Social and Cognitive Predictors of Cognitive Restructuring

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Abstract
Cognitive Behavioural Therapy (CBT) is an efficacious treatment for many forms of psychiatric disorders; however, and despite its efficacy, a substantial minority of patients do not benefit from CBT. As such, there is a need to further understand which patients will benefit from CBT. The ability to identify and challenge negative automatic thoughts is a shared component of variant forms of CBT, and is typically achieved clinically through cognitive restructuring. To date, very limited research has examined the role of socio-cognitive individual differences, such as analytical thinking, in predicting the capacity to perform effective restructuring. The present study examined the correlation between analytical thinking, as measured by the Cognitive Reflection Test (CRT), and cognitive restructuring capacity, as rated on a coded 6-item scale of cognitive restructuring performance (e.g., capacity to identify situation, thought, emotion, cognitive distortion category, etc.) created for this study. We recruited a sample of 281 participants (female n=119 or 42.3%) online through Mechanical Turk (MTurk) (Amazon Web Services, 2005) and asked them to complete measures of analytical thinking (CRT), and depressive symptoms and its cognitive correlates (rumination; cognitive distortions). Participants then watched a psychoeducation video on how to appropriately perform restructuring, and then asked to complete a task in which they were challenged to restructure a recent negative automatic thought of their own. Analyses revealed no significant correlation between CRT and restructuring scores ($r = -.05; p = 0.61$); however, there was significant negative correlations between rumination and cognitive restructuring scores, ($r = -.16; p = .009$), as well as cognitive distortions and cognitive restructuring scores ($r = -.13; p = 0.034$). No significant correlation was found between any demographic variables and cognitive restructuring scores. Higher baseline ruminative cognitive style and use of cognitive distortions may be associated with capacity for effective engagement with cognitive restructuring in the context of CBT.
Social and Cognitive Predictors of Cognitive Restructuring

Cognitive Behavioral Therapy (CBT) is effective for a wide range of psychiatric disorders including depression, anxiety, personality disorders, and psychosis (Clark, 2014). Despite its efficacy, a minority of patients do not benefit from CBT. Cognitive restructuring (CR), defined as identifying, evaluating, and modifying maladaptive automatic thoughts to change their emotional milieu (Clark, 2014), is a technique used in many different forms of CBT. Given the centrality of CR in CBT, examining whether certain demographic or cognitive factors can predict performance in cognitive restructuring itself is warranted, as this may elucidate the appropriateness of CBT for certain patients.

Beck’s model emphasized the role of schemas in guiding decision-making (Clark, 2014). Schemas are defined as memory representations of concepts such as the self and the self in relation to others (Clark, 2014). Schemas are self-perpetuating, hence schema-congruent information takes priority over schema-incongruent information. Accordingly, when negative schemas for depression are activated, they elicit the activation of negative automatic thoughts, or negative self-referent thoughts that lay just below the threshold of awareness (Beshai et al., 2013). During bouts of depression, negative automatic thoughts have themes of failure, rejection and loss (e.g., “I am a failure” “Nothing I do will ever work out”; Clark, 2014). In completing cognitive restructuring, these negative automatic thoughts take center stage, with patients learning to identify such negative thoughts and challenge their narrative through evidence gathered from the life of the patient.

A large body of literature suggests that patients often have difficulties in identifying schema-incongruent evidence and override schema activation with more rational thoughts (Dobson, 2013; Clark, 2014), which may partially explain why some do not engage with or benefit from CBT.
The Cognitive Reflection Test (CRT; Frederick, 2005) and Analytical Thinking

The Cognitive Reflection Test (CRT; Frederick, 2005) was designed to assess the ability of an individual to override an initial powerful intuitive, but wrong, response to a series of questions (Frederick, 2005). The CRT is commonly known as a measure that assesses individual differences in intuitive-analytical thinking (Pennycook, et al., 2015). Each item often evokes a superficially correct response, which is often termed the “intuitive response” (Frederick, 2005; Pennycook et al., 2015). The test is based on the dual processing theory, which poses that people are subject to miserly information processing, and often fail to reject prepotent incorrect information as it is congruent with existing schemas (Toplack, 2013). Hence, the ability to override a “gut response” (Frederick, 2005), such as with scores on the CRT, can be associated with one’s ability in identifying negative automatic thoughts and replacing them with more rational ones in restructuring.

Rumination, Cognitive Control and Cognitive Flexibility

Research has demonstrated that a ruminative style, defined as a tendency to passively dwell on negative emotions and thoughts and their meaning (Hilt et al., 2014), can have detrimental effects on patients’ ability to repair negative mood through cognitive means. Rumination has been found to be associated with difficulties in inhibiting negative thoughts and information in a go/no-go task, specifically in switching from negative blocks to positive blocks (Hilt et al., 2014). Greater ruminative tendencies among youth have been associated with greater interference from negative thoughts and information, as demonstrated by the same go/no-go task (Hilt et al., 2014). Rumination also plays a role in mediating cognitive control and depression (Demeyer et al., 2012). Cognitive control, defined as the ability to regulate thoughts and actions in the context of goal-directed behavior (Liao et al., 2019), is an underlying process in rumination, where impairment in
it is associated with depressive rumination and ultimately depressive symptoms (Demeyer et al., 2012).

Additionally, cognitive flexibility (CF), described as the ability to consider alternatives, modifying behavior in different situations and producing diverse ideas (Johnco et al., 2013), has shown different relationships with different types of ruminations (Greene, 2020). CF has shown a positive correlation with deliberate ruminations; which refer to internal problem solving to alleviate depressive symptoms, and reflective ruminations; which are a voluntary engagement in thoughts to explain events (Greene, 2020). Meanwhile, CF has been negatively correlated to brooding ruminations; which is the tendency to compare the present situation to unachieved outcomes, and intrusive rumination; which is an automatic and involuntary engagement in negative thoughts that creates ongoing distress (Greene, 2020). Watkins and Brown (2002) explained how repetitive negative thinking uses up cognitive resources that can otherwise be available for other tasks (as cited in Demeyer et al., 2012). Accordingly, rumination may be an important component to examine in the context of restructuring, as evidence summarized above suggests rumination can disrupt cognitive attempts to dampen negative mood states, which is akin to the restructuring process.

Cognitive Distortions and Attentional Control

Cognitive distortions, defined as habitual thinking errors which may not necessarily be negative in nature (Booth et al., 2019), have been related to emotional disorders (Booth et al., 2019). Although cognitive distortions may not always be negative in nature, their relevance is often unclear to patients suffering from emotional disorders (Booth et al., 2019). Likewise, such patients may be less amenable to processes relating to emotional regulation and attentional control, since a key focus of the restructuring component in CBT is to identify the cognitive distortion and
associated harm (Booth et al., 2019). Although attentional control and cognitive distortions have not been directly correlated, they each have correlations to negative affect (i.e. depression and anxiety) individually, and a strong correlation has been found between attentional control and a precise type of cognitive distortion (Booth et al., 2019). Should statements, which are a form of cognitive distortion, have shown significant and strong negative correlations to attentional control, while greater attentional control has been associated with less cognitive distortions of this form (Booth et al., 2019). This relationship, however, can be explained better through anxiety and depression (negative affect) (Booth et al., 2019). With respect to this relationship, it has been found that individuals with lower attentional control have greater difficulties in shifting attention away from negative information (Booth et al., 2019). Cognitive Distortions, being a critical feature of CBT, have been proposed to have a causative role in negative affect (i.e. depression and anxiety). This suggests that cognitive therapy, which targets these distortions, can be complimentary to traditional forms of psychotherapy in the treatment of depression and anxiety (Booth et al., 2019). Accordingly, based on these findings in the literature, cognitive distortions increase focus and attention on negative thoughts, even though they are not necessarily negative in nature themselves. As such, increased focus on negative thoughts can undermine and detriment restructuring negative moods through cognitive restructuring or any other cognitive means. Hence, studying cognitive distortions may aid in predicting cognitive restructuring outcomes.

**Cognitive Distortions, Self-Focused Attention and Rumination**

Self-focus can be categorized into two forms of analytical; referring to one’s direct thoughts of the self and has been found to increase ratings of worthlessness and incompetence of self, and experiential; which refers to thoughts and feelings of the present situation and has revealed no effect on such judgements in pre to post manipulation of analytical and experiential
self-focus for depressed participants (Rimes & Watkins, 2005). In another sense, self-focused
attention can be divided into a maladaptive form called self-rumination (repetitive negative
thoughts about negative aspects of the self) and an adaptive form called self-reflection (exploring
new perceptions of the self) (Boyraz & Kuhl, 2015). While self-rumination has been found to be
negatively correlated to well-being and authenticity, increased self-reflection has been positively
correlated to authenticity and well-being (Boyraz & Kuhl, 2015). Rumination has been found to
influence global negative self-evaluations, which are a form of negative over-generalized thinking
about the self (Rimes & Watkins, 2005). As such, based on these findings, analyzing the
correlation between cognitive distortions and cognitive restructuring can provide insight in how
generalized thinking (e.g. “I am never successful”) can influence performance and outcomes in
cognitive restructuring.

Analytical Thinking and Negative Emotions

Analytical thinking requires the expansion of cognitive resources (Tremolier et al., 2016).
It often requires normative reasoning, which has been found to be influenced by emotion
(Tremolier et al., 2016). Factors such as negative emotions, which prevent the allocation of
cognitive resources specifically to a task, impair individuals’ deductive reasoning (Tremolier et
al., 2016). Emotion disturbs task processing, as a great portion of cognitive energy and resources
is dedicated to processing emotion instead (Tremolier, 2016). Essentially, when emotions are
involved, ability to deductively reason decreases. When negative emotions are involved, this effect
can increase in strength. In a study that examined the impact of negative emotions on deductive
reasoning, participants who displayed greater emotion-related physiological arousal to negative
stimuli (e.g. pictures and words) as measured through skin conductance (SC), made more errors
on reasoning tasks with negative content, compared to neutral ones (Blanchette et al., 2011). In
essence, a negative correlation was found between SC and logicality, as it pertained to emotion-related arousal (Blanchette et al., 2011). Therefore, results suggested that emotional states (e.g. negative or sad states) can impair deductive reasoning (Blacnhette et al., 2011). Hence, based on the findings discussed above, rumination and cognitive distortions may elicit negative emotions in patients and undermine their ability to think deductively. In analytical tasks that involve such methods of thinking, performance can be compromised. Therefore, exploring analytical thinking skills (as measured by the CRT in this study), can offer insight on how this concept may influence performance in cognitive restructuring and its outcomes.

**Social and Cognitive Individual Differences and Analytical Thinking**

There is mounting evidence suggesting there are several socio-cognitive individual differences that may impact analytical thinking, emotions during decision making, and potentially performance on restructuring and other outcomes of CBT. Frederick (2005) examined the relationship between analytical thinking, as measured by the CRT, and decision making. Frederick found that higher analytical thinking was associated with higher patience and detachment from rewards in decision-making (Frederick, 2005). Such results suggest a potentially meaningful relationship between analytical thinking and cognitive processes involved in restructuring. The presence of such a relationship may clarify for whom CBT would be suitable and beneficial, and whether more work in certain areas is necessary for certain patients prior to starting treatment to ensure its maximal efficacy. Further, Hamilton and Dobson (2002) found that pre-treatment factors in CBT patients, such as marital status, familial history and age, produce different outcomes for each patient. That is, scores on pre-treatment factors were associated with different outcomes in CBT. These researchers found that higher dysfunctional attitudes towards psychiatric disorders was associated with a longer and less effective CBT as a whole (Hamilton & Dobson, 2002).
Accordingly, individual differences can serve as predictors of outcomes in CBT. In this study, we pose the novel question whether demographic and cognitive variables (e.g. analytical thinking at baseline), and cognitive correlates of depression (ruminative style and frequency of cognitive distortions at baseline) predict performance on a task designed to mimic the cognitive restructuring process in CBT.

Current Study

Provided the obvious theoretical linkages between analytical thinking and important processes in CBT, this study aimed to specifically examine the correlation between scores on a measure of analytical thinking, CRT, and capacity to restructure a negative thought surrounding a recent event (as measured by a coded scale created for this study). We hypothesize a moderate positive correlation between CRT scores and scores on the restructuring task, as coded in accordance with the Cognitive Restructuring Coding Checklist (CRCC). That is, we predict that a greater ability to override intuitive thoughts and engage in analytical thinking is associated with better performance on a cognitive restructuring task.

Method

Participants

Ethics approval was obtained through the University of Regina’s Research Ethics Board (REB File #2017-210). A total of 400 participants were initially recruited through Amazon’s Mechanical Turk (MTurk; Amazon Web Services, 2005), of which, \( n = 281 \) met criteria for inclusion. To be eligible for participation, participants were required be 18 years of age or older, fluent in English and agree to the terms indicated on the consent forms available through Qualtrics (SAP, 2002). Participants were compensated with a payment of 3.00 USD for completion of the
study. This rate is commensurate with compensation rates of other crowdsourcing studies (Shapiro et al., 2013). Participants were able to self-select to take part in the study and follow a Qualtrics hyperlink available on MTurk.

**Measures**

**Demographic Information**

After providing consent, participants filled out a form assessing their basic demographic information, wherein they specified their age, gender, spirituality, income, marital status, and education.

**The Cognitive Reflection Test (CRT; Frederick, 2005)**

The CRT was used to assess participants’ analytical thinking ability, and overriding automatic “gut responses” (Frederick, 2005). People are often default to processing with low computational and mental expenses (Toplak et al., 2014). The CRT-3 (Frederick, 2005) consists of 3 items, intended to trigger automatic responses elicited by “System 1” (Frederick, 2005), in Frederick’s dual process theory. Questions involved initial judgement of the situation and an initial response. For instance, one item asked respondents “A patch of mold doubles in size every day. After 40 days it covers all of the bread. How long did it take for the mold to cover half of the bread?” The score employed is the sum of the correct responses, which is indicative of greater “reflectiveness” (Pennycook et al., 2015). The CRT has shown good reliability across time in a sample of 3,302 participants in MTurk (Pennycook & Bailek, 2017) and good validity in a sample of 140 online participants (Haigh, 2016).
The Cognitive Restructuring Coding Checklist (CRCC)

Participants provided responses to 6 questions related to the process of restructuring. Each of the 6 questions served as a “checkpoint” for a segment in the restructuring process. Open-ended responses on the online restructuring task were coded in accordance with the CRCC. Each of the six items were rated on a 3-point Likert scale, and higher scores on the CRCC were indicative of better cognitive restructuring performance.

Questions on the restructuring task included, “can you bring to mind a specific scenario in the past two weeks where you experienced anxiety or negative thoughts?” and “what emotions did you experience during that time?” and “How intense would you rate them on a scale of 0 to 10?”

Participants were rated from 0 to 2 based on their performance on six sub-tasks: a) Identifying the negative thought b) Identifying and rating emotions (0-10); c) Identifying and labeling automatic thoughts, d) Identifying cognitive distortions (anywhere from one to three types), e) Finding evidence for and against the thought, and finally, f) challenging and replacing the automatic thought with a rational and balanced one. A score of zero in each sub-task was assigned if there was complete failure to do the task, while a score of one was assigned if the task was partially complete (e.g. incomplete attempt to find evidence in support or against the initial thought). A score of two was given if all criteria for effective restructuring for each segment was deemed to be met. A total score was computed for each participant by summing their scores in each of the restructuring sub-tasks.

The CRCC items and corresponding task was created in supervision of a registered Doctoral clinical psychologist with extensive clinical and research experience in CBT for depression. The first author was trained by the psychologist on how to appropriately code and score responses.
Patient Health Questionnaire (PHQ-9; Kroenker et al., 1999)

The PHQ-9 self-report is a tool that measures the severity of depressive symptoms in the population. This 9-item questionnaire is based on the DSM-IV (Kroenke et al., 2001) criteria for major depression. To assess the presence and severity of depression (Kroenke et al., 2001) participants self-rate the presence and severity of depression symptoms experienced in the past two weeks on a 3-point Likert scale ranging, from “0” (None at all) to “3” (Nearly everyday). The PHQ-9 has demonstrated good reliability and criterion validity among primary care patients (Kroenker et al., 2001).

The Cognitive Distortions Scale (CDS; Covin et al., 2011)

The CDS measures one’s tendency to make 10 types of cognitive distortions, namely mindreading, catastrophizing, all-or-nothing thinking, labelling, emotional reasoning, personalization, “should” statements, magnification and minimization, and mental filter (Ozdel et al., 2014) in interpersonal and achievement domains (Covin, 2011). Participants rate themselves in 20-items based on how often they have experienced each distortion in the past month, from 1 (“never”) to 5 (“very often”). The CDS has shown promising reliability and validity in a clinical sample (Ozdel et al., 2014).

The Ruminative Response Scale-Short Form (RRS-SF; Treynor et al., 2003)

The RRS-SF is commonly and widely used to assess individual ruminative tendencies across ten items, focusing on two components of reflection (e.g. “Write down what you are thinking and analyze it”) and brooding (e.g. “why do I always have problems that other people don’t have?”). The reflection items are thought to be neutrally balanced while the brooding ones have a more negative mood (Parola et al., 2009). The RRS-SF is a condensed version of the
Ruminative Response Scale (RRS; Nolen-Hoeksema & Morrow, 1991). Each item is rated by the participant on a Likert scale ("1" to "4") ranging from "almost never" to "almost always". The RRS-SF has shown satisfactory reliability in clinical studies with a sample of French patients diagnosed with Major Depression based on DSM-IV criteria, and has shown to correlate meaningfully with scores on the Beck Depression Inventory (Parola et al., 2009). In general, good reliability and validity have been reported in the assessment of ruminative thoughts using the RRS-SF, in a sample of patients with MDD (Parola et al., 2017).

**Procedure**

This study employed a cross-sectional design, and all data were collected online, through Qualtrics, which is a powerful web-based survey tool (SAP, 2002). Participants who met the eligibility criteria completed a series of questionnaires including the demographic form, CRT, RRS-SF, CDS, and provision of responses on questions of the restructuring task.

Subsequent to completing the restructuring task, participants were provided with a restructuring tutorial, which included a psychoeducational video created by a registered clinical psychologist on how to identify and challenge negative cognitions, and steps required to complete a successful restructuring exercise. Participants then had the opportunity to focus on one specific and recent event where they experienced "hot cognitions" (i.e., thoughts associated with a significant increase in anxiety, sadness, or drop in mood) in the past two weeks that they would like to restructure. Participants then were asked to use guidelines and techniques provided during the tutorial to restructure the automatic negative thought of choice (a. Identifying the situation; b. Identifying and rating the intensity of emotions; c. identifying the automatic thought; d. Identifying the cognitive distortion; e. Ability to find supportive and contradictory evidence; f. Ability to reformulate the negative thought into a healthy alternative based on the evidence analyzed in the
previous step). Finally, participants were debriefed and thanked for their participation, and offered information on self-help in managing depression and anxiety.

Data Analysis

Data for this study were analyzed using IBM 25.0 version (IBM corp., 2018). Data cleaning and preliminary analyses were conducted to identify and eliminate responses from participants who a) did not complete at least 80% of items on study measures (Resseguier et al., 2013), b) completed no items pertaining to the IV (restructuring task), and/or c) provided no responses to the demographics items. A total of \( n=119 \) participants met these criteria, and were accordingly not included in the final analyses. Additional dummy variables were created to differentiate those who scored low on the restructuring task but showed evidence of task engagement (e.g., clear attempts to appropriately respond to items), and those who simply did not attempt items or provided insufficient responses on the restructuring task. Interestingly, in the \( n=76 \) sample, all those who scored zero did not attempt any items on the restructuring task. Essentially, all those who scored zero simply did not engage with the task at all.

Descriptive statistics were calculated pertinent to the demographic variables among the current sample. Descriptive statistics were also analyzed for scores on each of the measures including the CRT, CDS, RRS-SF and PHQ-9.

To address our main hypothesis (that CRT scores would be significantly and positively correlated with restructuring task scores), a Pearson Product Moment correlation analysis (Pearson, 1896) was conducted to analyze any significant relationship between the main independent variable of interest.

Ancillary Analyses
We also analyzed any significant correlations between the dependent variable and exploratory study measures (i.e. between scores on RRS-SF, CRT, CDS, PHQ-9), and conducted an independent samples t-test to compare participants who received a total restructuring score of zero to those who did not, on scores for the RRS. In this case the IV was the total restructuring score (scores of 0 vs. 1 or higher) and the DV was the RRS scores.

**Results**

**Demographic Characteristics and Measures of Interest**

A total of 281 participants were retained in the final analyses. Of which, 42.3% (n=119) were female and 51.2% (n=144) were Christians. Pertinent sample demographics are summarized in Table 1.

**Relationship of Analytical Thinking and Cognitive Restructuring Performance**

A Pearson Product Moment Correlation analysis revealed no statistically significantly relationship between CRT scores and scores on the restructuring task, as measured by scores on the CRCC \( r = -0.04; p = 0.61 \). Pertinent correlation coefficients and results are summarized in Table 2.

**Ancillary Analyses**

Further analyses showed that a significant, negative relationship existed between scores on the RRS-SF and CRCC scores \( r = -0.16; p = 0.009 \), as well as CDS and CRCC scores \( r = -0.13; p = 0.034 \). Neither PHQ-9 scores, nor any demographic variable were found to be significantly correlated with CRCC scores. Results are summarized in Table 2.
Differences in Rumination among Varying Restructure Task Engagement

Independent samples t–test revealed a significant difference in RRS scores between those who obtained a low restructuring score (CRCC) but were genuinely engaged in the task (M= 21.15, SD= 5.25, N= 205), and those who scored low on the CRCC because they were not fully engaged (M= 22.95, SD= 6.03, N= 76), t (279) = -2.44, p = 0.02. Higher scores on the RRS were seen among those who were not engaged in the restructuring task and scored lowest. Similarly, this was seen between the same low score and engaged in task groups (M= 70.83, SD= 23.12, N=205) and low score with no task engagement group (M=76.38, SD= 24.30, N=76), t (279) = -1.76, p= 0.08, but was not found to be statistically significant. All results are summarized in Table 3.

Discussion

The purpose of this study was to examine whether analytical thinking, as measured by scores on the Cognitive Reflection Test (CRT; Frederick, 2005), was correlated with scores on a task designed to assess capacity to cognitively restructure a negative automatic thought, based on a coding checklist created specifically for the purposes of this study. Existing evidence suggested a correlation between analytical thinking and negative emotions, which prevent the allocation of cognitive resources to deductive reasoning and cognitive tasks (Tremoliere et al., 2016). In such cases, cognitive resources are used in processing emotions rather than focusing on the task (Tremoliere et al., 2016). Additionally, research suggested that cognitive distortions are correlated to negative affect (i.e. depression and anxiety) (Booth et al., 2019), while rumination has been found to be correlated to greater interference of negative thoughts (Hilt et al., 2014). Repetitive negative thinking, as described by Watkins and Brown (2002), undermines and depletes cognitive resources (as cited in Deymer et al., 2012). Accordingly, it was predicted that analytical thinking would be correlated with restructuring performance. While a few previous studies have examined
the relationship of individual difference factors (e.g. SES; explanatory models of depression) on outcomes in CBT, however this is the first study to examine whether analytical thinking is a predictor for scores on a cognitive restructuring task. Given the centrality of restructuring in CBT, this study paves the way for future research examining whether certain social and cognitive factors can predict performance on tasks critical for CBT outcomes, and whether these predictors can serve in offering treatments that are tailored specifically to the needs of each patient.

Contrary to evidence by Dobson (2002), who found that scores on pre-treatment factors in CBT patients (e.g. age, marital status, familial history, etc.) are associated with different outcomes in CBT, we found no significant correlation between any demographic variables and cognitive restructuring scores. This suggests that although a relationship may exist between certain individual factors and outcomes in CBT, it cannot firmly be concluded that certain demographic factors are strong predictors for restructuring success per se. The results of the present study conflicted with those of Hamilton and Dobson (2002), as their results were focused on mental health outcomes of CBT. Participants in the study by Dobson (2002), completed a full course of CBT and were treated specifically for their depression.

Results did not support the first hypothesis of a significant correlation between CRT scores and restructuring scores. This may be due to the simplicity of the restructuring task included in the present study. Those who engaged in the task and completed each required aspect were more likely to obtain relatively high scores. That is, the task itself may have been fairly self-explanatory and simple, hence not tapping directly into the more effortful, elaborative components of “System 2” required for high CRT performance. Since it may have not been challenging enough, it was difficult to differentiate those who scored high and those who did not on the basis of analytical thinking scores. As was observed, those who scored zero were ones who did not engage in the task
at all. Hence, engagement in the restructuring task almost always led to a high score on the checklist. Therefore the simplicity of the restructuring task may be constraining the range necessary to detect a meaningful relationship (i.e., ceiling effect).

Interestingly, ancillary analyses revealed a significant, negative relationship between RRS-SF and CRCC scores, as well as CDS and CRCC scores. Essentially, it was found that higher rumination and cognitive distortions were associated with less successful outcomes on the restructuring task. There are some plausible explanations behind these findings. First, as evidence from the literature suggested, rumination is correlated with greater interference of negative information (Hilt et al., 2014). Evidence discussed earlier also suggested that cognitive distortions are associated with negative affect (Booth et al., 2019) and negative emotions interfere with allocating cognitive resources to a task, as they are used instead to process emotions (Tremoliere et al., 2016). Accordingly, these results suggest that participants high on ruminative tendencies and cognitive distortions, as measured by the RRS-SF and CDS respectively, experienced more negative emotions and were more engaged in the processing of these emotions rather than the task. Hence, these participants scored lower on the CRCC, while displaying high RRS-SF and CDS scores. These findings were in alignment with evidence from the literature by Hilt et al. (2014), Booth et al. (2019), and Tremoliere et al. (2016). Furthermore, self-rumination, which is repetitive negative thoughts about negative aspects of the self (Boyraz & Kuhl, 2015), may have been higher among those who scored high on the RRS-Sf and CDS. Essentially, this tendency to repetitively affirm negative thoughts of the self, defeated the process of restructuring them. Therefore suggesting that high rumination and cognitive distortion scores were associated with greater difficulty in restructuring negative thoughts.
RRS scores between those who were fully engaged in the task and those who did not engage were significantly different, suggesting those who did not attempt the restructuring task at all displayed higher RRS scores. As discussed above, ruminative style is associated with greater interference of negative information (Hilt et al., 2014). Negative information may relate to negative emotions, where one may be constantly distracted by negative information and are engaged in negative emotion. Therefore rumination may be correlated to experiencing more negative emotions, which can interfere with focusing on the restructuring task. According to Tremolieri et al. (2016), emotions interfere with allocating cognitive resources to a task. Hence, high RRS scores among those who were not engaged in the restructuring task may be related to greater experience of negative emotions, which use up cognitive resources available for engaging in the task. Thus, those participants may have been unable to complete or carry out the full task. These findings lined up with those found by Tremolieri et al. (2016), as well as findings in Greene (2020) concerning intrusive rumination, described to be involuntary engagement in negative thoughts. Cognitive flexibility (CF) was found to have a negative correlation with intrusive ruminations (Greene, 2020). Likewise, these results may suggest that higher RRS scores were associated with greater involuntary engagement in negative thinking (intrusive ruminations), and ultimately with disengagement with the restructuring task. Hence, these findings were in alignment with those from Greene (2020), Hilt et al. (2014), and Tremolieri et al. (2016).

**Strengths, Limitations and Future Directions**

This study possessed several unique strengths. As discussed earlier, evidence in the literature was suggestive of a correlation between demographic factors, depression, rumination and cognitive distortions with processes related to mood repair and outcomes in CBT as a whole. However, our study was novel in that we specifically examined correlations between analytical
thinking, as measured by the CRT, and cognitive restructuring specifically. That is, cognitive restructuring is a core concept of any form of cognitive therapy. Therefore, focusing precisely on cognitive restructuring performance and ways to improve it, can enhance the effects of cognitive therapy. As discussed earlier, cognitive therapy can be complimentary to traditional psychotherapy, and by enhancing its effects, it may ultimately relate to greater success in treatment for patients.

Despite its strengths, the study does have several limitations. Since the study recruited participants through MTurk (Amazon Web Services, 2005), which is an American based crowdsourcing website, there is little diversity in ethnicity among participants. In addition, MTurk populations tend to be of a younger and more educated demographic than the general public (Poslacci & Chandler, 2014). Hence, generalizability of the study results is low. Also, being a fairly knowledgeable population, they may have had prior exposure to the CRT which would lead to higher scores. As it was seen, the majority of the demographic sample had a Bachelor’s degree and secondary education. Therefore, results of the study are not inclusive of people from lower educational groups and different ethnicities.

Further, this study was web-based and restructuring was done online through a module video and associated segments in the form of restructuring steps. This may have not yielded accurate results since miscommunication may impact how well participants did on the restructuring task. In-person and individualized restructuring training would likely give different results, especially with the presence of a qualified cognitive therapist. Therefore, the online nature of the study may have impacted the effectiveness of the restructuring process and how well participants were able to grasp and implement concepts of restructuring. With this said, it seemed that those who engaged in the restructuring task performed well and scored high. Given the
simplicity of the task, it may be possible that those who did not engage at all simply did not find it engaging to sustain their attention. A more complex task, that is simple to implement but also tested understanding of the restructuring steps, may have been a better assessment of whether those who scored high truly grasped the core concepts. It may have also been best if measures such as PHQ-9, RRS-SF and CDS were taken a second time after restructuring to assess whether the outcomes were truly successful or not.

Lastly, the recruited sample was not a clinical or treatment-seeking sample. Hence, the dedication each person had for the process may have not been very high, and results may be subject to biases. Additionally, individual and demographic factors that may exist in a clinical population may differ from those of a normal population (e.g. clinical populations may be of mixed ethnicities, have comorbid symptoms, be under the effect of medication, etc.). Thus, the study once again lacks generalizability of results from a typical population to a clinical treatment-seeking one.

Future research should extend these analyses among a clinical population, as they are more diverse in several demographic factors. Although Mturk is a relatively feasible and convenient method of recruiting participants, it does produce data that is low on generalizability due to its population selection. If social and cognitive predictors of restructuring are aimed at providing treatment options that are tailored to the specific needs of individuals, a more diverse population is necessary to support findings. This study should also motivate further research in implementing ways to improve restructuring outcomes and ultimately yielding higher success in core components of CT and CBT such as the ability to restructure negative automatic thoughts. Additionally, and if CRT performance is not readily amenable to change, restructuring scores can function as a way to select people into CBT.
Conclusions

In conclusion, the current study found no significant correlation between analytical thinking as measured by the CRT, and cognitive restructuring performance related to CBT on an online task. We found that ruminative style (RRS-SF) and cognitive distortions (CDS) were significantly and negatively correlated to restructuring scores; high scores on both were correlated to lower scores on the restructuring task. These results align with existing evidence in the literature for cognitive flexibility, analytical control, rumination and cognitive distortions. Further evidence is necessary to generalize these findings to more diverse and clinical populations. However, findings of the present study suggest that work to reduce rumination through non-cognitive means may be required before introducing cognitive techniques (i.e. cognitive restructuring; CR). Such a strategy can improve treatment outcomes since, according to the results discussed above, higher rumination tendencies and cognitive distortions may be related to difficulties and lower performance in cognitive restructuring.
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https://doi.org/10.1136/jnnp.72.3.400
Table 1

*Summary of Demographics Information*

<table>
<thead>
<tr>
<th>Sample of Participants</th>
<th>n = 281</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: $M \ (SD)$</td>
<td>38.54 (12.019)</td>
</tr>
<tr>
<td>Gender: n (%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>119 (42.3)</td>
</tr>
<tr>
<td>Male</td>
<td>161 (57.3)</td>
</tr>
<tr>
<td>Non-Binary</td>
<td>1 (.4)</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
</tr>
<tr>
<td>Single, Never Married</td>
<td>123 (43.8)</td>
</tr>
<tr>
<td>Married/Cohabiting</td>
<td>127 (45.2)</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>26 (9.3)</td>
</tr>
<tr>
<td>Religion/Spirituality</td>
<td></td>
</tr>
<tr>
<td>Christianity</td>
<td>144 (51.2)</td>
</tr>
<tr>
<td>Islam</td>
<td>4 (1.4)</td>
</tr>
<tr>
<td>Buddhism</td>
<td>3 (1.1)</td>
</tr>
<tr>
<td>Judaism</td>
<td>5 (1.8)</td>
</tr>
<tr>
<td>Atheism</td>
<td>41 (14.6)</td>
</tr>
<tr>
<td>Agnosticism</td>
<td>42 (14.9)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (2.8)</td>
</tr>
<tr>
<td>None</td>
<td>34 (12.1)</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------</td>
</tr>
</tbody>
</table>

### Yearly Household Income

<table>
<thead>
<tr>
<th>No Yearly Income</th>
<th>1 (0.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10,000-$30,000</td>
<td>55 (19.6)</td>
</tr>
<tr>
<td>$30,001-$50,000</td>
<td>82 (29.2)</td>
</tr>
<tr>
<td>$50,001-$75,000</td>
<td>73 (26)</td>
</tr>
<tr>
<td>$75,001 and over</td>
<td>67 (23.8)</td>
</tr>
</tbody>
</table>

### Education

<table>
<thead>
<tr>
<th>Secondary High School Graduation</th>
<th>75 (26.7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certificate or Equivalent</td>
<td></td>
</tr>
<tr>
<td>Trades certificate or Diploma</td>
<td>14 (5)</td>
</tr>
<tr>
<td>Other Non-University Certificate</td>
<td>11 (3.9)</td>
</tr>
<tr>
<td>University Certificate or Diploma Below</td>
<td>30 (10.7)</td>
</tr>
</tbody>
</table>

### Bachelor’s Degree

<table>
<thead>
<tr>
<th>Bachelor’s Degree</th>
<th>128 (45.6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master’s Degree</td>
<td>22 (7.8)</td>
</tr>
<tr>
<td>Doctorate</td>
<td>1 (0.4)</td>
</tr>
</tbody>
</table>

### Measures: M (SD)

<table>
<thead>
<tr>
<th>CRT</th>
<th>0.2316 (15.385)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRCC</td>
<td>6.8968 (4.744)</td>
</tr>
<tr>
<td>CDS</td>
<td>72.33 (23.53)</td>
</tr>
<tr>
<td>PHQ-9</td>
<td>4.9751 (5.192)</td>
</tr>
<tr>
<td>RRS-SF</td>
<td>21.64 (5.522)</td>
</tr>
</tbody>
</table>
Note: CRT = Cognitive Reflection Test Total Score CRCC = Cognitive Restructuring Coding Checklist Score, CDS= Cognitive Distortions Scale Total Score, FFMQ-SF = Five Facets of Mindfulness Questionnaire- Short Form Total Score, SCS = Self Compassion Scale- Short Form Total Score, PHQ-9 = Patient Health Questionnaire-9 Total Score
### Table 2

*Pearson Product Moment Correlation for Demographic Measures, PHQ-9, CRT, CDS, and RRS-SF*

<table>
<thead>
<tr>
<th>Demographic Variables</th>
<th>CRCC Scores (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.06</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.03</td>
</tr>
<tr>
<td>Religion</td>
<td>-0.01</td>
</tr>
<tr>
<td>Marital Status</td>
<td>-0.00</td>
</tr>
<tr>
<td>Income</td>
<td>0.03</td>
</tr>
<tr>
<td>Education</td>
<td>-0.05</td>
</tr>
<tr>
<td>PHQ-9</td>
<td>-0.11</td>
</tr>
<tr>
<td>CRT</td>
<td>-0.04</td>
</tr>
<tr>
<td>RRS-SF</td>
<td>-0.16**</td>
</tr>
<tr>
<td>CDS</td>
<td>-0.13*</td>
</tr>
</tbody>
</table>

Note: PHQ-9= Patient Health Questionnaire-9 Total Score, CRT= Cognitive Reflection Test Total Score, RRS-SF= Ruminative Response Scale –Short Form Total Score, CDS= Cognitive Distortions Total Score

*p < 0.05. **p < 0.01
Table 3

*Group Statistics from Independent Tests*

<table>
<thead>
<tr>
<th>Measures</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>RRS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Task Engagement</td>
<td>205</td>
<td>21.15</td>
<td>5.25</td>
<td>-2.44</td>
<td>279</td>
<td>0.02*</td>
</tr>
<tr>
<td>Low Task Engagement</td>
<td>76</td>
<td>22.95</td>
<td>6.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Task Engagement</td>
<td>205</td>
<td>70.83</td>
<td>23.12</td>
<td>-1.76</td>
<td>279</td>
<td>0.08</td>
</tr>
<tr>
<td>Low Task Engagement</td>
<td>76</td>
<td>76.38</td>
<td>24.30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: RRS = Ruminative Response Scale-Short Form Total Scores, CDS = Cognitive Distortions Scale Total Score
*p < 0.05. **p < 0.01