, because they refer to beliefs that are sometimes not consciously acknowledged (see Dweck 1999, for a review). Implicit theories are distinct from implicit attitudes or associations. Items are rated for agreement on a 5-point Likert-type scale. Incremental theory items are reverse scored, so that higher scores on the measure indicate greater entity beliefs about emotion and lower scores indicate greater incremental beliefs about emotion. The scale has shown good internal consistency in a sample of healthy controls ($\alpha = 0.91$) and good internal consistency in individuals with SAD ($\alpha = 0.80$) (De Castella et al. 2014). Internal consistency in this study was good ($\alpha = 0.79$).

General Functioning Measures The Sheehan Disability Scale (SDS; Sheehan 1983) is a 3-item measure that assesses functional impairment due to symptomatology at work, in social relationships, and in home and family responsibilities. The SDS has demonstrated good internal consistency ($\alpha = 0.89$; Leon et al. 1997) and has discriminated between patients with and without mental disorders (Leon et al. 1997). The SDS has also shown some evidence of poor internal consistency in a sample of patients with SAD ($\alpha = 0.55$; Hambrick et al. 2004), a finding common in

brief measures. Internal consistency in this study was good ($\alpha = 0.74$).

The *Satisfaction with Life Scale* (SWLS; Diener et al. 1985) is a 5-item measure used to assess life satisfaction. Example items include “In most ways my life is close to ideal,” and “I am satisfied with my life.” Items are rated on a 7-point Likert-type scale. The SWLS has demonstrated good internal consistency (e.g., $\alpha = 0.88$; Hultell and Gustavsson 2008) and good convergent and discriminant validity (e.g., Diener et al. 1985). Internal consistency in this study was good ($\alpha = 0.91$).

Measures Assessing Discriminant Validity

The *Attentional Control Scale* (ACS; Derryberry and Reed 2002) assesses attention focusing (9 items) and shifting (10 items). Example items include “when I need to concentrate and solve a problem, I have trouble focusing my attention,” and “I have trouble carrying on two conversations at once.” Internal consistency has been shown to be good for the focusing subscale ($\alpha = 0.82$) and acceptable for the shifting subscale ($\alpha = 0.68$; Ólafsson et al. 2011). Internal consistency was good in this study for both the focusing subscale ($\alpha = 0.85$) and the shifting subscale ($\alpha = 0.74$).

The *Pittsburgh Sleep Quality Index* (PSQI; Buysse et al. 1989) is a 19-item self-report questionnaire that assesses sleep quantity and quality over the past month. It has demonstrated good convergent and divergent validity and adequate internal consistency ($0.71 < \alpha < 0.83$) (e.g., de la Vega et al. 2015; Buysse et al. 1989). Internal consistency in this study was adequate ($\alpha = 0.73$).

Data Analyses

All data analyses were conducted in the SAD sample only, with the exception of the known-groups validity analyses, which compared CD-Quest scores in patients with SAD and HCs.

To assess convergent and discriminant validity, we calculated bivariate correlations. To account for the large number of correlations, we applied Bonferroni corrections to the resulting p -values within each family of analyses. For instance, we divided the critical p -value (α) used to assess statistical significance of correlations of the CD-Quest with each measure of social anxiety symptoms by four, as there were four measures used within the social anxiety family of analyses.

The confirmatory factor analysis was conducted using the latent variable software program Mplus (Mplus 2.12; Muthén and Muthén 1998). Goodness of fit was evaluated based on the root mean square error of approximation (RMSEA; Steiger 1990), its 90% CI, standardized root mean square residual (SRMR; Jöreskog and Sörbom 1986),

and comparative fit index (CFI; Bentler 1990). Acceptance or rejection of the model was based on conventional criteria for good model fit (RMSEA < 0.08; SRMR < 0.05; CFI > 0.90), item factor loadings > 0.35 each, and the conceptual comprehensibility of the model.

To determine whether change on the CD-Quest was related to change on the LSAS-SR, we computed change scores for each measure and then calculated a bivariate correlation of the change scores. As a further exploratory analysis, to examine whether cognitive distortions predicted treatment outcome, we used hierarchical linear regression. For all analyses that utilized post-treatment scores, patients from the WL group who were subsequently randomized to CBGT or MBSR were included to maximize power. Baseline scores for individuals from the WL group were taken again at the time when the patients originally randomized to CBGT or MBSR finished treatment (i.e., at post-treatment). Thus, the same amount of time elapsed for all patients between pre-treatment and post-treatment who were included in these analyses. A total of 87 patients completed the CD-Quest at post-treatment and were thus included in post-treatment analyses.

Results

Internal Consistency and Intra-scale Correlations

The internal consistencies of the CD-Quest total score, the CD-Quest intensity score, and the CD-Quest frequency score, were assessed using Cronbach's alpha. Internal consistency was good for CD-Quest total ($\alpha = 0.91$), CD-Quest intensity ($\alpha = 0.89$), and CD-Quest frequency ($\alpha = 0.91$).

The CD-Quest total score was significantly correlated with CD-Quest intensity ($r = 0.93$, $p < 0.001$) and CD-Quest frequency ($r = 0.96$, $p < 0.001$). CD-Quest intensity was significantly related to CD-Quest frequency ($r = 0.82$, $p < 0.001$). Due to the high correlation between the frequency and intensity scores, and the high correlation of each with the total score, we focused on the CD-Quest total score for the remainder of analyses.

Factor Analyses

The one-factor solution provided good, but not excellent, fit to the data (RMSEA = 0.077, 90% CI 0.055–0.097, SRMR = 0.057; CFI = 0.906). See Table 1 for individual factor loadings of each item.

Due to the proximity of our results to conventionally accepted criteria for good model fit, we conducted a *post hoc* exploratory factor analysis using principal axis factoring with an oblique rotation to determine whether a two-factor model would explain significantly more variance

Table 1 Confirmatory factor analysis of the CD-Quest in adults with social anxiety disorder: one factor solution

	Factor loadings
Item 1: Dichotomous thinking	0.620
Item 2: Fortune telling/catastrophizing	0.581
Item 3: Discounting the positive	0.603
Item 4: Emotional reasoning	0.520
Item 5: Labeling	0.608
Item 6: Magnification/minimization	0.621
Item 7: Selective abstraction	0.638
Item 8: Mind reading	0.690
Item 9: Overgeneralization	0.692
Item 10: Personalization	0.742
Item 11: Should statements	0.624
Item 12: Jumping to conclusions	0.719
Item 13: Blaming	0.518
Item 14: What if?	0.512
Item 15: Unfair comparisons	0.677
Total score: $M = 29.85$, $SD = 15.82$, possible range = 0–75, $\alpha = 0.91$	

Confirmatory factor analysis suggested a one-factor solution best fit the data; therefore, multiple factor solutions are not reported here

than a one-factor model. A Kaiser–Meyer–Olkin (KMO) test was conducted to examine whether the correlation matrix would be appropriate for this analysis. The KMO measure of sampling adequacy yielded a value of 0.89, indicating that the sample was factorable. Exploratory factor analysis yielded two factors with eigenvalues greater than 1.0. Examination of the Scree plot strongly suggested a one-factor solution. Factor 1's eigenvalue was 6.51, but Factor 2's eigenvalue was only 1.11, which falls just above the threshold of significance according to Kaiser's (1960) rule. However, the first eigenvalue is nearly six times as large as the second eigenvalue, strongly suggesting that the first factor is dominant over the remaining factors.

Known Groups Validity

Known groups validity was assessed using an independent samples *t*-test to compare CD-Quest total scores in patients with SAD and HCs. CD-Quest total was significantly higher in patients with SAD ($M = 29.85 \pm 15.82$) than HCs ($M = 10.05 \pm 6.62$), $t(144.89)$, equal variances not assumed = 11.03, $p < 0.001$. This result represented a very large effect size (Cohen's $d = 1.63$).

Convergent Validity

Table 2 presents correlations between the CD-Quest and other measures. As predicted, the CD-Quest was significantly positively correlated with all measures related to

Table 2 Bivariate correlations between the CD-Quest and other measures

	<i>r</i> with CD-Quest	<i>M</i> ± <i>SD</i>
Social anxiety measures		
Brief fear of negative evaluation scale	0.45**	32.77 ± 5.07
Subtle avoidance frequency examination	0.38**	84.07 ± 18.85
Social interaction anxiety scale	0.37**	46.37 ± 9.94
Liebowitz social anxiety scale—self-report	0.30**	90.89 ± 17.64
Other psychopathology measures		
NEO-FFI neuroticism subscale	0.51**	43.19 ± 7.59
Beck depression inventory—II	−0.06	9.49 ± 8.98
Cognitive measures		
Negative interpretation bias in social situations	−0.22*	1.82 ± 0.45
Maladaptive interpersonal beliefs	0.01	3.28 ± 0.32
Implicit theories of emotion scale	0.09	31.23 ± 8.51
General functioning measures		
Sheehan disability scale	0.48**	19.67 ± 7.11
Satisfaction with life scale	−0.44**	16.13 ± 7.43
Discriminant measures		
Attentional Control Scale	−0.19	48.28 ± 7.88
Pittsburgh sleep quality index	0.02	6.12 ± 2.82

Bonferroni corrections were applied to *p*-values within each family of analyses**Bonferroni-corrected *p* < 0.01; *Bonferroni-corrected *p* < 0.05

social anxiety and fear of negative evaluation. Also consistent with our hypotheses, the CD-Quest was significantly positively correlated with measures of neuroticism and functional impairment and significantly negatively correlated with life satisfaction. Finally, the CD-Quest was significantly negatively correlated with the total score on negative interpretation items on the Interpretation Questionnaire: Self-Relevant Version, indicating that greater endorsement of cognitive distortions on the CD-Quest was related to greater negative interpretation bias. Contrary to hypotheses, the CD-Quest was not significantly correlated with the measure of maladaptive interpersonal beliefs, implicit beliefs about emotion, or the BDI-II.

Discriminant Validity

Pearson's correlations of the CD-Quest with the Attention Control Scale and the Pittsburgh Sleep Quality Index indicated that the CD-Quest was not significantly related to either measure.

Treatment Outcome Analyses

In this sample, cognitive distortions decreased significantly from pre- to post-treatment in both CBT and MBSR, with no differences between the groups (Goldin et al. 2016). In further examination of the treatment sensitivity of the CD-Quest, as predicted, change in CD-Quest scores from pre- to post-treatment was significantly related to change in

social anxiety as measured by the LSAS-SR from pre- to post-treatment ($r=0.43$, $p<0.001$). To investigate whether pre-treatment CD-Quest scores predicted treatment outcome, we ran an exploratory hierarchical multiple linear regression with LSAS-SR pre-treatment score entered in the first step and CD-Quest score in the second step predicting post-treatment LSAS-SR. We first ran this regression for all treated patients. CD-Quest scores did not predict of treatment outcome across treatments ($p=0.23$). To determine whether CD-Quest scores predicted outcome in one treatment but not the other, we ran the same regression twice more, first in patients who received MBSR, then in patients who received CBGT. The CD-Quest did not predict outcome among CBGT patients ($p=0.97$). In contrast, baseline CD-Quest scores significantly predicted change in social anxiety as measured by the LSAS-SR in the MBSR group (part $r=0.32$, $p=0.04$), such that higher CD-Quest scores predicted worse outcome.

Discussion

Cognitive distortions are theorized to play a central role in the development and maintenance of various mental disorders (e.g., Beck 1976; Beck et al. 1979), and reduction in cognitive distortions is thought to be a key mechanism in the treatment of such disorders (Clark and Beck 2010). However, despite the theoretical prominence of cognitive distortions in the etiology, maintenance, and treatment of

anxious and depressive pathology, relatively few measures have been developed to assess the content and quantity of cognitive distortions, and such measures have accumulated variable amounts of psychometric support.

A brief and easily administered measure of cognitive distortions could facilitate treatment planning (e.g., act as a guide for which distorted thinking patterns to challenge). Such a measure would enable evaluation of the relative importance of distinct cognitive distortions not only in individuals, but also across various disorders, helping researchers refine treatments based on relevant thinking patterns (Morrison et al. 2015). The CD-Quest has the potential to be such a measure. Recent research has demonstrated it to be reliable and valid in Portuguese and English-speaking undergraduate samples (de Oliveira et al. 2015; Kostoglou and Pidgeon 2016; Morrison et al. 2015) and a Turkish clinical sample (Batmaz et al. 2015). The current study aimed to conduct the first evaluation of the CD-Quest in an English-speaking clinical population and in a sample of patients with SAD.

Our study confirmed the high correlation between the CD-Quest's intensity and frequency scores, suggesting that there is little added benefit of looking at them separately. Thus, we used the combined total score as broader marker of cognitive distortion severity. As predicted, and consistent with all previous studies on the measure (Batmaz et al. 2015; de Oliveira et al. 2015; Kostoglou and Pidgeon 2016; Morrison et al. 2015), confirmatory factor analysis and *post hoc* exploratory factor analysis demonstrated that the CD-Quest possessed a unidimensional factor structure. Our results confirm this structure in an adult sample of English-speaking SAD patients, providing further evidence that one broad factor underlies the tendency to experience the types of thinking patterns identified in the CD-Quest.

Results provided good evidence of the reliability and construct validity of the CD-Quest in patients with SAD. Consistent with hypotheses, the CD-Quest demonstrated moderate to large positive correlations with self-report measures of fear of negative evaluation, safety behaviors, social anxiety, and neuroticism. Furthermore, greater endorsement of cognitive distortions was related to higher levels of negative interpretation bias in social situations, greater disability, and lower life satisfaction. These findings provide further support for the convergent validity of the CD-Quest with measures of anxiety, symptom severity and impairment, and cognitive processing biases. These findings also corroborate cognitive-behavioral theories that assert the importance of cognitive distortions in the maintenance of cognitive, emotional, and behavioral symptoms of social anxiety (e.g., Clark and Wells 1995; Hofmann 2007; Rapee and Heimberg 1997). The CD-Quest also showed good known-groups validity; endorsement of cognitive distortions was significantly greater among patients with SAD

than among HCs. The results further indicated good discriminant validity of the CD-Quest; the CD-Quest was not significantly related to attentional control or to sleep quality or quantity, suggesting that the measure does not correlate with constructs that are not directly theoretically linked.

Contrary to hypotheses, the CD-Quest was not significantly related to self-reported depression. This finding was surprising in light of previous reports of significant correlations of the CD-Quest with the BDI-II (Batmaz et al. 2015; Morrison et al. 2015). However, the distribution of BDI-II scores was considerably positively skewed, suggesting that depression scores were uniformly low in this sample and potentially accounted for the lack of correlation. Moreover, our sample included few patients diagnosed with mood disorders; only 11 had a diagnosis of major depressive disorder. Future research should examine convergent validity in samples of patients with SAD and a greater range of depressive symptoms in order to determine whether depression correlates with endorsement of cognitive distortions among individuals with SAD. Also contrary to hypotheses, CD-Quest score was not significantly correlated with implicit theories of emotion or maladaptive interpersonal beliefs. One possible explanation for the lack of correlation of the CD-Quest with maladaptive interpersonal beliefs and implicit theories of emotion is that these beliefs may not yet have reached a level of conscious awareness in individuals with SAD; socially anxious persons may be more aware of their own specific thoughts and interpretations than their underlying beliefs and theories about emotion and interpersonal situations in general. Regardless of the explanation, the lack of correlation emphasizes the importance of having a measure used specifically to assess distorted cognitions, which may be more accessible to clients and therefore more tangible targets for modification, at least during earlier stages of treatment.

Change in CD-Quest scores from pre- to post-treatment was associated with change in social anxiety from pre- to post-treatment. Interestingly though, baseline CD-Quest scores were not predictive of treatment outcome. However, when examined separately by treatment condition, CD-Quest scores predicted outcome in MBSR, but not in CBGT. One possible explanation for this finding could be that CBGT, a treatment that aims to directly target dysfunctional thinking patterns, adequately addresses cognitive distortions across the range of severity. However, more severe (i.e., more frequent and/or intense) cognitive distortions, if not addressed, as would be the case in MBSR, predict worse outcome. This finding suggests that the CD-Quest may be a useful measure to assess cognitive correlates of treatment outcome across a range of treatments. Furthermore, baseline endorsement of cognitive distortions as measured by the CD-Quest could be used to guide treatment plans, with greater distorted thinking indicating a greater need for a

cognitive-behavioral approach. Future research should continue to examine the CD-Quest's predictive validity. Furthermore, given that more severe baseline cognitive distortions relate to better treatment outcome at the end of CBT, future research should examine the mechanism of this relationship, using related questionnaires (e.g., the Cognitive-Behavioral Therapy Skills Questionnaire; Jacob et al. 2011) to examine whether changes in one's ability to recognize logical thinking errors mediates this effect.

The current study has several limitations that should be addressed in future research. The clinical sample in the study was predominantly Asian and white. In fact, the nature of our sample was somewhat unusual based on the high proportion of Asians. Future studies should examine whether our findings are replicated in more diverse samples and across cultural groups. In addition, convergent and discriminant validity were assessed exclusively with self-report measures, which are subject to biases and are limited to information available only through conscious awareness. Our findings indicated the CD-Quest scores were not related to implicit theories about emotion or maladaptive interpersonal beliefs; however, it is possible that distorted beliefs about emotions or core beliefs about the self do exist but have not yet reached conscious awareness. Our study did not compare the CD-Quest to other known measures of cognitive distortions. Research comparing the psychometric properties, utility, and applicability of the English version of the CD-Quest to other measures of cognitive distortions in a clinical sample is needed. Furthermore, future research could compare the CD-Quest to measures of constructs related to cognitive distortions, such as automatic thoughts (e.g., Anxious Self-Statements Questionnaire, Kendall and Hollon 1989; Automatic Thoughts Questionnaire; Hollon and Kendall 1980) and cognitions and beliefs specific to social anxiety (e.g., Social Thoughts and Beliefs Scale, Turner et al. 2003; Self-Beliefs Related to Social Anxiety Scale; Wong et al. 2013). Finally, though our study examined CD-Quest scores pre- and post-treatment, it did not examine changes in the CD-Quest throughout the course of treatment. Future research should validate the use of the CD-Quest as a measure to assess changes during treatment to determine whether it could help clinicians assess treatment progress by tracking which of the patients' cognitive distortions are changing over time and which could benefit from further cognitive restructuring.

The current study is the first to demonstrate the sound psychometric properties of the CD-Quest in an English-speaking clinical sample and also in a sample of individuals with SAD. Findings extend prior research indicating the reliability and validity of the CD-Quest in nonclinical English- and Portuguese-speaking samples and a clinical Turkish-speaking sample. The findings in the current study have important implications for the use of the CD-Quest to

understand and hone treatment of individuals with anxiety disorders. The current support of the CD-Quest is likely to spark more research focusing on the role of cognitive distortions in the differential conceptualizations and treatment of individuals with SAD and other anxiety disorders.

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Compliance with Ethical Standards

Conflict of Interest None of the authors of this manuscript have any other financial interests or potential conflicts of interest to report.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Animal Rights No animal studies were carried out by the authors for this article.

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