Reductions in negative repetitive thinking and metacognitive beliefs during transdiagnostic internet cognitive behavioural therapy (iCBT) for mixed anxiety and depression

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ARTICLE INFO
Article history:
Received 12 September 2013
Received in revised form
25 March 2014
Accepted 23 May 2014
Available online 2 June 2014

Keywords:
Cognitive behavioural therapy
Depression
Anxiety
Treatment
Rumination
Worry

ABSTRACT

We explored whether transdiagnostic internet-delivered cognitive behavioural therapy (iCBT) for mixed anxiety and depression effectively reduces repetitive negative thinking (RNT), and whether reductions in RNT and positive metacognitive beliefs mediate symptom improvement during iCBT.

Participants with generalized anxiety disorder (GAD), major depressive disorder (MDD), or mixed GAD/MDD diagnoses were randomly allocated to a 6-lesson clinician-guided iCBT anxiety and depression program (n = 46) or wait-list control (WLC, n = 53). Depression (PHQ-9), generalized anxiety (GAD-7), RNT (Repetitive Thinking Questionnaire) and positive beliefs about RNT (Positive Beliefs about Rumination Scale) were assessed at pre-, mid-, and post-treatment or matched time points for WLC. Tests of serial indirect effects explored the potential mediating role of RNT and positive belief reductions on the impact of iCBT on depression and anxiety symptoms post-treatment.

Results showed that both RNT frequency and positive beliefs about the value of RNT reduced significantly following iCBT compared to WLC, with gains maintained at 3-month follow-up. Reductions between pre- and mid-treatment in positive beliefs and RNT mediated improvements in depression symptoms post-iCBT, and reductions in positive beliefs mediated improvements in GAD symptoms. These findings indicate that iCBT is an effective treatment for RNT and positive metacognitive beliefs. Future dismantling studies are needed to assess the most effective treatment components.

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Introduction

Major depressive disorder (MDD) and generalized anxiety disorder (GAD) are disabling and highly comorbid conditions (Hunt, Slade, & Andrews, 2004) that contribute substantially to the global burden of disease (World Health Organization, 2008). MDD and GAD have some of the highest comorbidity rates of the inter- nalising disorders cluster, reaching as high as 58–70% (Brown, Campbell, Lehman, Grisham, & Mancill, 2001; Hunt et al., 2004). Although they are distinct disorders, they are closely related (Watson, 2005); MDD and GAD share similar genetic and environmental vulnerabilities (Hettema, 2008), are both characterized by trait negative affectivity or neuroticism (Andrews, 1990), share overlapping symptoms (e.g., sleep disturbance, APA, 1994), and similar cognitive and behavioural maintenance processes (e.g., avoidance).

One of the core cognitive processes that characterizes and perpetuates both disorders is repetitive negative thinking (RNT) in the form of worry and rumination. Although there appear to be some minor differences between rumination and worry in features such as temporal orientation (i.e., past versus future focus) (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008), there is growing evidence that rumination and worry are highly similar cognitive processes (Watkins & Moulds, 2005) that are both associated with a broad construct of negative repetitive thought (RNT). RNT, capturing both rumination and worry, has been conceptualized as perseverative, frequent, and uncontrollable cognitive activity focused on negative aspects of the self and world (Ehring & Watkins, 2008; Segerstrom, Stanton, Alden, & Shorter, 2003). RNT is a critical transdiagnostic maintaining factor across many Axis I disorders, including social phobia and post-traumatic stress disorder (PTSD), as well as GAD and MDD (Aldao & Nolen-Hoeksema, 2010; Harvey, Watkins, Mansell, & Shafran, 2004;
There have been promising efforts to develop ruminative-focused treatments for depression (e.g., ruminative-focused CBT and concreteness training; Watkins et al., 2007, 2012), and worry-focused treatments for GAD (e.g., Metacognitive therapy for GAD, Wells, 1995) that specifically target rumination and worry, respectively. Cognitive Behavioural Therapy (CBT) has also been shown to effectively reduce the frequency of rumination in depression (Jones, Siegle, & Thase, 2008; Manicavasagar, Perich, & Ruheker, 2012) and pathological worry in GAD (Covin, Quimet, Seeds, & Dozois, 2008). However, few augmentations to therapy have been made to address maladaptive RNT processes from a transdiagnostic perspective. In addition, the degree to which transdiagnostic treatments for mixed depressed and anxious samples effectively reduces RNT and the factors which drive the tendency for RNT still needs to be evaluated.

Various contemporary theories of RNT (Dugas, Gagnon, Ladouceur, & Freeston, 1998; Nolen-Hoeksema, 1991; Papa-georgiou & Wells, 2001; Wells, 1995; Wells & Matthews, 1996)] such as the Self-Regulatory Executive Function model (S-REF) (Wells & Matthews, 1994) propose that positive metacognitive beliefs which emphasize the perceived advantages of RNT (“e.g., “rumination helps me understand and solve my problems,” “worrying helps me prevent future catastrophes”) reinforce the tendency to use RNT as a coping strategy. In support for the hypothesized role of positive metacognitive beliefs, research has demonstrated that positive metacognitive beliefs about RNT are prevalent in GAD, MDD and comorbid GAD/MDD (Dugas et al., 1998; Dupuy & Ladouceur, 2008; Papa-georgiou & Wells, 2001), are associated with increased frequency of RNT (as indexed by worry and rumination) (Cartwright-Hatton & Wells, 1997) and predict symptom maintenance (Papa-georgiou & Wells, 2001). Studies of patients with GAD have also shown that directly challenging positive beliefs about the utility, function and consequences of worry reduces worry frequency (e.g., Robinson et al., 2010), suggesting positive beliefs are an important clinical target.

With these empirical findings in mind, we developed a transdiagnostic cognitive behavioural treatment for comorbid MDD and GAD to be delivered over the internet (iCBT), which placed a focus on reducing RNT and positive metacognitive beliefs. There are many advantages to developing such a program: iCBT offers an effective low-intensity mode of treatment that is easily disseminated and accessible to a large number of patients in the community (Andersson & Cuijpers, 2008; Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010; Spek et al., 2007). iCBT has been shown to have similar efficacy to face-to-face CBT (Andrews, Davies, & Titov, 2011), is cost-effective, and symptom improvements are maintained over long-term, even up to 5-year follow-up for some programs (Hedman et al., 2011). Transdiagnostic treatments also present a novel approach to address comorbidity across the internalizing disorders. Such treatments aim to target shared symptoms and maintaining factors across anxiety and depressive disorders (e.g., Barlow et al., 2004), and have received growing support in various treatment delivery modes including when delivered individually (Barlow, Allen, & Choate, 2004), in a group format (Norton, 2012), and via the internet (Carlbring et al., 2011; Titov et al., 2011). Using a randomised controlled trial (RCT) design, we demonstrated large effect size reductions in both depression and generalized anxiety symptoms following our iCBT program compared to a wait-list control (see Newby et al., 2013). In the current study, using data drawn from the RCT, we sought to test whether this iCBT program was also effective in reducing RNT, and whether it performed better than wait-list control in reducing RNT. We measured RNT frequency at pre, mid, and post-treatment using the Repetitive Thinking Questionnaire (RTQ) (McEvoy, Mahoney, & Moulds, 2010), a symptom-independent measure of RNT that has been validated in non-clinical and clinically anxious and depressed samples. We also aimed to test whether iCBT reduced positive metacognitive beliefs about RNT; one of the factors that are hypothesized to drive the tendency to engage in maladaptive RNT in MDD and GAD.

In the current study, we also aimed to extend our understanding beyond the efficacy of our iCBT program, by exploring whether reductions in positive metacognitive beliefs and RNT frequency would mediate the impact of iCBT on symptoms of both depression and generalized anxiety. We tested for serial indirect effects (Hayes, 2013) to investigate this possibility. Because the CBT skills that aimed to target and alleviate negative repetitive thinking and positive beliefs about the value of repetitive thinking were included in the first half of treatment (lesson 1–3), we placed our focus on analysing whether changes in these variables in the first half of treatment mediated the impact of treatment on depression and generalized anxiety symptom outcomes. We hypothesized that by targeting positive beliefs about the value of RNT, patients in the iCBT group would experience reductions in beliefs that would lead to a reduction in RNT frequency, and in turn, lead to symptom reduction. To our knowledge, no previous trials have investigated the impact of CBT (in online or face-to-face modality) on a transdiagnostic measure of RNT and positive metacognitive beliefs, nor investigated the mediating role of RNT from a transdiagnostic perspective on symptom improvement.

In summary, the aims of this study were to examine whether: 1) transdiagnostic iCBT for mixed anxiety and depression was more effective than wait-list control in reducing RNT and positive metacognitive beliefs about RNT, and whether 2) reductions in RNT frequency and positive beliefs about RNT mediate the impact of iCBT on depression and generalized anxiety. We hypothesized that iCBT would be more effective than wait-list control at effectively reducing both RNT frequency and positive metacognitive belief ratings. Second, we predicted that the effect of iCBT on primary symptoms of depression and generalized anxiety would at least partially be mediated by the reductions in RNT and positive metacognitive belief ratings.

Methods

Design

A CONSORT 2010 compliant (Schulz et al., 2010) RCT design compared a group who received immediate iCBT (iCBT group) to a wait-list control group (WLC). The iCBT group was followed up until 3 months post-treatment. The WLC group commenced the iCBT program after the post-treatment assessment. The study was approved by the Human Research Ethics Committee (HREC) of St Vincent’s Hospital (Sydney, Australia) (HREC 11/SVH/95), and the trial was registered as ACTRN12611001055998. For more extensive
Participants and randomisation

Participants (>18 years, who self-identified as suffering from GAD, MDD or mixed anxiety and depression) were recruited from an existing wait-list for iCBT and online advertisement, and completed online screening at www.virtualclinic.org.au. Online screening included the PHQ-9, and GAD-7, as well as self-report items that assessed the exclusion criteria. Exclusion criteria were: self-reported history of a psychotic disorder, bipolar disorder, substance or alcohol dependence, self-reported history of suicide attempts or frequent suicidal ideation (on more than half of the days in the past two weeks), severe depression symptoms (PHQ-9 score > 20), current benzodiazepine or atypical antipsychotic use. Participants who were taking current antidepressant medication or receiving current psychological treatment were not excluded, but must have been on a stable dosage for at least 2 months prior to participating, and agreed to not make any changes to their treatment during the entire duration of the study.

Participants who had GAD-7 and PHQ-9 scores above clinical threshold (greater than or equal to 10), and met the study’s inclusion criteria were then interviewed by telephone by trained interviewers to confirm the presence of DSM-IV GAD and/or MDD using the Mini International Neuropsychiatric Interview (MINI, Version 5.0.0, Sheehan et al., 1998). Following online screening and telephone interview administration of the MINI, eligible participants were randomised to iCBT (n = 49) or WLC (n = 60).\(^1\)

Description of treatment

The iCBT program is a clinician-assisted treatment delivered via www.virtualclinic.org.au, which consists of six illustrated online lessons and a corresponding lesson summary (which includes practical homework exercises), and is completed over a 10-week period. Lesson content is presented in the form of an illustrated story about two fictional characters who experience anxiety and depression, and gain mastery over their symptoms with the help of a clinician using CBT techniques. The specific components that were designed to target RNT and positive beliefs were: psycho-education, self-monitoring, identification and cognitive restructuring of positive and negative beliefs about RNT, behavioural activation, structured problem-solving, attention shifting, worry time, and imaginal exposure to worry scenarios. See Table 1 for lesson-by-lesson content. All patients received the same standardized treatment. Following each lesson, participants download and print out a lesson summary, which includes practical homework exercises to complete before the next lesson (e.g., graded exposure tasks). Participants also have access to frequently asked questions, former patients’ recovery stories, and extra resources on a range of topics such as sleep hygiene, medications and panic attacks. Once participants downloaded their homework, they were considered to have ‘completed the lesson.’ A new lesson was made available each week for the first six weeks to encourage completion of one lesson before moving onto the next lesson. Participants were encouraged to practice their lesson homework for at least one week (and two weeks each for lessons 4 and 5 which both included exposure tasks) before starting the next lesson. Participant comprehension of the lesson content was not assessed.

Clinician guidance

The primary clinician was the practice manager of CRUfAD (an administrative assistant), who was supervised by a Therapist (JN, a PhD-level Clinical Psychologist). The iCBT group participants received regular email and/or phone contact with their Clinician until they completed lesson 2, after which contact was made in response to patient request. All emails requiring clinical advice were responded to by the Therapist. If clinically indicated, or if patients’ Kessler-10 (K-10) and/or PHQ-9 scores deteriorated (increased by at least 0.5 SD), the Therapist would make telephone contact with the participant. The Kessler-10 (Kessler et al., 2002) was administered prior to each lesson to keep track of lesson-by-lesson progress and enable early detection of any increase in symptoms, but was not a primary outcome measure in the current study.

Outcome measurement

Outcome measures were administered at pre-, mid-treatment (prior to commencing lesson 4), post-treatment, and 3-month follow-up (for the iCBT group only). The WLC participants commenced iCBT immediately after post-treatment assessment, and thus did not provide 3-month follow-up data. Forty six iCBT and 53 WLC participants completed pre-treatment questionnaires and were included in analyses. All of the WLC participants provided complete post-treatment data. Forty three out of 46 and 40/46 had complete post-treatment and 3-month follow-up data respectively in the iCBT group.

Outcome measures included the Patient Health Questionnaire-9 (depression) (PHQ-9, Kroenke, Spitzer, & Williams, 2001) and the Generalized Anxiety Disorder 7-item scale (generalized anxiety) (GAD-7, Spitzer, Kroenke, Williams, & Lowe, 2006). The 10-item version of the Repetitive Thinking Questionnaire (McEvoy et al., 2010) assessed RNT frequency. This measure has been validated in clinical samples and has good internal reliability (α = .89) (Mahoney, McEvoy, & Moulds, 2012). Items (e.g., ‘Once I started

### Table 1

<table>
<thead>
<tr>
<th>Lesson number</th>
<th>Content</th>
<th>Homework tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Psychoeducation about anxiety and depression, the fight or flight response, controlled breathing, and physical exercise</td>
<td>Controlled breathing, physical exercise</td>
</tr>
<tr>
<td>2</td>
<td>Cognitive therapy components: education about the cognitive model, cognitive distortions, and introduction to thought monitoring; activity planning</td>
<td>Thought monitoring, activity planning</td>
</tr>
<tr>
<td>3</td>
<td>Thought challenging/cognitive restructuring; challenging positive and negative metacognitive beliefs about repetitive negative thinking; shifting attention, hunt for positives</td>
<td>Thought challenging, hunt for positives</td>
</tr>
<tr>
<td>4</td>
<td>Education about avoidance and safety behaviours; graded exposure and structured problem solving</td>
<td>Graded exposure and structured problem solving</td>
</tr>
<tr>
<td>5</td>
<td>Advanced graded exposure (imaginal exposure, interoceptive exposure); troubleshooting difficulties with graded exposure</td>
<td>Graded exposure</td>
</tr>
<tr>
<td>6</td>
<td>Relapse prevention</td>
<td>Relapse prevention plan</td>
</tr>
</tbody>
</table>

\(^1\) To randomly allocate participants to the relevant group, 110 random numbers (1 or 2 to determine group allocation) were generated using www.random.org (a tool which does not necessarily restrict group allocation to ensure there are even numbers across groups) by a research assistant independent from the trial. Group allocation was concealed in an opaque envelope, which was only opened at the point when an offer of treatment was made.
thinking about the situation, I couldn’t stop’) were rated on a 5-point scale about how they tended to respond to distressing situations (1 = not true, to 5 = very true). The 9-item Positive Beliefs about Rumination Scale-Adapted Version (PBRS-A; Watkins & Moulds, 2005) measured positive beliefs about RNT more generally, as opposed to ruminating about depression which was assessed with the original version of the PBRS (Papageorgiou & Wells, 2001). Participants’ agreement with each item (e.g., ‘I need to think about things to find answers to how I feel’) was rated on a 4-point scale generally (1 = do not agree to 4 = agree very much). This measure has good internal reliability (α = .89; Watkins & Moulds, 2005).

Results

Statistical analyses

Baseline comparisons

Independent samples t-tests and chi-square (for nominal data) were used to compare the groups at pre-treatment to examine whether there were any baseline group differences.

Intent-to-treat (ITT) marginal model analyses

To examine the impact of iCBT on depression and anxiety symptoms, as well as the frequency of RNT and positive beliefs, we conducted separate analyses for each outcome measure (the PHQ-9, GAD-7, RTQ, PBRS-A) with group as a fixed factor and baseline scores entered as a covariate to participant drop-outs. Marginal models are appropriate for pre-post designs and RCTs with multiple time points (Salim, Mackinnon, Christensen, & Griffiths, 2008). This analysis has added advantages over ITT analyses using the last observation carried forward, because it does not assume that the last measurement was stable (Gueorguieva & Krystal, 2004). As the primary outcome measures were also collected at mid-point, effects for the primary measures were modelled using the restricted maximum likelihood (REML) model estimation method with an autoregressive (AR1) covariance structure to account for the correlation between the time-points. Significant effects were followed up with pairwise contrasts comparing pre-treatment to post-treatment scores.

Mediation analyses

Tests of the indirect effects (mediation) were conducted using PROCESS (Hayes, 2013). This method was chosen over the causal steps approach (Baron & Kenny, 1986) based on recent research advocating for the use of modern statistical approaches to quantifying intervening variable models (Hayes, 2009). As recommended, particularly for small samples, estimates of indirect effects were generated using bootstrapping analysis (see Preacher & Hayes, 2004; Williams & MacKinnon, 2008). Bootstrapping is a nonparametric resampling method that generates an estimate of the indirect effect, and does not require assumptions about the shape of the sampling distribution that underlie the Sobel test. In bootstrapping analysis, the most stringent test of an indirect effect (mediation) is if the 95% bias corrected and accelerated confidence intervals for the indirect effect do not include the value of 0. When zero is outside of the 95% confidence interval estimate, the indirect effect is declared statistically different from zero at p < .05 (two-tailed), indicating that the effect of the independent variable on the dependent variable is contingent upon the effect of the proposed mediator (Hayes & Preacher, 2010; Preacher & Hayes, 2004). In the current study, we estimated 5000 bias-corrected bootstrap 95% confidence intervals using PROCESS for SPSS.

Participants were on average 44 years old (SD = 12.2) and moderately depressed and anxious (see Table 2). The majority were female (77.8%), married or de-facto (62.6%), were educated with a bachelor or postgraduate degree (58.6%), in full-time (36.4%) or part-time paid work (23.2%). Groups were matched on demographics, scores on outcome measures (see Table 2) and diagnostic status (ps > .05). The majority had co-morbid GAD/MDD (47%) followed by GAD with sub-threshold MDD (38%). As determined by the MINI interviews, in the iCBT group, 19 met criteria for co-morbid GAD/MDD (41.3%), 21 had GAD (45.7%) (but with sub-threshold MDD), and 6 met criteria for MDD (13.0%) and had sub-threshold GAD. In the WLC group, 28 met criteria for co-morbid GAD/MDD (52.8%), 16 (30.2%) had GAD, and 9 (17.0%) had MDD, but each had sub-threshold GAD or MDD respectively. There were no differences in the proportions of participants per group who had a diagnosis of GAD, MDD or co-morbid GAD/MDD respectively. There were no differences in the proportions of participants per group who had a diagnosis of GAD, MDD or co-morbid GAD/MDD when a participant had an elevated score (>5) on the relevant self-report measure (GAD-7, and PHQ-9), but did not endorse sufficient diagnostic criteria on the MINI to warrant a diagnosis of GAD or MDD.

Adherence, outcome measures and effect sizes

Of the 46 participants in the iCBT group, 41 completed the total six lessons, representing an adherence rate of 89%. The main effects for all outcome measures were qualified by significant Group × Time interactions, ps ≤ .001 (see Table 2 for observed means, standard deviations, statistics and effect sizes). Between-group comparisons on all measures revealed that post-treatment scores were significantly lower in the iCBT group relative to WLC, with moderate to large observed effect sizes (Cohen’s d) (ranging from .78 (PBRS-A) to 1.00 (PHQ-9)). Within-group comparisons between pre- and post-treatment for the iCBT group revealed large effect sizes (Hedges g) (range = .96 (GAD-7) to 1.40 (RTQ)). The within-group reductions in the WLC group on all measures were not significant (ps > .05).

Clinically significant change

Following Jacobson and Truax (1991), we calculated reliable change index values for the RTQ and PBRS-A, and found reliable improvement at post-treatment in greater proportions of the iCBT group than the WLC group using chi square analyses (ps < .001). For the iCBT group, 55% evidenced reliable change on the RTQ and 35% on the PBRS-A; whereas in the WLC group only 7% showed reliable change on the RTQ and on the PBRS-A. Seven percent of WLC participants indexed reliably increased RTQ and PBRS-A at post-treatment.

Three-month follow-up data (iCBT group only)

For the iCBT group, marginal model analyses with Time as variable fixed factor and baseline scores entered as a covariate were conducted for each DV (PHQ-9, GAD-7, RTQ AND PBRS-A) to compare mean score reductions between post-treatment to 3-month follow-up. For GAD-7 and RTQ scores, the main effects of Time were significant, corresponding to a small effect size for reductions in GAD-7 scores (ES = .26, F (13.736) = 4.39, p < .04, r = .67) and a moderate effect size for RTQ scores (ES = .48, F (13.567) = 13.30 p = .001, r = .64). Follow-up RTQ scores in the iCBT
Observed means, standard deviations and effect sizes for depression, anxiety, repetitive thinking and positive beliefs about repetitive thinking before and after Internet-based negative behavioural treatment.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre</th>
<th>Mid</th>
<th>Post</th>
<th>3-months</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHQ-9</td>
<td>30.30</td>
<td>23.73</td>
<td>17.90</td>
<td>14.30</td>
</tr>
<tr>
<td>GAD-7</td>
<td>11.88</td>
<td>10.37</td>
<td>10.43</td>
<td>10.37</td>
</tr>
<tr>
<td>RTQ</td>
<td>23.52</td>
<td>22.71</td>
<td>22.54</td>
<td>22.54</td>
</tr>
<tr>
<td>PBRS-A</td>
<td>18.17</td>
<td>17.81</td>
<td>17.42</td>
<td>17.42</td>
</tr>
<tr>
<td>Cohen’s d</td>
<td>1.47</td>
<td>1.35</td>
<td>1.33</td>
<td>1.33</td>
</tr>
<tr>
<td>Hedges’ g</td>
<td>1.50</td>
<td>1.47</td>
<td>1.49</td>
<td>1.49</td>
</tr>
<tr>
<td>95% CI</td>
<td>1.00 to 1.99</td>
<td>0.99 to 1.99</td>
<td>0.99 to 1.99</td>
<td>0.99 to 1.99</td>
</tr>
</tbody>
</table>

**Indirect effects (serial multiple mediation analyses)**

The mediating role of reductions in positive beliefs and repetitive thinking between pre- and mid-treatment on post-treatment outcome (depression and generalized anxiety)

**Depression symptoms.** First, we examined whether the reductions in positive metacognitive beliefs and RNT between pre- and mid-treatment mediated the impact of iCBT on post-treatment depression symptoms. To explore this question, in the first model, we estimated a serial multiple mediator model with two theoretically-derived mediators [M1: changes in positive metacognitive belief ratings (PBRS-A scores) and M2: change in RNT frequency (RTQ scores) between pre-treatment and mid-treatment] using PROCESS (Hayes, 2013). This enabled us to test the serial indirect effects of treatment on post-treatment depression (PHQ-9) scores via changes in positive metacognitive belief ratings and change in RNT scores (see Fig. 1 for model). Because reductions in positive beliefs were hypothesized to contribute to reductions in RNT, positive belief change scores were entered as the first mediator in the proposed causal chain. Baseline PHQ-9 scores were entered as a covariate. A negative change score between pre- and mid-treatment indicates a reduction in positive belief ratings (or RNT scores). The treatment variable (X) was coded as 0 = wait-list control, and 1 = iCBT. All 95% bias-corrected bootstrap confidence intervals for the specific indirect effects are presented in brackets.

Results indicated that the total effect of treatment on post-treatment PHQ-9 scores was significant (Effect = -4.55, t = -5.96, SE = .76, p < .001). The predicted model of the serial indirect effect of treatment on post-treatment depression via reductions in positive beliefs and reductions in RNT scores (between pre- and mid-treatment) was supported, as the indirect effect was statistically different from zero (95% CI: -5.22 to -0.50). The indirect effect of treatment on depression via change in positive beliefs (between pre- and mid-treatment) was also statistically different from zero (95% CI: -0.88 to -0.04), but the indirect effect of treatment on depression via changes in RNT scores was not (95% CI: -0.73 to -0.03). When we repeated the same analysis with gender (coded as 0 = female and 1 = male) and baseline scores on the PHQ-9, RTQ and PBRS-A entered as covariates, the serial indirect effect of treatment on post-treatment depression scores via reductions in positive beliefs and repetitive thinking scores (between pre- and mid-treatment) remained significant (95% CI: -0.42 to -0.02), but the indirect effect of treatment via reductions in positive beliefs was no longer significant (95% CI: -0.60 to 1.21).

These results suggest that the early reductions in positive metacognitive belief ratings mediated the positive impact of iCBT on post-treatment depression symptoms by influencing reductions in RNT frequency. However, the two mediators were examined at the same time-point, meaning we would be unable to rule out the alternative causal pathway; reductions in RNT influencing reductions in positive beliefs. To test this model, we repeated the
above analyses with changes in RNT entered as the first mediator. The serial indirect effect of interest (treatment on depression scores via change in RNT and change in positive beliefs) was not statistically different from zero (95%CI: −.18 to .01). We found the same results when gender and baseline scores on the PHQ-9, RNT, and positive belief ratings were entered as covariates (95%CI: −.26 to .01).

Generalized anxiety symptoms. Next, we sought to examine whether the reductions in positive metacognitive beliefs and RNT between pre- and mid-treatment mediated the impact of iCBT on post-treatment generalized anxiety symptoms. To examine this question we repeated the same serial multiple mediation analysis with post-treatment GAD-7 scores as the outcome variable, pre-treatment GAD-7 scores entered as a covariate, with positive belief change scores (from pre- to mid-treatment) entered as the first mediator, and RNT change scores (from pre- to mid-treatment) as the second mediator in the proposed causal chain (see Fig. 2). The total effect of treatment on GAD-7 scores was significant (Effect = −4.54, t = −5.91, SE = .77, p < .001). The predicted model of the serial indirect effect of treatment on GAD-7 symptoms via reductions in positive beliefs and reductions in RNT (between pre- to mid-treatment) was not different from zero (95%CI: −.17 to .01), nor was the indirect effect of treatment via RNT scores (95%CI: −.53 to .07). However, the indirect effect of treatment on post-treatment GAD-7 scores via change in positive belief scores was statistically different from zero (95%CI: −1.23 to −.05). These results suggest that iCBT had a positive impact on generalized anxiety symptoms through reducing positive beliefs about the value of RNT between pre- and mid-treatment. When we carried out the same analysis with gender, baseline GAD-7, baseline RNT and baseline positive belief scores as the covariates, none of the indirect effects were statistically different from zero. Results were as follows: the serial indirect effect via change in positive beliefs and change in RNT scores: (95%CI = −.32 to .01), the indirect effects via change in positive belief scores: (95%CI = −1.06 to .14), and the indirect effect via change in RNT scores (95%CI = −.72 to .04).³

³ Within this analysis, baseline positive belief scores and baseline GAD-7 scores were significant predictors of post-treatment GAD-7 scores (ps < .05), when all other variables were held constant, such that higher scores predicted greater reductions in symptoms.

### The mediating role of reductions in positive beliefs and repetitive thinking between pre- and post-treatment outcomes (depression and generalized anxiety)

Next, we repeated the same analyses to examine whether the reductions in RNT and positive beliefs throughout the entire program (between pre- and post-treatment) mediated the impact of iCBT on post-treatment outcomes on the PHQ-9 and GAD-7. Although we cannot establish a causal relationship between the proposed mediating variables and outcome variables, this analysis provides a preliminary step towards understanding how reductions in repetitive thinking and positive beliefs throughout the entire course of treatment influenced outcomes. In this analysis, we entered gender, and baseline PHQ-9, RNT and positive belief scores as covariates. Positive belief change scores (from pre- to post-treatment) were entered as the first mediator, and RNT change scores (from pre- to post-treatment) as the second mediator in the proposed causal chain. In this model, the serial indirect effect of treatment on post-treatment depression via reductions in positive beliefs and reductions in RNT scores was supported, as the indirect effect was statistically different from zero (95%CI: −.72 to −.01). The indirect effect of treatment on depression via change in RNT scores was also statistically different from zero (95%CI = −2.49 to −.58). However, the indirect effect of treatment on depression via change in positive belief scores was not statistically different from zero (95%CI = −.58 to .98). These results suggest that when gender, and baseline symptom severity, repetitive thinking frequency and positive beliefs ratings are controlled for, the positive effects of iCBT on post-treatment depression symptoms is mediated in part by reductions in positive beliefs influencing reductions in repetitive thinking, and in part by direct reductions in repetitive thinking.⁴

⁴ Within this analysis, when all other variables were held constant, both baseline RNT scores and baseline PHQ-9 scores significantly predicted post-treatment PHQ-9 scores (ps < .05), with higher scores predicting higher post-treatment PHQ-9 scores.
The serial indirect effect of treatment on GAD-7 symptoms via reductions in positive beliefs and reductions in RNT scores between pre- and post-treatment was statistically different from zero (95%CI = –.73 to –.02), as was the indirect effect of treatment via change in RNT scores (95%CI = –.41 to –.49). However, the indirect effect of treatment via changes in positive belief scores was not statistically different from zero (95%CI = –.71 to .85). These results for GAD symptoms are similar to those for PHQ-9 symptoms, and suggest that iCBT had a positive impact on generalized anxiety symptoms through reducing positive beliefs about the value of repetitive thinking which may in turn reduce the frequency repetitive thinking throughout the program between pre- and post-treatment. Notably, within all of the mediation analyses conducted, we found no evidence of an effect of gender on post-treatment outcome (depression and generalized anxiety) after controlling for baseline symptoms severity and ratings of positive beliefs and RNT frequency.

Discussion

We assessed the impact of a transdiagnostic internet-delivered CBT program for mixed GAD and MDD on negative repetitive thinking (RNT) and positive metacognitive beliefs about RNT in a RCT comparing iCBT to a wait-list control condition. As hypothesized, we found significant reductions in RNT frequency and ratings of positive metacognitive beliefs about the value of RNT following iCBT, with large observed effect sizes. We also found evidence for further (albeit small) reductions in RNT between post-treatment and 3-month follow-up for the iCBT group. Importantly, these results show clinician-assisted transdiagnostic iCBT program effectively reduces RNT and positive metacognitive beliefs, which are two critically important maintaining factors in GAD and MDD (Nolen-Hoeksema, 2000). We are unable to conclude which specific components of the iCBT program were most effective in reducing RNT and positive beliefs because of its’ integral design (where patients received the same fixed treatment). Dismantling studies are now needed to isolate the key therapeutic ingredients so that outcomes can be improved, particularly when considering that 45–60% of patients did not show clinically reliable change on RNT and positive belief ratings at post-treatment.

We hypothesized that reductions in positive beliefs about RNT and the frequency of RNT between pre-treatment and mid-treatment would mediate the impact of treatment on therapeutic outcomes (depression and anxiety symptoms) at post-treatment. We chose to focus our examination on changes between pre- and mid-treatment, rather than changes between pre- and post-treatment to establish temporal precedence between the mediators and outcome variables of interest (post-treatment depression and anxiety scores), which is one of the criteria needed to establish causality (Hayes, 2012). Notably, all of the core skills that specifically targeted RNT were included in the first three lessons prior to mid-treatment assessment, and were thus hypothesized to contribute to the greatest change in these cognitive variables. Our results were consistent with predictions for depression symptoms, but not for generalized anxiety symptoms. That is, the results suggested that relative to those in the WLC group, participants in the iCBT group showed greater reductions in depression symptoms at post-treatment, and these improvements were influenced by greater reductions in positive beliefs observed at mid-treatment, which were associated with reductions in RNT, which in turn was associated with improved depression outcomes.

We also tested the alternative causal model (that reduced RNT frequency influenced the extent to which participants endorsed positive beliefs about the value of RNT), and found no evidence for this model. This preliminary analysis suggests that reductions in positive beliefs influenced reductions in RNT and not vice versa, although we acknowledge we cannot definitively rule out the possibility of an alternative causal pathway between the two mediating variables. Further research is needed to establish the causal relationship between belief change and reductions in RNT frequency during treatment, as well as the mechanism by which these reductions promoted improvements in depression symptoms. Reduced RNT may have had a positive impact on a range of different cognitive, affective and behavioural symptoms of depression. For example, we would expect that reduced RNT about the self, world and future would have a direct influence on improving day-to-day mood, but also may reduce the tendency to engage in maladaptive withdrawal and avoidance. In addition, it is possible that the skills targeting RNT and positive beliefs were still being consolidated after the mid-treatment time-point (and thus leading to further improvement). The average scores on our measures of RNT and positive beliefs were lower at post-treatment than mid-treatment, which is consistent with this possibility. Notably, we found the same pattern of findings when we investigated whether reductions between pre- and post-treatment in positive beliefs and RNT mediated post-treatment depression symptoms. However, the latter analysis provides a weaker test of the casual relationship between these variables because the mediator and outcome variables in were measured at the same time-point. Future RCTs of iCBT which aim to explore mediation would benefit from inclusion of additional follow-up assessments to examine the mediating role of these cognitive processes between pre- and post-treatment on follow-up outcomes.

Unexpectedly, we found a different pattern of results for generalized anxiety symptoms. Reductions in positive beliefs at mid-treatment mediated the impact of treatment on generalized anxiety symptoms, but not via reductions in RNT. This indirect effect was not observed when participants’ baseline levels of RNT and degree of positive beliefs were controlled for. It is unclear why the results differed for depression versus generalized anxiety symptoms. We chose to conduct a more stringent test of mediation by entering pre-treatment GAD-7 scores as a covariate in our analysis. Because worry frequency forms a core feature of GAD and is therefore assessed using the GAD-7, controlling for it in the mediation analysis may have obscured a potential mediating role of RNT frequency. Alternatively, it is possible that it may take longer for a shift in beliefs to lead to measurable changes in how frequently patients engage in RNT for patients with primary GAD. These effects may have been detectable at the time of the 3-month follow-up, but unfortunately we could not test this proposal as the wait-list group had commenced iCBT at this time point. In addition, we used the adapted version of the Positive Beliefs about Ruminative Scale, which has been adapted to assess positive beliefs about RNT independent of depression symptoms. It was initially designed to assess positive beliefs about rumination in depression, and may not have captured critically important positive beliefs about RNT that are tied to the maintenance of generalized anxiety symptoms, which may be better captured by other existing measures such as the Metacognitions Questionnaire which place a greater focus on worry.

Our findings provide some additional support for cognitive theories of MDD and GAD which argue for an important relationship between positive beliefs about RNT and RNT in the maintenance of depression and anxiety symptoms (e.g., Wells, 1995). We

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Within this analysis, baseline positive belief scores and baseline GAD-7 scores were significant predictors of post-treatment GAD-7 scores (ps < .05), such that higher baseline levels predicted lower GAD symptoms after treatment.
do acknowledge that our study only explored two possible mechanisms by which iCBT influenced depression and anxiety outcomes. Our study did not account for all possible mechanisms that may have mediated symptom improvement. For example, there are a large range of other cognitive, emotional and behavioural variables that may have accounted for the reductions in depression and generalized anxiety symptoms we observed in the iCBT group. For instance, behavioural activation is an important clinical target and may mediate the improvements during iCBT. In addition, it also remains untested whether iCBT effectively reduces negative metacognitive beliefs about RNT which are also theorised to maintain worry and rumination. Negative metacognitive beliefs emphasize the perceived danger and harm related to engaging in RNT (e.g., ‘this worrying is sending me crazy’). The potential role of these variables in treatment outcomes awaits empirical investigation.

Future studies are also needed to explore the degree to which the Repetitive Thinking Questionnaire, a relatively new transdiagnostic measure of RNT (McEvoy et al., 2010) captures constructive versus unconstructive forms of RNT such as concrete/experiential and abstract thinking (Watkins, 2008). Additionally, the impact of our iCBT program on symptoms of other important comorbid disorders, such as panic disorder and social anxiety disorder, requires further examination. Notwithstanding these limitations, the current study provides evidence that iCBT for mixed GAD and MDD is an effective treatment for RNT and positive metacognitive beliefs about RNT. Moreover, to our knowledge, our results provide the first evidence that reductions in positive beliefs about RNT, and for depression symptoms, reductions in RNT frequency are important mediators of the positive impact of iCBT on therapeutic outcomes.

Acknowledgements

Jill M. Newby was supported by an Australian National Health and Medical Research Council (NHMRC) Fellowship (1037787). Alishia D. Williams was supported by an Australian National Health and Medical Research Council (NHMRC) Fellowship (630746).

References


