THESIS TITLE: AN EXPLORATION OF REPETITIVE NEGATIVE THINKING, EXECUTIVE FUNCTIONS AND DEPRESSIVE SYMPTOMS

LITERATURE REVIEW: Rumination-focused Interventions for Depression and Anxiety: A Systematic Review

EMPIRICAL PAPER: Exploring the Relationships between Executive Functioning, Repetitive Negative Thinking, Stress and Depression: A Brief Longitudinal Study

Submitted by **Claire Stephens** to the University of Exeter as a thesis for the degree of **Doctor of Clinical Psychology,** May, 2017

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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Author's Declaration

The author completed the literature review independently. For the empirical work, participants were recruited at two time-points between October 2016 and January 2017, independently by the author. This study is part of a collaborative project with fellow trainee Clinical Psychologist, Erika Baker. Her project entitled '*Adolescents' Coping Methods During Exam Time'* will follow-up with participants recruited within this study to explore the effects recovery following the exam period including an additional measure of effortful control. Data will also be shared for journal submissions to compare early, middle and late adolescents completing exams in university and secondary schools in the Exeter area. As a result, the selection of questionnaires and assessments was collaborative and ethical approval was sought jointly for both parts of this project. The author completed all other components of the study including data entry, analysis and write-up independently.

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SCHOOL OF PSYCHOLOGY

DOCTORATE IN CLINICAL PSYCHOLOGY

LITERATURE REVIEW

Interventions Targeting Rumination to Improve Depressive and Anxious Symptomology: A Systematic Review

Trainee Name:	**Claire Stephens**
Primary Research Supervisors:	**Dr. Nicholas Moberly** Senior Lecturer, Research tutor for Professional Doctorates **Dr. Anna Adlam** Senior Lecturer, Deputy Director of Research for Professional Doctorates
Secondary Research Supervisor:	**Professor Edward Watkins** Professor of Experimental and Applied Clinical Psychology, Director of Research for Professional Doctorates, Mood Disorder Centre
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Abstract

Objective: Repetitive negative thinking (RNT) is a maladaptive emotion regulation process and is a transdiagnostic risk factor for the onset and maintenance of depression and anxiety. The psychological processes of depressive rumination (DR) and worry are examples of RNT (Ehring & Watkins, 2008). Interventions targeting DR have been proposed for reducing comorbid depressive and anxious symptomology. However, less is understood regarding the effectiveness of interventions that explicitly and specifically target rumination for anxiety and depression. The aim of this review is to explore whether interventions focused on reducing rumination are effective in doing so and in turn, whether such interventions are effective in improving DR and clinical symptoms of depression and/or anxiety.

Methods: Interventions focused on reducing DR as a primary treatment target were explored including randomised control trials to prevent and reduce rumination and/or non—randomised studies using pre- and post-measures of change with comparator groups. The systematic literature search yielded 216 full-text publications with 179 non-duplicated results. Screening of 24 full-text publications led to eight eligible studies synthesized in this review.

Results: Results found that a range of interventions are effective in reducing rumination with interventions varying between cognitive control training, group-based interventions utilising modified versions of cognitive behavioural therapy principles and competitive memory training. It appears that the most effective intervention may be modified rumination-focused cognitive behavioural therapy (RFCBT; Watkins et al., 2007), which has demonstrated equivocal effectiveness when delivered online versus individually. Contrastingly, cognitive control training was shown to have limited transfer effects indicating its limitations in reducing rumination and subsequent depressive symptoms.

Conclusions: While non-specific therapeutic factors may account for changes in a number of the studies, effect sizes for RFCBT are good indicating its potential effectiveness in reducing rumination and preventing future onset of DR in high risk groups. A number of limitations are discussed.

Keywords**:** *Rumination; depression; intervention; prevention*

Introduction

This review explores whether interventions targeting rumination are effective in reducing symptoms of anxiety and depression in individuals between 12 to 90 years of age, vulnerable to, diagnosed with or in remission from depression or comorbid depression and anxiety. The review builds on the work by Querstet and Cropley (2013) who broadly examined interventions to reduce rumination and worry. This review differs in that it explores interventions explicitly and specifically targeting ruminative processes to reduce clinical symptomology.

Current aetiological theories of depression increasingly incorporate depressive rumination (DR) as a mediating link between cognitive, environmental and psychological risk factors (e.g., Demeyer, De Lissnyder, Koster, & De Raedt, 2012; Kinderman, Schwannauer, Pontin, & Tai, 2013; Ruscio et al., 2015; Snyder & Hankin, 2016, Watkins, 2015). Along with worry, DR is an example of repetitive negative thinking (RNT) which refers to repetitive, passive and/or uncontrollable thinking focused on negative content (Ehring & Watkins, 2008). DR and worry are processes, which differ only in their content and orientation towards either the past or future respectively (McEvoy & Brans, 2013; Segerstrom, Tsao, Alden, & Craske, 2000). Like worry, rumination is proposed as a transdiagnostic feature across a variety of clinical presentations and is a risk factor for the onset and maintenance of depression and anxiety (Ehring & Watkins, 2008; Harvey, Watkins, Mansell, & Shafran, 2004). As part of RNT, interventions targeting worry have been widely researched within the generalized anxiety disorder (GAD) literature (e.g., Covin, Ouimet, Seeds, & Dozois, 2008; Hanrahan, Field, Jones, & Davey, 2013). This review chose to target maladaptive or DR (such as brooding or the tendency to passively focus on negative symptoms; Treynor, Gonzalez, & Nolen-Hoeksema, 2003) as a potential treatment target for depressive and/or anxious symptoms. In their review of interventions targeting RNT and worry, Querstet & Cropley (2013) found generalised interventions to reduce depressive symptoms, e.g., Cognitive Behavioural Therapy (CBT) and Mindfulness-Based Cognitive

Therapy (MBCT) to be effective in reducing symptoms of RNT. However, RNT improvements are often a by-product rather than a primary target for such interventions. Therefore, this review explored the potential effectiveness of interventions, which directly and explicitly target rumination (e.g., rumination-focused CBT) as a treatment target where the primary aim is to reduce rumination and where depressive and anxiety symptom reductions are a secondary target.

Depression and anxiety

Anxiety and depression are the leading cause of disability worldwide with a lifetime prevalence of 21.4% for mood disorders and 33.7% for anxiety disorders (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012; Whiteford et al., 2013). GAD and major depressive disorder (MDD) often co-occur with a high degree of estimated comorbidity across the lifespan, ranging from 48-72% (Axelson & Birmaher, 2001; Moffitt et al., 2007). Comorbidity is also associated with poorer treatment adherence (Haby, Donnely, Corry, & Vos, 2006), longer response times (Andreescu et al., 2007) and reduced remission with increased recurrence in later life (Pennix et al., 2011; Pine, Cohen, Gurley, Brook, & Ma, 1998).

CBT remains the most widely evaluated and utilised intervention for treating anxiety and depression (e.g., Cuijpers et al., 2014; Watts, Turnell, Kladnitski, Newby, & Andrews, 2015), backed up by national guidelines (National Institute of Care Excellence [NICE], 2009, 2011). However, causal mechanisms underlying the effectiveness of such interventions are still unclear and studies vary in their effect sizes, where lasting improvements are often limited, particularly for individuals with residual symptoms of depression (Olatunji, Cisler, & Deacon, 2010; Teismann et al., 2014). Disorder-specific treatments have recently come under scrutiny as clinicians struggle to select appropriate interventions for individuals presenting with co-morbid difficulties (Clark & Taylor, 2009; DeRubeis et al., 1990; McHugh, Murray, & Barlow, 2009).

Rumination as a potential target for clinical change

Transdiagnostic interventions have the potential to target underlying mechanisms and symptoms across multiple disorders (Barlow, Allen, & Choate, 2004; McEvoy, Nathan & Norton, 2009) and may address limitations imposed by disorder-specific treatments (e.g., Brown, DiNardo, Lehman, & Campbell, 2001; Mansell, Harvey, Watkins, & Shafran, 2008). Meta-analysis of 47 studies found large overall effect sizes for transdiagnostic approaches improving symptoms of anxiety and depression (*gs* = .85 and .91 respectively; Newby, McKinnon, Kuyken, Gilbody, & Dalgleish, 2015) with interventions loosely based on CBT principles (e.g., cognitive restructuring, graded exposure, behavioural experiments; Johnston, Titov, Andrews, Spence, & Dear, 2011; McEvoy & Nathan, 2007).

Rumination is proposed as a transdiagnostic risk factor, symptom and mechanism for change in depressive and anxious symptomology following treatment (e.g., Grierson, Hickie, Naismith, & Scott, 2016; Spinhoven, Penninx, Krempeniou, Van Hemert, & Elzinga, 2015; Verstraeten, Bijttebier, Vasey, & Raes, 2011; Watkins, 2009). Evidence suggests that rumination may mediate the effect of treatment on depressive and anxious symptoms (e.g., Donegan & Dugas, 2012; Kertz, Koran, Stevens, & Björgvinsson, 2015; Van Aalderen et al., 2012). Increased levels of rumination have also been associated with diagnostic comorbidity of mood and anxiety disorders within clinical groups (Olatunji, Naragon-Gainey, & Wolitzky-Taylor, 2013). DR has also been found to contribute to inferior treatment gains, reduced early remission and increased likelihood of relapse following traditional CBT and MBCT in individuals with MDD, dysthymic disorder and comorbid GAD and MDD (Kocsis et al., 2009). As a result, interventions explicitly targeting rumination may improve outcomes for those who may have previously attempted traditional treatment models without meaningful change, those seeking additional improvements following poor treatment outcomes and/or those at risk of psychopathological distress due to high levels of DR (Mennin & Fresco, 2013).

Theories linking rumination to depressive and anxious symptoms propose that rumination results in an initial internal focus on verbal thoughts, leading to the suppression of dysphoric emotions and is therefore negatively reinforced over time (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Watkins, Moulds, & Mackintosh, 2005). Rumination is also characterized by abstract styles of information processing, hypothesised to result in impaired problem-solving and inhibition of emotional processing (Ehring & Watkins, 2008; Watkins & Moulds, 2007).

Semi-structured interviews with individuals diagnosed with depression indicated that all those interviewed held positive beliefs regarding the helpfulness of rumination as a potential coping strategy (e.g., 'I must ruminate to find solutions to my depression') as well as negative beliefs regarding the uncontrollable nature and potential harm of rumination (e.g., 'ruminating is uncontrollable'; Papageorgiou & Wells, 2001). Wells and Matthews (1994) suggested that individuals' beliefs regarding their tendencies to ruminate form feedback loops or vicious cycles. These cycles may become perpetuated as positive beliefs motivate individuals to engage in sustained rumination, triggering negative beliefs regarding the uncontrollable and harmful nature of rumination and in turn increasing depressive symptoms, leading to further rumination as an attempted coping strategy. Over time, such strategies may become maladaptive, increasing suffering and distress (Nolen-Hoeksema, Stice, Wade, & Bohon, 2007; Papageorgiou & Wells, 2003). Nolen-Hoeksema's response style theory of depression (2004) posits that individual differences in coping with sadness may explain differences in vulnerability to depressed mood where ruminative styles contribute to onset, severity and persistence of depressive symptoms. Watkins (2009) suggested that rumination might also have trait-like characteristics that increase the likelihood of future depressive symptoms, implicating the need for rumination-focused interventions.

Current review

The recent paradigm shift within the literature, moving away from disorder-specific treatments, suggests that rumination is likely to be a legitimate treatment target to reduce symptoms associated with a range of emotional disorders (McEvoy, Watson, Watkins, & Nathan, 2013). Less is understood regarding the effectiveness of rumination-focused interventions for anxiety and depression (Topper, Emmelkamp, & Ehring, 2010; Watkins, 2015). In their review, Querstret and Cropley (2013) reviewed treatments to reduce rumination and/or worry. However, this review was broad, reviewing any study reporting reductions in symptoms of rumination and worry, rather than rumination-specific interventions. This review aims to provide an updated account of the potential effectiveness of interventions explicitly and specifically targeting ruminative processes to improve depressive and/or anxious symptomology. This review is relevant given the current emphasis within the literature on identifying underlying mechanisms of psychopathology, particularly depression and anxiety as a means to inform interventions applicable across diagnoses and to populations who may have comorbid diagnoses. Should transdiagnostic interventions demonstrate positive outcomes for participants there is the potential that they might be also be applied to preventative programmes, emphasised within the United Kingdom's (UK) national strategies and government initiatives, such as the Five Year Forward View for mental health (National Health Service [NHS] England, 2015).

As a result, the current systematic review aims to answer the question: *"Are interventions that explicitly and specifically focus on rumination effective in reducing depressive rumination, depressive and/or anxious symptoms in populations at risk of developing mental health difficulties or who meet criteria for formal diagnosis or current diagnosis of depression and/or anxiety?"*

Methods

Systematic reviews are essential to summarise the evidence relating to the safety and efficacy of health care interventions and should include explicit, pre-defined questions using a systematic and transparent approach to identify,

select and critically evaluate relevant literature (Akers, Aguiar- Ibáñez, & Baba-Akbari Sari, 2009; Liberati et al., 2009). As a result, this review followed the Preferred Reporting Items for Systematic Review and Meta-analysis Protocol (PRISMA-P) to guide identification, screening, eligibility and synthesis of studies (Moher, Liberati, Tetzlaff, Altman, & the PRISMA Group, 2009; Moher et al., 2015).

Eligibility criteria

Selection for inclusion and exclusion in this review was based on PICO (Population, Intervention, Comparator, Outcome) criteria, with the addition of a criterion based on study design (see Table 1). Participants included were individuals aged 12-90 years who were either: vulnerable to developing depressive and/or anxious symptoms, met criteria for diagnosis according to formal classification systems or were in remission from depression and/or anxiety. Children under 12 years and adults over 90 years were excluded in order to limit the sample to those classified as adolescents, adults and/or older adults. Adults over 90 years were excluded as research indicates that approximately 50% of individuals over the age of 90 will demonstrate either mild or moderate cognitive impairment, that just under 40% will have a diagnosis of dementia and a greater percentage will have some form of functional disabilities (Corrada, Berlau, & Kawas, 2012; Christensen et al., 2013; Corrada, Brookmeyer, Paganini-Hill, Berlau, & Kawas, 2010). As a result, the high-risk of cognitive and physical frailty within this age group may confound results for intervention studies, particularly those utilising cognitive measures as a method for change and/or an indicator of effectiveness. Due to resources limitations, studies written up in a language that was not English and where a translation was not available were also excluded.

Table 1

Systematic Literature Review Eligibility Criteria for Inclusion and Exclusion

Inclusion	Exclusion
Population • Humans between 12-90 years AND • Individuals identified as vulnerable or 'at risk' of developing depressogenic and/or anxious symptoms and/or formal diagnosis of depression and/or anxiety using elevated symptoms of RNT (>75th percentile on some standardised measure of RNT) or other legitimate methods OR • Individuals who meet or have previously met criteria for diagnosis of depression and/or anxiety under formal diagnostic classification criteria where individuals in remission must have had at least one previous clinical episode of depression and/or anxiety determined by either the SCID or DSM-IV	**Population** • Previous or current known mental health diagnoses aside from depression and/or anxiety • Individuals with learning disabilities
Intervention • Preventative strategies aimed at reducing rumination/RNT AND/OR • Interventions which explicitly and specifically target rumination and/or RNT to improve symptoms of anxiety and depression	**Intervention** • Interventions that aim to improve depression and/or as a primary treatment target, where rumination and/or RNT may be recorded but not identified as explicitly targeted by the intervention
Comparator • Control groups receiving no intervention, waiting list control (WLC) and/or treatment as usual (TAU)	**Comparator** • Correlational studies which do not include pre- post- measures of rumination and/or depressive symptoms
Outcome • Rumination scores AND • Depression and/or anxiety symptom scores or diagnoses	**Outcome** • Neuroimaging data only (e.g., MRI, EEG, PET)
Design • Randomised controlled trials • Controlled trials • Experiments and non-randomised studies (quasi-experiments) with controlled groups	**Design** • Prospective and retrospective studies without intervention • Qualitative studies • Case series, case studies with no comparison group included • Studies without control groups

Note: DSM-IV = Diagnostic and Statistical Manual -4th Edition; EEG = Electroencephalogram; MRI = Magnetic Resonance Imaging; PET = Positron Emission Tomography RNT = Repetitive Negative Thinking; SCID = Structured Clinical Interview for DSM; TAU = Treatment As Usual; WLC = Waiting List Control.

Interventions must be focused on developing skills to manage, cope with and reduce depressive rumination as a primary treatment target. Study designs eligible included (1) randomised-control trials (RCTs) of interventions targeting rumination for the prevention and reduction of depressive and/or anxious symptoms (2) non-randomised studies utilising pre- and post- measures of change following interventions, utilising some form of comparator group. Studies must be reported in the English language and must include primary outcome measures of change in rumination scores from pre- to post-treatment as well as measures of depressive symptoms. Studies where rumination was not a primary treatment target for interventions were excluded.

For this review, rumination was operationalized as the maladaptive process of unconstructive repetitive thoughts focused on the fact one is depressed and/or anxious, depressive/anxious symptoms (e.g., '*I feel so low/anxious*'), causes, meanings and consequence of depressive symptoms (e.g., 'Why can't I get better'; Nolen-Hoeksema, 1991, 2000). A tendency to ruminate is stable over time and indexed by perseveration and associated negative affect (Nolen-Hoeksema, Morrow, & Fredrickson, 1993). The most common measure of rumination is the Ruminative Response Scale of the Response Style Questionnaire (RRS; Nolen-Hoeksema & Morrow, 1991) although a number of measures exist.

Depression and anxiety were operationalized according to the Diagnostic and Statistical Manual-4th Edition (DSM-IV; American Psychiatric Association, 1994). Participants with sub-threshold depressive symptoms were also included who may not meet criteria for MDD but have elevated symptoms above population norms measured through scales such as the Beck Depression Inventory-Second Edition (BDI-II; Beck, Steer, & Brown, 1996) and Patient Health Questionnaire-Ninth Edition, depression scale (PHQ-9; Kroenke & Spitzer, 2002).

Formal diagnosis of GAD requires that patients display two major symptoms and three additional symptoms (from six) present for at least six

months, impairing daily functioning. Common measures of anxiety include the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) and Generalized Anxiety Disorder-Seven (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006).

Vulnerable populations or groups at higher risk of developing anxiety or depression were operationalized as those who displayed elevated scores on screening measures of anxiety, depression and/or rumination, where participant scores above cut-off were used to identify those who may be classified as vulnerable to developing future depressive or anxious symptoms (where cut-off usually relates to scores above the 75th percentile on one or more screening measure). Populations may also be identified through common risk factors for depression, for example, family factors such as maternal depression, low socioeconomic status (e.g., Beardslee et al., 1997) and individuals in remission from previous depressive episodes (e.g., residual depressive symptoms; Tranter, O' Donovan, Chandarana, & Kennedy, 2002).

Information sources

The following electronic databases were searched to locate relevant studies published in the last 10 years (between 2007 and 13th March 2017): Embase, Ovid Medline(r) In-Process & Other Non-Indexed Citation, Ovid Medline(r), PubMed, PsycARTICLES, PsycINFO, Social Policy and Practice and Web of Science. Supplementary searches were conducted using the Open Thesis and Electronic Thesis Online System (EThOS) and the reference lists of selected articles, seminal publications (e.g., Newby et al., 2015) and review papers (Watkins, 2015) were also inspected to identify further relevant studies and additional search terms.

Search strategy

Keywords and search string characters were altered to suit each database's use of Boolean operators and truncation (see Table 2). Once

duplicates were removed, abstracts were screened and full-text articles were retrieved to assess eligibility (see Figure 1).

Table 2

Search Terms for Ovid Database

Individual Search Terms (in title or abstract)	
Population Section 1 Depression and/or Anxiety	Psychopathol* OR depress* OR dysphoria OR anxi*, psychpathol*,
Intervention Rumination Section 2 Rumination	Rumination OR ruminat* AND thought(s) OR thinking OR perseverative AND thought(s) OR thinking, depress* AND ruminat* OR repetitive AND Negative AND think* OR thought(s) OR worry* OR worrie*
Outcome Section 3 Rumination and Depression or anxiety	Ruminat* OR repetitive AND Negative AND think* OR psychopathol* OR depress* OR dysphoria OR anxi*
Search	Search 1 AND Search 2 AND Search 3

Study selection

After duplicates were removed, study titles and abstracts generated from the initial search were screened against the PICO criteria including the study design criterion (see Table 1; Higgins & Green, 2011). As recommended by the Centre for Reviews and Dissemination guidance (Akers et al., 2009), the full texts of studies meeting the eligibility criteria following the screening stage were checked individually by the researcher and reasons why any studies that did not meet criteria at the full text screening were noted. An independent reviewer confirmed eligibility of full-text records (100% inter-rater reliability).

Quality Evaluation

Full text versions of potentially relevant articles were obtained to assess the methodological quality of the studies further using criteria outlined within the Quality Assessment Tool (QAT) for Quantitative Studies from the Effective Public Health Project (Armijo-Olivo, Stiles, Hagen, Biondo, & Cummings, 2012; Appendix A & B). This tool was selected for its widespread use within the healthcare literature and its ability to evaluate and compare quantitative intervention studies, which may or may not include RCTs. Such tools are important as compiling studies of insufficient quality can result in biased estimation of concluded effects (Akers et al., 2009). Evaluation is based on criteria covering selection, design, confounds, blinding, data collection methods and study attrition. Points-based ratings were assigned for each criterion, where an overall rating of 'STRONG' represents no weak ratings, 'MODERATE' represents one weak rating and 'WEAK' represents two or more weak ratings. Studies were not excluded based on the basis of quality but judgments were used to weigh up the evidential quality provided by the studies within the synthesis. PICO criteria and study results on the key variables (intervention, rumination, depression, anxiety) and their interrelationship were extracted as reported in the results section. All data were crosschecked with original publications to ensure accuracy of the data following extraction and ensuring extracted data addressed the researcher question. An independent researcher rated four studies of records for reliability of quality criteria and no disagreement on component or global ratings were found (100% inter-rater reliability).

Results

Two hundred and sixteen citations were derived from the initial search terms across databases and online searches (Figure 1). After removal of duplicates, 24 full text articles were assessed for eligibility based on specified inclusion and exclusion criteria (Table 1). Exclusion criteria and full reference list for the 16 studies excluded are outlined in Appendix C, and details of the eight studies included for review are outlined in Table 3.

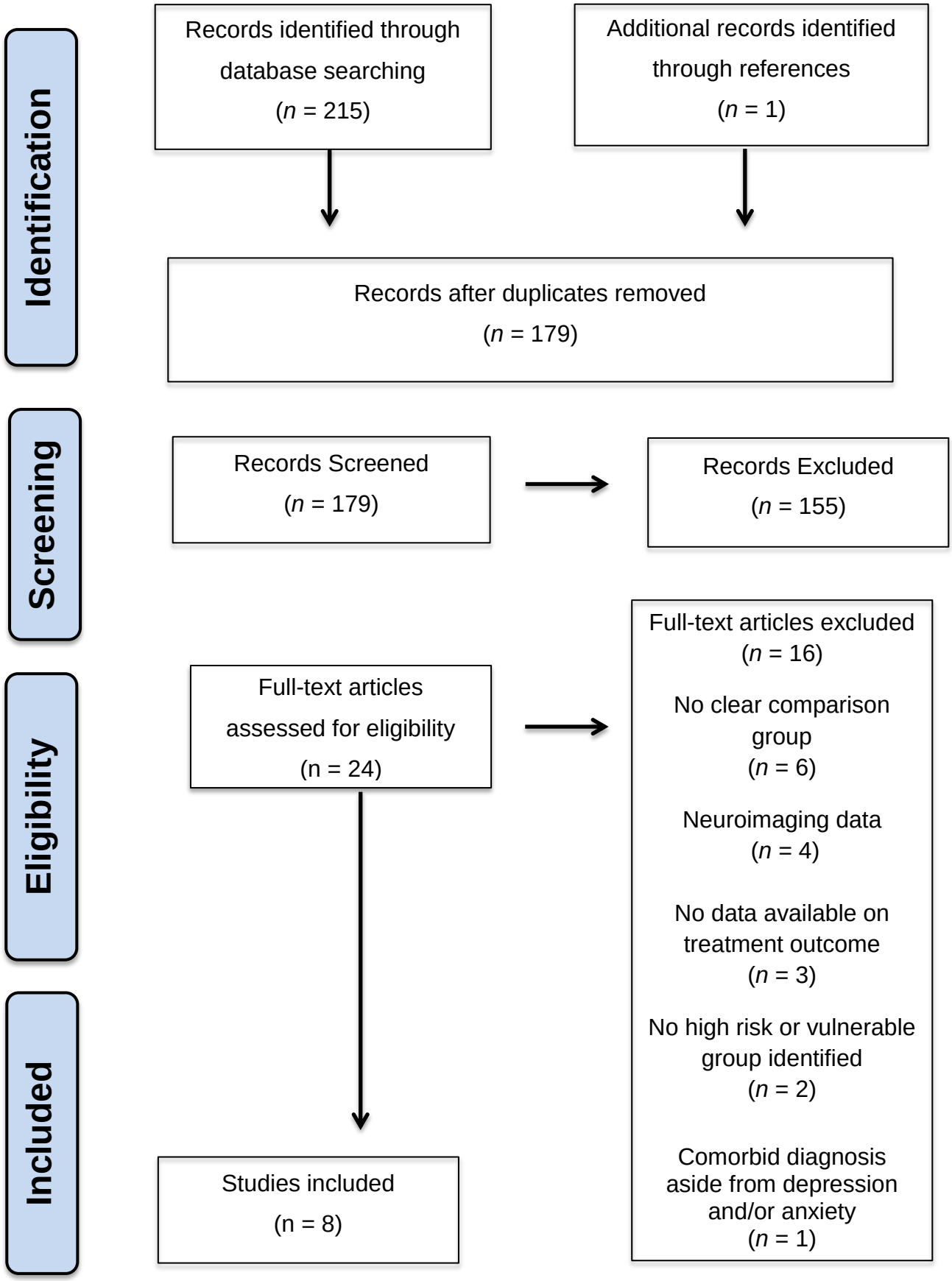

Figure 1. Flow diagram of article selection through different stages

Table 3

Summary of Eligible Studies in Alphabetic Order by Author

Author	Population	Intervention	Comparator	Outcome 1)Rumination /RNT 2)Depressive /anxious symptoms	Results and conclusion	Evaluation	QAT
1. Ekkers et al. (2011): Competitive Memory Training for treating depression and rumination in depressed older adults: A randomized controlled trial	93 elderly individuals diagnosed with depression according to DSM-IV criteria, scoring 11 or more on the GDS, suffering from self-reported rumination	Seven weekly group-based, manualised sessions, 90 minutes each following COMET protocol (Korrelboom, Visser, & Ten Broeke, 2004). Involves six steps targeting underlying cognitive processes by activation of emotional network, being indifferent and adopting an attitude of acceptance to become more emotionally salient.	40 individuals assigned to TAU condition (M_{age} = 73.9 years, *SD* = 5.7, no. of males = 6) 53 individuals assigned to COMET + TAU condition (M_{age} = 71.8 years, *SD* = 5.8, no. of males = 15)	1) RRS, RSS 2) QIDS-SR, GDS	1) Significant improvement in depressive symptomology (*d* = .57) and reduction in rumination (*d* = .39) following COMET intervention. 2) Effects for TAU + COMET significantly different to TAU although large dropout rate in TAU group (50%). **Key findings:** Of the 48 individuals who completed TAU + COMET, 44% made a reliable change for the better on QIDS-SR, 25% made a clinically significant change (reaching normal population range) and 6% made reliable change for the worse. 31% showed decrease in rumination, 27% made clinically significant improvements. One patient accomplished clinically significant change on rumination in TAU group no changes in depression observed in TAU group. **Conclusion:** Those assigned to TAU + COMET demonstrated less depression and rumination post-intervention compared with TAU.	**Strengths:** Randomization procedures. Analysis procedures detailed and thorough. **Limitations:** Large drop-out rate within TAU group (50%) making comparison difficult. Recruitment through mental health teams-selection bias, professional contacts as non-specific factor. Lack of blinding to treatment group from participant and therapist. No FU.	A = strong B = moderate C = strong D = weak E = strong F = moderate **Global: MODERATE**
2. Hoorelbeke et al. (2015): The influence of cognitive control training on stress reactivity and rumination	53 undergraduates screened for heightened trait rumination (above percentile 70) > 43 RRS.	10 sessions of CCT involving a modified version of the PASAT (Siegle, Ghinassi, & Thase, 2007) auditory digits presented and asked to continuously respond to sum of last two digits). 400 trials completed at each session or 20mins.of training per session.	22 individuals randomly assigned to 10 session active control training (VST; M_{age} = 20.5 years, *SD* = 2.0, no. of males = 4) 25 individuals assigned to CCT condition (M_{age} = 20.8 years, *SD* = 2.3, no. of males = 0)	1) RRS 2) BDI-II, MASQ-30	1) Increases in WM functioning in CCT group was significant predictor of post-training brooding and resilience. 2) Stress induction led to an increased amount of negative thoughts in both groups. 3) Following natural stressor (exams) brooding remained stable in VST group while CCT group it decreased significantly ($p < .01$). **Key findings:** Transfer effects for CCT targeting WM were not found. Those	**Strengths:** Active control. Use of natural stressor. **Limitations:** Limited sample size at follow-up, no reporting of power to detect effects. Lack of causal relationships between rumination and CCT. WM measure used as	A = moderate B = moderate C = weak D = weak E = moderate F = weak **Global: WEAK**

		Time 1: questionnaires + 10 session CCT or VST training over 14 day period Time 2 (14-days after Time 1): questionnaires + assessment of CC + stress induction procedure Time 3 (four weeks after Time 2): exam period as naturalistic stressor + questionnaires.			who demonstrated higher increases in WM reported less ruminative brooding following training, controlling for baseline levels in contrast with active control group. Increases in WM functioning may predict adaptive responses to stressful situations. **Conclusion:** The transfer effects for cognitive control training are minimal. Cognitive control effects may therefore be more evident under stressful conditions because those who demonstrated improvements in WM performance following training report higher levels of resilience and less ruminative brooding under stressful lab-based conditions, controlling for baseline levels and in comparison with active controls.	indicator of CCT, conceptual limitation. No measure of stress reactivity at Time 1.	
3. Newby, Williams, Andrews (2014): Reductions in negative repetitive thinking and metacognitive beliefs during transdiagnostic internet cognitive behavioural therapy (iCBT) for mixed anxiety and depression	109 individuals suffering with GAD, MDD or mixed anxiety and depression M_{age} = 44years, *SD* = 12.2, no. of males = 25). Participants with GAD-7 and PHQ-9 scores above clinical threshold were interviewed by telephone to check criteria met according to DSM-IV and/or the MINI.	Clinician-assisted iCBT program delivered through www.virtualclinic.org.au, six illustrated online lessons (including homework exercises) completed over 10 weeks. Components designed to target RNT including: psychoeducation, self-monitoring, identification, cognitive restricting of positive/negative beliefs about RNT, BA, problem-solving, attention shift, worry time, imaginal exposures.	60 individuals randomised to WLC (no group specific means available as matched according to demographics, outcome measures and diagnostic status). WLC commenced iCBT post-treatment assessments, therefore no FU data available. 49 individuals randomised to iCBT (no group specific means available as matched according to demographics, outcome measures and diagnostic status)	1) RTQ, PBRS-A 2) PHQ-9, GAD-7	1) Post-treatment scores significantly lower for all measures compared with WLC with moderate to large effect sizes (*d* = .78-1.00). 2) 55% of iCBT group met reliable change on RTQ and 35% on PBRS-A compared with 7% for both in the WLC group. 3) Reductions maintained for GAD (ES = .26) and RTQ (*d* = .48) at 3-month FU. PHQ-9 and PBRS-A scores did not indicate main effect of Time. **Key findings:** significant reductions in RNT frequency and positive ratings of metacognitive beliefs about value of RNT in iCBT group compared with WLC. Participants in the iCBT group showed greater reduction in depression, influence by greater reductions in positive beliefs observed mid-treatment, associated with reductions in RNT, associated with improved depression outcomes. **Conclusion:** iCBT for mixed GAD and MDD effective treatment for RNT and positive metacognitive beliefs about RNT. Reductions in RNT and	**Strengths:** Measures selected, regular assessment, three month FU data for all measures, analysis procedures. **Limitations:** Mechanisms for changes in iCBT group not known. Lack of change in PBRS-A and GAD at three months FU with 45-60% not showing clinically reliable change on RNT at post-treatment.	A = moderate B = moderate C = moderate D = weak E = strong F = strong **Global: MODERATE**

					depressive symptoms important mediators of positive impact of iCBT on therapeutic outcomes.		
4. Onraedt & Koster (2014): Training working memory to reduce rumination	72 undergraduates screened for an RRS score > 46 to ensure population had high tendency to ruminate.	Six day dual n-back (WM) training. Installed to be completed at home. Visual and auditory information presented sequentially. Blue square appears randomly in location within 3X3 grid (eight possible locations). Simultaneously hear spoken letter. Participants compare the current square position and letter with the square position and letter presented two steps before and must respond to whether matching positions (press 'Q') or sounds (press 'L'). Complete 20blocks X 20 trials each day.	21 randomly allocated to active control group (single one-back; M_{age} = 20.9years, *SD* = 3.2, no. of males = 7) 26 randomly allocated to no training group (M_{age} = 19.9years, *SD* = 2.0, no. of males = 0) 21 individuals randomly allocated to six-day dual n-back (WM) training (M_{age} = 20.2years, *SD* = 2.0, no. of males = 2).	1) RRS 2) BDI-II	1) Performance on dual n-back improved significantly across six days (*d* = 1.10). 2) No correlation between n-back increase and difference scores on RRS but marginally significant correlation between dual n-back improvement and BDI-II difference scores 3) No change in RRS or BDI-II scores across time or condition **Key findings:** WM gains following dual n-back training did not transfer to clinical outcomes of rumination and depression. No evidence for causal role of WM in cognitive bias modification approach to reduce rumination and depressive symptomology. **Conclusion:** Meaningful transfer effects from WM tasks to clinical outcomes hard to attain in training confined to six-day period.	**Strengths:** Random allocation of participants to active control groups, no training and training conditions. Sample adequately powered to detect effects. **Limitations:** Six day WM training short period compared with other studies. Confounding factors, e.g. group demographics, life events unaccounted for. University students may provide lack of variability in terms of cognitive performance.	A = strong B = moderate C = weak D = weak E = strong F = strong **Global: MODERATE**
5. Teismann et al. (2014): A randomized controlled trial on the effectiveness of a rumination-focused group treatment for residual depression	Individuals meeting criteria for major depressive disorder (DSM-IV), recurrent partial remission, an initial score >9 on the BDI-II.	10, 90-minute group-based sessions (five groups ranging in no. of participants 1-10). CBT-DR combines metacognitive therapy techniques with BA (Martell, Dimidjian, & Herman-Dunn, 2010) and RFCBT (Watkins et al., 2007)	29 individuals waiting-list receiving no treatment for at least three months (M_{age} = 46.62 years, *SD* = 12.5, no. of males = 8) 31 individuals receiving CBT group treatment for depressive rumination (CBT-DR; Teismann, Hanning, Von Brachel, & Willutzki, 2012; M_{age} = 47.6 years, *SD* = 11.3, no. of males = 9)	1) PTQ, RSQ-B, PBRS 2) BDI-II	Compared with WLC, CBT-DR group demonstrated 1) significantly lower rumination post-intervention (PTQ: *d* = 1.06; RSQ-B: *d* = .40), maintained at 1year FU. 2) significantly fewer depressive symptoms post-intervention (*d* = 1.25) maintained at FU. **Key Findings:** CBT-DR effective treatment for patients suffering from residual depression compared with WLC. Rates of remission (42%). 25% of patients suffered relapse in year post-treatment. **Conclusion:** CBT-DR focused on rumination may be effective in improving depressive symptoms and	**Strengths:** Integrated treatment based with strong theoretical underpinnings. One year FU period **Limitations:** Self-selecting sample. Analysis failed to control/co-vary for symptoms at baseline (variation in depression/rumination unaccounted). No active control.	A = moderate B = strong C = strong D = weak E = strong F = moderate **Global: MODERATE**

					rumination compared with WLC.		
6.Topper et al. (2017): Prevention of anxiety disorders and depression by targeting excessive worry and rumination in adolescents and young adults: A randomized controlled trial	251 individuals screened for worry (PSWQ) and rumination (RRS). Only included is scored above 75th percentile on one/other measure and 66th percentile on other.	Six-week preventative intervention (1.5hours each) based on modified version of RFCBT protocol using psychoeducation, functional analysis, identifying warning signs, If-Then plans, experiential exercises, behavioural activation, behavioural experiments.	85 adolescents on WLC (M_{age} = 17.7 years, *SD* = 2.2, no. of males = 14) 82 adolescents receiving group-based intervention (M_{age} = 17.3 years, *SD* = 2.0, no. of males = 14) 84 adolescents receiving internet-based intervention (M_{age} = 17.4 years, *SD* = 2.2, no. of males = 13)	1) RRS, PTQ, PSWQ 2) BDI-II, MASQ-30, PHQ, GADQ-IV.	Both versions of the intervention (group/internet) demonstrated 1) reduction of rumination maintained over a 12m FU period (medium to large effects; *d* = .97**; .77**) compared to WLC (*d* = .19) which found no effects in reduction of RNT 2) reduction in depressive (*d* = .43**, .44**), anxious (*d* = .41**, .30*) symptoms maintained over 12m FU **Key Findings:** Reduction in RNT, depression and anxiety symptoms following intervention compared with WLC. Lower prevalence of depression at 12-month FU where the change to RNT from pre- to post-intervention mediated the relationship between condition and prevalence rates of MDD and GAD at 12-month FU where RNT explained 38.9% and 45% of the effect on the prevalence of MDD and GAD respectively. **Conclusion:** By targeting RNT as risk factor for psychopathology, prevalence of depression and GAD can be reduced by 12-month FU in 'at risk' groups. Reductions in worry and rumination mediate the effects of both group and internet-based interventions on the prevalence of MDD and GAD	**Strength:** Transdiagnostic measures assessed and evaluated across time (three-month and 12-month FU) compared with WLC. First RCT examining prevalence data in 'at risk' population of adolescents. **Limitation:** no history assessed of previous MH difficulties, no active control group. Unclear whether aggregate measure of RNT used or individual measures used in mediation analysis.	A = strong B = strong C = moderate D = moderate E = strong F = strong **Global: STRONG**
7. Watkins et al. (2011): Rumination-focused CBT for residual depression: phase II randomised controlled trial	42 individuals meeting criteria medication-refractory residual depression, meeting DSM-IV criteria within past 18 months but not past two months, reaching at least eight on the HRSD and nine on the BDI-II	12 weekly RFCBT individual, manualised sessions. Designed to coach individuals to shift from unconstructive to constructive rumination using functional analysis, experimental/imagery exercises and BEs,	21 individuals receiving TAU (anti-depressant medication and outpatient clinical management; M_{age} = 45.2 years, *SD* = 9.4, no. of males = 11) 21 individuals receiving TAU + individual RFCBT (M_{age} = 43.1	1) RRS 2) HRSD, BDI-III	After co-varying for baseline levels and compared with TAU, the RFCBT group reported 1) significantly lower rumination post-intervention (*d* = .65) 2) significantly fewer depressive symptoms post-intervention *(d* = .94, 1.11) **Key Findings:** RFCBT effective in improving depressive symptoms and	**Strengths:** active control group. Addition of RFCBT to TAU in treatment group. **Limitations:** small sample size within each group (*n* = 21), no follow-up, no standard CBT	A = moderate B = strong C = moderate D = moderate E = strong F = strong **Global: STRONG**

		with BA explicitly focused on rumination (Watkins, 2008; Watkins & Moulds, 2007).	years, *SD* = 11.1, no. of males = 7)		reducing rumination more than TAU. Rumination indicated as a significant mediator of the effect of treatment condition on depressive symptoms. **Conclusion:** RFCBT may offer added benefit in treatment of medication-refractory residual depression, reducing acute symptoms and depressive rumination, potentially mediating the effects of RFCBT on changes in depressive symptoms.	comparison group. Mechanisms of change not identified.	
8. Watkins et al. (2012): Guided self-help concreteness training as an intervention for major depression in primary care: A Phase II randomized controlled trial	121 individuals randomised across conditions, meeting criteria for current episode MDD according to SCID for DSM-IV or sub-threshold MDD.	CNT and RT consisted of: 1.5 hour individual session, practicing training exercises recorded and supposed by workbook recommend between 15-30 mins., daily for six weeks, up to 30 minutes telephone sessions, one week after initial training and at two week intervals. CNT involved identifying mild to medium upsetting scenarios and working through them using standardised steps to facilitate concrete thinking. RT training involved progressive muscle relaxation skills.	42 individuals randomly allocated to TAU (M_{age} = 46.4years, *SD* = 12.3, no. of males = 19) provided by their GP, including watchful waiting, regular appointments, on-going antidepressant medication and clinical management. 40 individuals allocated to TAU + concreteness training (CNT; M_{age} = 46.4 years, *SD* = 12.7, no. of males = 14). 39 individuals allocated to TAU + relaxation training (RT; M_{age} = 46.1 years, *SD* = 11.6, no. of males = 10)	1) RRS 2) HRSD, BDI-II, PHQ-9, GAD-7	1) TAU + CNT resulted in significantly greater reduction in rumination than TAU, greater than TAU +RT. 2) There was a significant main effect of condition for depression and across all three FU periods (post-treatment, three months, six months) compared to TAU. **Key findings:** CNT had added benefit compared with TAU in reducing depressive and rumination symptoms and findings were stable and durable over time although no differences were found between CNT and RT, which likely demonstrate similar efficacy. **Conclusion:** CNT and RT potentially effective in reducing depressive and rumination symptoms	**Strengths:** Comparison of interventions within study. Blinded allocation and randomisation with FU periods. **Limitations:** Reduced power to detect differences between CNT and RT arms. Mechanisms hypothesised but lack power to draw causal links.	A = strong B = strong C = strong D = strong E = strong F = strong **Global: STRONG**

Note. BA = behavioural activation; BDI-II = Beck Depression Inventory 2nd Edition; BEs = behavioural experiments; CBT-DR = cognitive behavioural therapy for depressive rumination; CC = cognitive Control; CCT = cognitive control training; CNT = concreteness training; COMET = Competitive Memory Training; *d* = Cohen's *d* effect size; DSM-IV = Diagnostic and Statistical Manual-4th Edition; ES = effect size; FU = follow-up; GAD = generalized anxiety disorder; GAD-7 = Generalized Anxiety Disorder 7-item scale; GADQ-IV = Generalized Anxiety Disorder Questionnaire-4th edition; GDS = Geriatric Depression Scale; HRSD = Hamilton Rating Scale for Depression; iCBT = internet cognitive behavioural therapy; WLC = waiting list control; *M* = mean; M_{age} = mean age; MASQ-30 = Mood and Anxiety Symptom Questionnaire; MBCT = mindfulness-based cognitive therapy; MDD = major depressive disorder; MINI = Mini International Neuropsychiatric Interview; PASAT = Paced Auditory Serial Addition Test; PBRS = Positive Beliefs about Rumination Scale; PBRS-A = Positive Beliefs about Rumination Scale-Adapted Version; PHQ-9 = Patient Health Questionnaire-Nine; PSWQ = Penn State Worry Questionnaire; PTQ = Perseverative Thinking Questionnaire; QIDS-SR = Quick Inventory of Depressive Symptomology-Self-Report; RFCBT = rumination-focused cognitive behavioural therapy; RNT = repetitive negative thinking; RRS = Ruminative Response Scale; RSQ-B = Brooding Scale of the Response Styles Questionnaire; RSS = Rumination on Sadness Scale; RT = relaxation training; RTQ = Repetitive Thinking Questionnaire; SCI = Structured Clinical Interview; *SD* = standard deviation; TAU = treatment as usual; VST = visual search training; WLC = waiting list control; WM = working memory; WRR = Weekly Rumination Rating.

Discussion

Intervention types

All of the interventions utilised within the studies varied considerably in relation to their content, length and method of delivery.

Cognitive control training. Three studies utilised cognitive control training (CCT) protocols aiming to directly target cognitive processes as a means to increase cognitive control, reduce negative attentional bias and the propensity for rumination in response to stressful events, in turn reducing associated depressive symptoms (De Raedt & Koster, 2010). In study (2), Hoorelbeke and colleagues (2015) utilised a protocol requiring participants to repeatedly add sums of numbers under time pressure, aiming to increase cognitive control as multiple answers are presented consecutively. Four hundred trials were completed daily over a 14-day period. Onraedt and Koster (2014) in study (4) had participants complete dual *n*-back training protocol made of up 200 trials performed daily over a six-day period. Watkins and colleagues (8) utilised a modified cognitive bias modification (CBM) training protocol or concreteness training (CNT) completed daily over a six-week period that was supported by 30 minutes of telephone contact from the researchers and designed to reduce ruminative and over-generalisation using real-life scenarios.

Of the interventions focused on improving cognitive control, neither study (2) nor (4) found any transfer effects of cognitive training to other measures of working memory (WM) performance, measured using the Automated-O-Span task (Turner & Engle, 1989) and Running-Memory Span Task (Broadway & Engle, 2010) respectively. Furthermore, justification for utilising tasks of WM in isolation to reduce rumination and associated depressive symptoms is questionable given that previous research cites that alternative cognitive functions such as inhibitory control (IC) and switching may demonstrate stronger links with a propensity to ruminate than WM (see Joormann & D'Avanzato, 2010 for review). Although study (8) found that depressive

symptoms and rumination were significantly reduced in depressed patients following CNT training compared with patients randomised to treatment as usual (TAU), no differences were found between the experimental group (CNT + TAU) and the active control group (relaxation training + TAU) indicating a difficulty in deciphering the underlying mechanism that may lead to reductions in symptoms as these mechanisms may or may not have been common across both therapeutic modalities utilised by the study.

Modified cognitive behavioural therapy. With one exception, the remaining studies utilised intervention protocols based on modified principles of cognitive behavioural therapy (CBT). Unlike CBT, rumination-focused interventions do not focus on the content of thoughts but rather the process of thinking, shifting participants away from unconstructive forms of rumination (characterised by abstract and evaluative styles of processing) towards constructive forms of rumination (concrete and contextualised processing styles; Watkins, 2008). Both study (3) and (5) utilised modified rumination-focused CBT (RFCBT) protocols, based on the work of Watkins and colleagues (2008, 2016). Study (5) utilised a version of RFCBT entitled ‘cognitive behaviour group program for depressive rumination’ (CBT-DR, Teismann et al., 2012). This approach combined principles and concepts from RFCBT with strategies and techniques borrowed from metacognitive therapy (Wells, 2009). Study (3) utilised an internet-based paradigm with more traditional CBT strategies (iCBT) with specific components targeting RNT and positive beliefs regarding RNT through psychoeducation, self-monitoring and cognitive restructuring.

Competitive memory training. Finally, study (1) utilised a Competitive Memory Training (COMET; Korrelboom, Visser, & Ten Broeke, 2004) approach. In contrast to cognitive training approaches used by study (2, 4 and 8) and in line with RFCBT approaches (7 and 8), the COMET intervention aims to change patients’ involvement with thoughts and emotions through repetitive retrieval of emotionally salient memories, strengthening counter themes to rumination including ‘being indifferent’ and ‘adopting an attitude of acceptance’ (p. 589).

The number of sessions varied from six (6) to 12 sessions (7). Format for the delivery of interventions was also variable including: online (3 and 6), group-based (1, 5 and 6) and individual therapy (7). The length of sessions was usually 90 minutes although one study (3) did not report session timings. Such variations make comparisons and generalizability of findings more difficult.

Effects of interventions on rumination

Seven of the eight studies reviewed reported some reduction in rumination following intervention with effect sizes varying widely from small to large effects. Such findings indicate the potential for interventions targeting rumination in reducing maladaptive rumination or repetitive negative thinking (RNT). All studies utilised a validated measure of rumination with six studies choosing to utilise the RRS (Nolen-Hoeksema & Morrow, 1991). Study (3) and (5) utilised newer measures of rumination incorporating the process of worry as part of RNT, the Repetitive Thinking Questionnaire (RTQ; McEvoy, Mahoney, & Moulds, 2010) and Perseverative Thinking Questionnaire (PTQ; Ehring, Zetsche, Weidacker, Wahl, Schönfeld, & Ehlers, 2011) respectively. The largest reductions in rumination from pre- to post-intervention were found for studies based on RFCBT approaches (5, 6 and 7), with medium-large effect sizes across these studies (Cohen's *d* = .65-1.06). Effect sizes were also large in study (3), which utilised more traditional CBT approaches when compared with waiting list controls (WLCs; *d* = .78-1.00) with reductions in rumination scores maintained at three month follow-up (FU). It could be argued that this intervention was closely related to RFCBT given that the content was adapted to include identification and self-monitoring of positive and negative beliefs about RNT. A number of studies found that reductions in rumination were maintained during FU periods although such periods varied across studies from six weeks to one year. Study (5) and (6) found that at 12-month FU, rumination was further reduced in both group-CBT and internet-RFCBT conditions (*d* = .97, *d* = .77, respectively).

On the other hand, three studies (2, 4 and 8), found minimal reduction in RNT following interventions. Study (2) found that CCT did not reduce ruminative responses compared with control groups aside from small changes observed for individuals who demonstrated higher WM transfer effects following training and where small reductions in reported RNT were only observed under stressful conditions within the lab. Similarly, study (4) found no differences between the groups' RNT scores following six days of n-back training. Both of these studies utilised adolescent populations identified as being at risk of developing future depressive symptoms based on elevated RNT scores (above the 75th percentile on measures of RNT), limiting their generalizability to clinical samples. Furthermore, small sample sizes in both studies may have reduced the power of these studies to detect small-medium effects. Recruiting adults of working age who met criteria for current episode MDD, study (8) also found no significant differences between the treatment group (concreteness training) and active control group (relaxation training) although both groups demonstrated reduced RNT compared with TAU, indicating the difficulty in isolating the potential mechanisms for change without further exploration. Together, these three studies indicate the limited evidence that exists for interventions based on CCT alone to reduce rumination in comparison with CBT-based or RFCBT-based approaches.

Effects of interventions on depression and anxiety

Of the eight studies reviewed, three studies, (2), (4) and (6) targeted populations identified as being at risk of developing future depressive symptoms. Each of these studies identified such populations by targeting adolescents who self-reported elevated RNT based on scores from the RRS. Only individuals scoring above the 75th percentile range were included as such scores indicate high levels of trait RNT, a known risk factor for and closely associated with depressive symptoms (Ehring & Watkins, 2008). It could also be argued that study (5) and study (7) utilised populations at risk of future depressive symptoms by recruiting participants who were in partial remission from depression, where residual symptoms were displayed by participants who

had previously received a diagnosis of major depressive disorder (MDD) yet no longer met criteria for MDD based on self-reported symptoms over the last two months. Although populations in remission from depression are qualitatively different from those who have not received a formal diagnosis of depression, both groups are at risk of future depressive symptoms and/or episodes. All of these studies utilised the Beck Depression Inventory-Second Edition (BDI-II; Beck et al., 1996) to measure depressive symptoms.

Studies (2) and (4) utilised forms of CCT to reduce RNT with at risk populations. Neither found any changes or reductions in depressive symptoms following interventions in comparison with active control groups. However, it is difficult to generalize interpretations from these studies due to a number of methodological flaws and limited sample sizes, particularly at FU. In study (2), 25 individuals took part in the treatment condition, with 20 individuals reporting on symptoms at four-week FU (during the university examination period). Furthermore, it was conceptually unclear how the PASAT (Siegle et al., 2007), aiming to improve cognitive control (CC) skills using auditory digits was related to RNT based on the theoretical evidence provided. Indeed, the limited transfer effects found for the CC condition to WM skills may have been evidence of this conceptual limitation. Although study (4) utilised a well-validated task to train CC skills (dual n-back task), the intervention was limited to six days with no FU information provided. Such information is particularly relevant given the nature of the population recruited. Relevant demographic information regarding participants was also not reported by study (4), such as any previous diagnoses, limiting the generalizability of these results.

In contrast, studies (5), (6) and (7) utilised interventions based on RFCBT where study (6) utilised adolescents at risk of future depressive symptoms, similar to (2) and (4), while study (5) and (7) recruited adult participants of working age in remission from MDD. All three of these studies reported reductions in depressive symptoms following interventions. However, only study (5) and (6) reported data at 12-month FU where reductions in depressive symptoms (d = 1.25 and d = .43, respectively) were maintained.

Study (5) found that the rate of individuals fulfilling remission criteria was higher for those who had completed the 10-week intervention (*n* = 13; 42%) compared with the WLC group (*n* = 3; 10.3%). However, no active control group was utilised making it difficult to unpick the mechanisms responsible for such findings. Study (6) found that adolescents who had completed both the intervention modalities (internet and group) had significantly lower prevalence of depression and anxiety (*p* = .003; *p* = .003 respectively) at 12-month FU compared with the WLC group. Furthermore, the change in RNT from pre- to post-intervention mediated the relationship between condition and prevalence rates of MDD at FU. However, as in study (4), study (6) did not report on participants' previous diagnostic history. Although study (7) reported reductions in depressive symptoms following the intervention (*d* = 1.11), no FU data was assessed, limiting the generalizability of these results for a population at increased risk of depressive relapse.

Of the three studies utilising currently depressed populations, only study (1) found a marked reduction in depression scores compared with controls (*d* = .57) with 44% (*n* = 21) of participants within the intervention group making reliable changes for the better compared with 30% (*n* = 3) of the TAU group. However, three individuals made reliable changes for the worst and the high level of attrition within the TAU group (50%) made it difficult to compare results across groups. The data for study (1) were also collected immediately following the intervention without any active control group (ACG) as well as no FU data, limiting how much is known about the longevity of these results. Furthermore, the high dropout rate within the TAU group made it difficult to adequately compare groups. Study (3) found a reduction in depressive symptoms following the ten week, online CBT-based intervention (*d* = .78). However, the effects were only clinically reliable for anxious versus depressive symptoms and at three month FU, effects were only maintained for anxiety scores on the GAD-7 (*d* = .26) rather than depression scores on the PHQ-9. Although study (8) found that depression scores reduced following the intervention, no differences were found between the intervention group (concreteness training) and the active

control group (relaxation training) at six month FU, so that any potential mechanisms of change were unable to be identified using these findings.

Taken together, the evidence for the effectiveness of rumination-focused interventions to reducing depressive and anxious symptoms is mixed based on the studies reviewed. Methodological flaws made it difficult to decipher the data on CCT training as a potential intervention in particular and long-term FU was not reported by studies (1), (2), (3), (4) and (7). Of the two studies that did include a 12-month FU, studies (5) and (6), reductions in depressive symptoms were observed following RFCBT. However, neither study utilised participants who were currently experiencing depression but instead recruited populations either in remission from or at risk of future depressive episodes. These findings indicate the need for increased research utilising clinical populations to further investigate the potential for rumination-focused interventions to reduce depressive and anxious symptoms. Similarly, for interventions utilising CCT, more stringent methods should be applied by future studies in order to identify the potential for these approaches to benefit participants who are struggling with depressive and/or anxious symptoms.

Potential mechanisms of change

Given the strong association between RNT, depressive and anxious symptoms it is recommended that interventions reporting changes in RNT and/or depression explore the potential mechanisms underlying any changes (Kertz et al., 2015). Three studies (3, 6 and 7) conducted further exploration beyond group differences to investigate hypotheses regarding potential mechanisms for change in rumination scores following interventions. Each of these studies explored whether reductions in RNT and/or positive beliefs about rumination mediated the association between pre- and post-reductions in depressive and/or anxiety symptoms. All three found that rumination was a significant mediator of the effect of treatment condition on depressive symptoms and study (6) found that changes in RNT from pre- to post-intervention mediated the relationship between condition and prevalence rates of both

depression and anxiety at 12-month FU, where lower rumination post-intervention predicted reduced prevalence of depression and anxiety in adolescents at risk of developing psychopathology. Such findings indicate that rumination may be an important mechanism in depressive and anxious symptom improvement following interventions. However, further research is required to establish whether this is a consequence of treatment outcome (reduced depression and/or anxiety) rather than a contributor to outcome and whether or not this is a robust finding across populations, symptom type and/or is specific to particular interventions (Watkins et al., 2011).

Limitations

The studies reviewed utilised a range of experimental designs. All eight studies utilised a randomised control trial (RCT) design, which varied in their use of WLCs, TAU or active control groups (ACGs). Utilising TAU as well as ACGs is seen as the gold standard for RCTs to best compare the effectiveness of treatments. Only two of the studies reviewed did this (4 and 8) and neither study found significant differences between ACGs and intervention groups for measures of rumination. Such findings illustrate the limitation of intervention studies where non-specific therapeutic factors (e.g., group process or relationship with therapist) may influence findings and mediate the links between interventions and outcomes. Although not an ACG, study (6) compared WLCs with an internet- and group-based RFCBT intervention where content was the same in both intervention groups. As no differences were found, this study demonstrated the potential for mechanisms of RFCBT to be effective in reducing rumination beyond non-specific factors traditionally cited as confounding face-to-face interventions.

A further limitation of these studies was the lack of controls for psychopharmacological interventions. Medications prescribed for participants with diagnosed depression and/or anxiety or in remission from depression and/or anxiety are commonplace within the literature. However, as interventions increasingly strive to decipher causal mechanisms underpinning improvements following interventions, it is difficult to ascertain the impact that pharmacological

interventions may have on outcomes. Only one study (7) controlled for antidepressant use where participants continued to take medication in both TAU and intervention groups. Study (6) did not control for participants' past history of psychopathological diagnoses, raising questions as to whether the effects related to prevention of first episode of depression or recurrence of depressive episodes. Similarly, other studies (2 and 3) failed to control for participants' previous psychopathological histories. It is critical that future studies outline the medications being prescribed to participants during the period of testing in order to control for its potential effects and it is recommended that future studies control for such confounding variables.

As discussed, the lack of long-term FU in five out of the eight studies reviewed makes it difficult to generalize findings beyond the period of testing. This is particularly relevant for those studies examining rumination-focused interventions as a potential preventative approach and in the case of populations either at increased risk of developing future depressive symptoms or in remission from MDD. Furthermore, as only three out of eight of the studies explored the effects of interventions on populations currently suffering with depressive, anxious and/or comorbid disorders there is a lack of consistency within the clinical literature in order to generalize findings to clinical populations. The heterogeneity in the populations recruited, interventions utilised and FUs conducted makes interpretation of results difficult. Such variability coupled with a number of methodological flaws discussed within certain studies further limits the validity of findings.

Clinical Implications

There are a number of clinical implications that may be drawn from this review. Firstly, the evidence for the effectiveness of interventions to reduce RNT and depressive symptoms beyond those based on CBT approaches and more specifically, RFCBT approaches are minimal. However, the evidence for RFCBT interventions is predominantly based on populations not currently suffering with MDD and/or GAD, indicating the need for more research that

aims to explore the helpfulness of RFCBT to reduce current depressive and anxious symptoms, generalizing findings to clinical populations. Secondly, the review suggests that the evidence for interventions utilising CCT approaches alone may not be as effective as those targeting individuals' thought processes and beliefs about RNT. However, as with RFCBT, few studies have explored CCT approaches with clinical populations using stringent methodological approaches. Thirdly, the evidence suggests that RFCBT approaches may be useful in populations at risk of developing depressive symptoms or relapsing into depression. However, the evidence is based on a limited number of studies with few researchers exploring how participants' symptoms may change over time through the use of long-term follow-ups. In other words, the immediacy of many of the findings reviewed indicates a need to investigate the longevity and feasibility of any proposed approaches using follow-up questionnaires and interviews, where possible.

Conclusions

Overall, the evidence indicates that rumination-focused interventions have the potential to reduce RNT as well as the prevalence and number of reported depressive symptoms at FU. Examining the effect size and ratings of rumination, it appears that interventions utilising a modified version of RFCBT may be most effective in preventing and reducing future rumination rather than depressive symptoms and/or anxious symptoms. While adapted internet-based CBT for rumination found high reductions in rumination following treatment (*d* = .78-1.00), RFCBT found similar effect sizes in samples of high risk (6), currently depressed (5) and remised (7) participants, indicating its potential for reducing rumination across wider age ranges and clinical presentations. Furthermore, RFCBT-based interventions (5, 6 and 7) found larger effect sizes than more traditional CBT methods (3), the COMET protocol (1) and CCT (2, 4), particularly for reductions in depressive symptoms. Fewer of the studies reviewed focused their interventions on the outcomes for participants' anxiety symptoms, although two studies (3 and 6) reported reductions in anxiety symptoms (*d* = .48, *d* = .41) following CBT and RFCBT, respectively and both

studies found that effects were maintained at three (3) and 12-month FU (6). In contrast, study (8) only found reductions in depressive symptoms compared with anxious symptoms following a concreteness intervention. The limited number of studies including anxiety as a measure of change limits the generalizability of these findings. Finally, exploratory analysis indicated that changes in rumination might mediate the association between treatment condition and clinical outcomes. However, further research is required to explore the potential mechanisms underlying changes following interventions, such as non-specific therapeutic factors. Furthermore, due to the small number of studies and heterogeneity between studies and populations recruited within this review, any conclusions and recommendations made should be tentative.

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Appendices

Appendix A

Quality Assessment Tool for Quantitative Studies

QUALITY ASSESSMENT TOOL FOR QUANTITATIVE STUDIES

EPHPP
Effective Public Health Practice Project

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

1 Very likely
2 Somewhat likely
3 Not likely
4 Can't tell

(Q2) What percentage of selected individuals agreed to participate?

1 80 - 100% agreement
2 60 – 79% agreement
3 less than 60% agreement
4 Not applicable
5 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

B) STUDY DESIGN

Indicate the study design

1 Randomized controlled trial
2 Controlled clinical trial
3 Cohort analytic (two group pre + post)
4 Case-control
5 Cohort (one group pre + post (before and after))
6 Interrupted time series
7 Other specify _____
8 Can't tell

Was the study described as randomized? If NO, go to Component C.

No Yes

If Yes, was the method of randomization described? (See dictionary)

No Yes

If Yes, was the method appropriate? (See dictionary)

No Yes

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

C) CONFOUNDERS

(Q1) Were there important differences between groups prior to the intervention?

1 Yes
2 No
3 Can't tell

The following are examples of confounders:

1 Race
2 Sex
3 Marital status/family
4 Age
5 SES (income or class)
6 Education
7 Health status
8 Pre-intervention score on outcome measure

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?

1 80 – 100% (most)
2 60 – 79% (some)
3 Less than 60% (few or none)
4 Can't Tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

D) BLINDING

(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?

1 Yes
2 No
3 Can't tell

(Q2) Were the study participants aware of the research question?

1 Yes
2 No
3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

E) DATA COLLECTION METHODS

(Q1) Were data collection tools shown to be valid?

1 Yes
2 No
3 Can't tell

(Q2) Were data collection tools shown to be reliable?

1 Yes
2 No
3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

F) WITHDRAWALS AND DROP-OUTS

(Q1) Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?

1 Yes
2 No
3 Can't tell
4 Not Applicable (i.e. one time surveys or interviews)

(Q2) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

1 80 -100%
2 60 - 79%
3 less than 60%
4 Can't tell
5 Not Applicable (i.e. Retrospective case-control)

RATE THIS SECTION	STRONG	MODERATE	WEAK	
See dictionary	1	2	3	Not Applicable

G) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?

1 80 -100%
2 60 - 79%
3 less than 60%
4 Can't tell

(Q2) Was the consistency of the intervention measured?

1 Yes
2 No
3 Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

4 Yes
5 No
6 Can't tell

H) ANALYSES

(Q1) Indicate the unit of allocation (circle one)

community organization/institution practice/office individual

(Q2) Indicate the unit of analysis (circle one)

community organization/institution practice/office individual

(Q3) Are the statistical methods appropriate for the study design?

1 Yes
2 No
3 Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

1 Yes
2 No
3 Can't tell

Component Ratings of Study:

For each of the six components A – F, use the following descriptions as a roadmap.

A) SELECTION BIAS

Strong: The selected individuals are very likely to be representative of the target population (Q1 is 1) **and** there is greater than 80% participation (Q2 is 1).

Moderate: The selected individuals are at least somewhat likely to be representative of the target population (Q1 is 1 or 2); **and** there is 60 - 79% participation (Q2 is 2). 'Moderate' may also be assigned if Q1 is 1 or 2 and Q2 is 5 (can't tell).

Weak: The selected individuals are not likely to be representative of the target population (Q1 is 3); **or** there is less than 60% participation (Q2 is 3) **or** selection is not described (Q1 is 4); and the level of participation is not described (Q2 is 5).

B) DESIGN

Strong: will be assigned to those articles that described RCTs and CCTs.

Moderate: will be assigned to those that described a cohort analytic study, a case control study, a cohort design, or an interrupted time series.

Weak: will be assigned to those that used any other method or did not state the method used.

C) CONFOUNDERS

Strong: will be assigned to those articles that controlled for at least 80% of relevant confounders (Q1 is 2); **or** (Q2 is 1).

Moderate: will be given to those studies that controlled for 60 – 79% of relevant confounders (Q1 is 1) **and** (Q2 is 2).

Weak: will be assigned when less than 60% of relevant confounders were controlled (Q1 is 1) **and** (Q2 is 3) **or** control of confounders was not described (Q1 is 3) **and** (Q2 is 4).

D) BLINDING

Strong: The outcome assessor is not aware of the intervention status of participants (Q1 is 2); **and t**he study participants are not aware of the research question (Q2 is 2).

Moderate: The outcome assessor is not aware of the intervention status of participants (Q1 is 2); **or** the study participants are not aware of the research question (Q2 is 2); **or b**linding is not described (Q1 is 3 and Q2 is 3).

Weak: The outcome assessor is aware of the intervention status of participants (Q1 is 1); **and** the study participants are aware of the research question (Q2 is 1).

E) DATA COLLECTION METHODS

Strong: The data collection tools have been shown to be valid (Q1 is 1); **and** the data collection tools have been shown to be reliable (Q2 is 1).

Moderate: The data collection tools have been shown to be valid (Q1 is 1); **and** the data collection tools have not been shown to be reliable (Q2 is 2) **or** reliability is not described (Q2 is 3).

Weak: The data collection tools have not been shown to be valid (Q1 is 2) **or** both reliability and validity are not described (Q1 is 3 and Q2 is 3).

F) WITHDRAWALS AND DROP-OUTS - a rating of:

Strong: will be assigned when the follow-up rate is 80% or greater (Q2 is 1).

Moderate: will be assigned when the follow-up rate is 60 – 79% (Q2 is 2) **OR** Q2 is 5 (N/A).

Weak: will be assigned when a follow-up rate is less than 60% (Q2 is 3) or if the withdrawals and drop-outs were not described (Q2 is 4).

GLOBAL RATING

COMPONENT RATINGS

Please transcribe the information from the gray boxes on pages 1-4 onto this page. See dictionary on how to rate this section.

A	**SELECTION BIAS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
B	**STUDY DESIGN**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
C	**CONFOUNDERS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
D	**BLINDING**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
E	**DATA COLLECTION METHOD**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
F	**WITHDRAWALS AND DROPOUTS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	Not Applicable

GLOBAL RATING FOR THIS PAPER (circle one):

1	STRONG	(no WEAK ratings)
2	MODERATE	(one WEAK rating)
3	WEAK	(two or more WEAK ratings)

With both reviewers discussing the ratings:

Is there a discrepancy between the two reviewers with respect to the component (A-F) ratings?

No Yes

If yes, indicate the reason for the discrepancy

1	Oversight
2	Differences in interpretation of criteria
3	Differences in interpretation of study

Final decision of both reviewers (circle one):

1	**STRONG**
2	**MODERATE**
3	**WEAK**

Appendix B

Quality Assessment Tool for Quantitative Studies Dictionary

Quality Assessment Tool for Quantitative Studies Dictionary

The purpose of this dictionary is to describe items in the tool thereby assisting raters to score study quality. Due to under-reporting or lack of clarity in the primary study, raters will need to make judgements about the extent that bias may be present. When making judgements about each component, raters should form their opinion based upon information contained in the study rather than making inferences about what the authors intended.

A) SELECTION BIAS

(Q1) Participants are more likely to be representative of the target population if they are randomly selected from a comprehensive list of individuals in the target population (score very likely). They may not be representative if they are referred from a source (e.g. clinic) in a systematic manner (score somewhat likely) or self-referred (score not likely).

(Q2) Refers to the % of subjects in the control and intervention groups that agreed to participate in the study before they were assigned to intervention or control groups.

B) STUDY DESIGN

In this section, raters assess the likelihood of bias due to the allocation process in an experimental study. For observational studies, raters assess the extent that assessments of exposure and outcome are likely to be independent. Generally, the type of design is a good indicator of the extent of bias. In stronger designs, an equivalent control group is present and the allocation process is such that the investigators are unable to predict the sequence.

Randomized Controlled Trial (RCT)

An experimental design where investigators randomly allocate eligible people to an intervention or control group. A rater should describe a study as an RCT if the randomization sequence allows each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. If the investigators do not describe the allocation process and only use the words 'random' or 'randomly', the study is described as a controlled clinical trial.

See below for more details.

Was the study described as randomized?

Score YES, if the authors used words such as random allocation, randomly assigned, and random assignment.

Score NO, if no mention of randomization is made.

Was the method of randomization described?

Score YES, if the authors describe any method used to generate a random allocation sequence.

Score NO, if the authors do not describe the allocation method or describe methods of allocation such as alternation, case record numbers, dates of birth, day of the week, and any allocation procedure that is entirely transparent before assignment, such as an open list of random numbers of assignments.
If NO is scored, then the study is a controlled clinical trial.

Was the method appropriate?

Score YES, if the randomization sequence allowed each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next. Examples of appropriate approaches include assignment of subjects by a central office unaware of subject characteristics, or sequentially numbered, sealed, opaque envelopes.

Score NO, if the randomization sequence is open to the individuals responsible for recruiting and allocating participants or providing the intervention, since those individuals can influence the allocation process, either knowingly or unknowingly.

If NO is scored, then the study is a controlled clinical trial.

Controlled Clinical Trial (CCT)
An experimental study design where the method of allocating study subjects to intervention or control groups is open to individuals responsible for recruiting subjects or providing the intervention. The method of allocation is transparent before assignment, e.g. an open list of random numbers or allocation by date of birth, etc.

Cohort analytic (two group pre and post)
An observational study design where groups are assembled according to whether or not exposure to the intervention has occurred. Exposure to the intervention is not under the control of the investigators. Study groups might be non-equivalent or not comparable on some feature that affects outcome.

Case control study
A retrospective study design where the investigators gather 'cases' of people who already have the outcome of interest and 'controls' who do not. Both groups are then questioned or their records examined about whether they received the intervention exposure of interest.

Cohort (one group pre + post (before and after)
The same group is pretested, given an intervention, and tested immediately after the intervention. The intervention group, by means of the pretest, act as their own control group.

Interrupted time series
A time series consists of multiple observations over time. Observations can be on the same units (e.g. individuals over time) or on different but similar units (e.g. student achievement scores for particular grade and school). Interrupted time series analysis requires knowing the specific point in the series when an intervention occurred.

C) CONFOUNDERS

By definition, a confounder is a variable that is associated with the intervention or exposure and causally related to the outcome of interest. Even in a robust study design, groups may not be balanced with respect to important variables prior to the intervention. The authors should indicate if confounders were controlled in the design (by stratification or matching) or in the analysis. If the allocation to intervention and control groups is randomized, the authors must report that the groups were balanced at baseline with respect to confounders (either in the text or a table).

D) BLINDING

(Q1) Assessors should be described as blinded to which participants were in the control and intervention groups. The purpose of blinding the outcome assessors (who might also be the care providers) is to protect against detection bias.

(Q2) Study participants should not be aware of (i.e. blinded to) the research question. The purpose of blinding the participants is to protect against reporting bias.

E) DATA COLLECTION METHODS

Tools for primary outcome measures must be described as reliable and valid. If 'face' validity or 'content' validity has been demonstrated, this is acceptable. Some sources from which data may be collected are described below:

Self reported data includes data that is collected from participants in the study (e.g. completing a questionnaire, survey, answering questions during an interview, etc.).

Assessment/Screening includes objective data that is retrieved by the researchers. (e.g. observations by investigators).

Medical Records/Vital Statistics refers to the types of formal records used for the extraction of the data.

Reliability and validity can be reported in the study or in a separate study. For example, some standard assessment tools have known reliability and validity.

F) WITHDRAWALS AND DROP-OUTS

Score **YES** if the authors describe BOTH the numbers and reasons for withdrawals and drop-outs.

Score **NO** if either the numbers or reasons for withdrawals and drop-outs are not reported.

The percentage of participants completing the study refers to the % of subjects remaining in the study at the final data collection period in all groups (i.e. control and intervention groups).

G) INTERVENTION INTEGRITY

The number of participants receiving the intended intervention should be noted (consider both frequency and intensity). For example, the authors may have reported that at least 80 percent of the participants received the complete intervention. The authors should describe a method of measuring if the intervention was provided to all participants the same way. As well, the authors should indicate if subjects received an unintended intervention that may have influenced the outcomes. For example, co-intervention occurs when the study group receives an additional intervention (other than that intended). In this case, it is possible that the effect of the intervention may be over-estimated. Contamination refers to situations where the control group accidentally receives the study intervention. This could result in an under-estimation of the impact of the intervention.

H) ANALYSIS APPROPRIATE TO QUESTION

Was the quantitative analysis appropriate to the research question being asked?

An intention-to-treat analysis is one in which all the participants in a trial are analyzed according to the intervention to which they were allocated, whether they received it or not. Intention-to-treat analyses are favoured in assessments of effectiveness as they mirror the noncompliance and treatment changes that are likely to occur when the intervention is used in practice, and because of the risk of attrition bias when participants are excluded from the analysis.

Appendix C

Exclusion Criteria for Selected Full-Text Papers

Table C1

Summary and Exclusion Criteria for Studies Not Eligible for Review in Alphabetical Order by Author

Author	**P**opulation	**Exposure (Intervention)**	**C**omparator	**O**utcome 1)Rumination/RNT 2)Depression/anxious symptoms	**Reason for Exclusion**
1. Alderman et al., 2016	22 Adults meeting (M_{age} = 20.70; *SD* = 3.1) criteria for diagnosis of MDD according to DSM-IV	Eight week MAP training	30 non-depressed individuals (M_{age} = 21.2; *SD* = 3.3), baseline and post-intervention scores, no formal comparison group	1) RRS 2) BDI-II	**Neuroimaging study** **Behavioural intervention only**
2.Cook & Watkins, 2016	Undergraduate students with elevated RNT (>75th percentile) on the PSWQ and RRS	Guided iRFCBT, unguided iRFCBT	No intervention randomised control group	1) PSWQ, RRS 2) PHQ-9, GAD-7, SCID-I (3, 6, 16months post-intervention)	**Study protocol only, no results available**
3.Deplus et al., 2016	33 adolescents (M_{age} = 15.41; *SD* = 1.97) meeting criteria for MDD according to DSM-IV	8-week RFCBT	Pre- and post-fMRI brain scans	1) RRS 2) RADS; CDRS-R	**Neuroimaging study**
4.DeVoogd et al., 2016	168 non-selected adolescents (M_{age} = 14.36; *SD* = 1.15)	EmoWM training, interpretation bias modification, attentional bias modification	129 EmoWM group (M_{age} = 14.33; *SD* = 1.17), 39 placebo group (M_{age} = 14.40; *SD* = 1.14)	1) PTQ 2) SCARED, CDI	**No high risk or vulnerable group identified**
5. Gortner et al., 2006	90 undergraduate students (M_{age} = 19.12; *SD* = 2.13), formally meeting criteria but no longer depressed according to	Three x writing sessions (20minutes) on three separate days	Pre- and post-measures (6month follow-up), no comparison group	1) RRS 2) BDI-II, IDD-L	**No comparison group**

	IDD-L				
6. Hilt & Pollack, 2012	Children and adolescents (9-14 years of age)	Negative mood induction followed by either distraction or rumination induction	26 children and adolescents (M_{age} = 12.21; *SD* = 1.61) assigned to rumination or distraction groups	1) State rumination using visual analog scale (VAS) 2) Negative affect using VAS and blood pressure	**No high-risk populations identified** **Induction vs. intervention**
7.Hvenegaard et al., 2015	Patients 18-65 years of age meeting criteria for current unipolar MDD according to DSM-IV criteria	G-RFCBT and g-CBT	Participants randomly allocated to either g-RFCBT or g-CBT	1) PSWQ; RRS 2) HRSD; HAM-D6; BADS; GAD-7	**Study protocol only, no results available**
8. Ietsugu et al., 2015	104 adults (M_{age} 43.8 years, *SD* = 11.5) identified as in remission from MDD according to DSM-IV with 3 previous episodes of MDD but none in previous 8 weeks	Eight, weekly group-based MBCT sessions	Within-subjects, no comparison group	1) WRR 2) PHQ-9, GAD-7	**No comparison group, intervention not explicitly targeting RNT**
9.Jacobs et al., 2016	33 adolescents meeting criteria for MDD in the past but not currently according to DSM-IV	Eight, weekly individual sessions of RFCBT	16 individuals randomised to assessed only group (M_{age} = 15.69; *SD* = 1.89), 17 individuals assigned to RFCBT with four year FU using fMRI (M_{age} = 15.41; *SD* = 1.97	1) RRS 2) RADS, CDRS	**Neuroimaging study**
10.Jones, Siegle & Thase, 2008	81 adults meeting criteria for diagnosis of MDD (M_{age} = 44.80; *SD* = 11.78) according to DSM-IV	16-20 weekly sessions of CT		1) RSQ 2) BDI-II, HRSD	**No comparison group**
11.Kertz et al., 2015	131 adults (no ages reported) under admission to the partial hospitalisation	Five sessions of brief, hospital-based CBT	Within group, pre-post intervention measures	1) PTQ 2) CES-D, GAD-7	**Range of comorbid diagnosis within sample, no comparison**

	programme				**group**
12. Krahé et al., 2017	Participants between 18-65 years of age meeting criteria for GAD or MDD according to DSM-V	CBM-I with prior RNT induction	Participants randomised to CBM-I without prior RNT induction or active control	1) PSWQ, RRS, RNTQ 2) PHQ-9, GAD-7	**Study protocol only, no results available**
13.McEvoy et al., 2015	52 individuals (M_{age} = 38.57; *SD* = 14.33) meeting criteria for diagnosis of GAD according to DSM-IV	Six weekly sessions of group-based MCT	Within group, pre- and post measure, no comparison group available	1) RTQ 2) K10	**No comparison group, no formal measure of depression, RNT not primary target of intervention**
14. Michalak, Holz, & Tiesmann, 2011	24 adults with two or more previous episodes of MDD according to DSM-IV (M_{age} = 47.72; *SD* = 10.34)	Eight, weekly group-based MBCT	Within group, pre-post treatment measures and 12-month FU	1) RRS 2) HRSD	**No comparison group, no rumination-focused intervention**
15.Snippe et al., 2015	Six females over 18years of age (M_{age} = 45.21; *SD* = 7.67) meeting criteria for mild depression according to PHQ-9	Eight, week group-based MBCT	Within group, pre- and post-measure, no comparison group available	1) PTQ 2) PHQ-2	**No comparison group**
16.Vanderhas selt et al., 2014	17 adults between 18 and 65 years of age (M_{age} = 41.00; *SD* = 11.54) meeting criteria for MDD according to HAM-D6 and DSM-IV	5-minute blocks of PASAT, 5 days per week for 2 weeks	20 individuals randomised to tDCS group (M_{age} = 46.26; *SD* = 10.67)	1) RRS 2) BDI-II, HAM-D6	**Neurological-stimulation comparator group**

Note. BADS = Behavioural Activation for Depression Scale; BDI-II = Beck Depression Inventory; CBM-I = Cognitive Bias Modification For Interpretations; CBT = Group-Based Cognitive Behavioural Therapy; CDI = Children's Depression Inventory; CDRS-R = Children's Depression Rating Scale-Revised; CES-D = Center for Epidemiological Studies of Depression-10; CT = Cognitive Therapy; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders; 4th Edition, EmoWM = emotional working memory training; fMRI = functional magnetic resonance imaging; FU = Follow-Up; GAD = generalised anxiety disorder; GAD-7 = Generalized Anxiety Disorder Screener; g-g-RFCBT = Group-Based Rumination Focused Cognitive Behavioural Therapy; HAM-D6 = Hamilton Depression Rating Scale; HRSD = Hamilton Rating Scale for Depression; iRFCBT = Internet-Based Rumination-Focused Cognitive Behavioural Therapy; IDD-L = Inventory to Diagnose Depression-Lifetime; K10 = Kessler Psychological Distress Scale-10; MAP = Mental and Physical Training; MDD = major depressive disorder; MBCT = Mindfulness Based Cognitive Therapy; MCT = Metacognitive Therapy; PHQ-9 = Patient Health Questionnaire; PSWQ = Penn State Worry Questionnaire; PTQ = Perseverative Thinking Questionnaire; RADS = Reynolds Adolescent

Depression Scale; RNT = Repetitive Negative Thinking; RNTQ = Repetitive Negative Thinking Questionnaire; RRS = Ruminative Response Scale; RSQ = Response Style Questionnaire; tDCS = Transcranial Direct Current Stimulation; SCARED = Screen for Child Anxiety Related Emotional Disorders; VAS = Visual Analog Scale; WRR = Weekly Rumination Rating.

Appendix D

Submission Requirements and Instructions for the International Journal of Cognitive Therapy

INSTRUCTIONS TO AUTHORS

The *International Journal of Cognitive Therapy* is the official journal of the International Association for Cognitive Psychotherapy (IACP), a professional, scientific, interdisciplinary organization whose mission is to facilitate the utilization and growth of cognitive therapy as a professional activity and scientific discipline.

The journal is devoted to advancing all scientific and clinical aspects of cognitive therapy, including rigorous research on cognitive factors and vulnerabilities in psychological disorders, mediating processes in treatment outcome, cognitive assessment and treatment, expert perspectives on specific clinical problems and populations, and critical issues in translating research to practice.

We welcome articles of the following types:

1. Empirical research studies of cognitive clinical theories and applications
2. Theoretical papers and particularly innovative contributions to theory or extensions of current theory
3. Systematic case studies that either extend the current base of knowledge about applications of treatments to new clinical problems or that describe new interventions
4. Reports on new treatment manuals that describe their procedures and contributions in relation to previous ones
5. Literature reviews and meta-analyses
6. Special thematic issues

All submissions must be made electronically at http://ijct.msubmit.net. Only original articles will be considered. Submissions must be double-spaced. Authors should include an abstract of fewer than 150 words and must prepare manuscripts according to the format and style rules set forth in the publication manual of the American Psychological Association. Blind reviews are optional. If authors desire a blind review they should request this in the submission letter. For blind reviews, only a separate coverage page should contain identifying information about the authors and their affiliations.

TABLES should be submitted in Excel. Tables formatted in Microsoft Word's Table function are also acceptable. (Tables *must not* be submitted using tabs, returns, or spaces as formatting tools.)

FIGURES *must* be submitted separately as graphic files (in order of preference: tif, eps, jpg, bmp, gif; note that PowerPoint is *not* acceptable) in the highest possible resolution. Figure caption text should be included in the article's Microsoft Word file. All figures must be in black & white.

PERMISSIONS: Contributors are responsible for obtaining permission from copyright owners if they use an illustration, table, or lengthy quote (100+ words) that has been published elsewhere. Contributors should write both the publisher and author of such material, requesting nonexclusive world rights in all languages for use in the article and in all future editions of it.

REFERENCES: Authors should consult the publication manual of the American Psychological Association for rules on format and style. Any manuscripts with references that are incorrectly formatted will be returned by the publisher for revision.

SAMPLE REFERENCES

Davis, C. G., & McKearney, J. M. (2003). How do people grow from their experience with trauma or loss? *Journal of Social & Clinical Psychology, 22*(5), 477-492.

Dweck, C., & Wortman, C. (1982). Learned helplessness, anxiety and achievement. In H. Kron & L. Laux (Eds.), *Achievement, stress, and anxiety* (pp. 93-125). Washington, DC: Hemisphere Publishing Group.

Roelofs, J., Meesters, C., Ter Huurne, M., Bamelis, L., & Muris, P. (2006). On the links between attachment style, parental rearing behaviors, and internalizing and externalizing problems in nonclinical children. *Journal of Child and Family Studies, 15*, 331-344.

An annual award will be given by the IACP to any empirical article in the journal that the editors and IACP Board judge to have contributed the most original breakthrough research of the year. A similar competitive award may be given to articles in another category such as review articles, theoretical articles, or case studies. These awards will consist of a certificate from the IACP given in recognition of the accomplishment, a mention in the following volume of the *International Journal of Cognitive Therapy*, and a cash award of $150.00.

SCHOOL OF PSYCHOLOGY

DOCTORATE IN CLINICAL PSYCHOLOGY

EMPIRICAL PAPER

Exploring the Relationships between Executive Functions, Repetitive Negative Thinking, Stress and Depression: A Brief Longitudinal Study

Trainee Name:	**Claire Stephens**
Primary Research Supervisors:	**Dr. Nicholas Moberly** Senior Lecturer, Research tutor for Professional Doctorates **Dr. Anna Adlam** Senior Lecturer, Deputy Director of Research for Professional Doctorates
Secondary Research Supervisor:	**Professor Edward Watkins** Professor of Experimental and Applied Clinical Psychology, Director of Research for Professional Doctorates, Mood Disorder Centre
Target Journal:	*Cognitive Therapy and Research*
Word Count:	7, 996 (excluding abstract, table of contents, list of figures, references, footnotes, appendices)

Submitted in partial fulfilment of requirements for the Doctorate Degree in Clinical Psychology, University of Exeter

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Abstract

Research is increasingly attempting to understand the developmental nature of depressive symptomology and its links with executive functioning (EF), repetitive negative thinking (RNT) and stress (e.g., Snyder & Hankin, 2016). Prospective studies are needed to explore the potential mechanisms underlying these associations. This study investigated whether EFs can predict changes in RNT, stress and depressive symptoms during a period of stress. One hundred and two undergraduates completed questionnaires measuring life events, trait and state RNT, depressive and anxious symptoms as well as behavioural EF tasks of cognitive switching and inhibitory control at baseline (Time 1). Follow-up questionnaires of RNT, stress, depression and anxiety were gathered approximately two months later (Time 2), during students' formal examinations, a period of naturally elevated stress. Findings indicated no association between EF and RNT, depression or anxiety but found that the interaction between high levels of trait RNT and low levels of EF (switching) at baseline was a significant predictor of change in state RNT under stress. Findings are discussed in light of current research attempting to unpick associations between EF, RNT and depression in young adults.

Keywords:

Rumination; executive function; depression; stress; young adults

Introduction

Depression and young adulthood

Depression is a debilitating disorder, projected to be the second leading cause of disability globally by 2020 (Murray & Lopez, 1996). Current research is focused on aetiological predictors of depressive vulnerability, targeted to improve interventions (e.g., Kendler, Gardner, & Prescott, 2002). Prevalence rates suggest that between 8-12% of the United Kingdom's (UK) population experience depression annually (Office for National Statistics Psychiatry Morbidity, 2001) with a lifetime prevalence of approximately 20.8% for mood disorders (Kessler et al., 2005). According to national estimates from the United States, major depressive disorder (MDD) as defined by the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV; American Psychiatric Association, 1994) has the highest lifetime prevalence (16.6%) compared with other psychiatric disorders while anxiety disorders are the most prevalent class of disorders (Kessler et al., 2005).

While periods of development are relatively fluid concepts, traditional age boundaries define the period of youth as those aged 12-24 years, adolescence as 12-19 years and young adulthood as 18-21 years (Rutter & Smith, 1995; World Health Organization, 2005). Adolescence and young adulthood are both marked by significant transitions where young people move through the final stages of education, begin the process of employment and embark for the first time on adult pursuits. Such transitions may also include increased independence and autonomy coupled with an increased sense of responsibility as young adults move away from their families of origin (Sussman & Arnett, 2014). Young adulthood is also marked by rapid changes that can occur physically, socially and cognitively as lifestyle patterns become established and health-related behaviours start to become stable (Rutter & Smith, 1995). Although sexually mature by approximately 18 years of age (Santrock, 2010), the young adult brain and, in particular, areas within the prefrontal lobes, critical

for decision-making and focusing our attention continue to develop during this period and on into adulthood (Paus, 2005; Tamnes et al., 2010).

Given the critical changes occurring throughout adolescence and young adulthood, it may seem unsurprising that most lifetime mental health disorders have first onset before the age of 24 years (Kessler et al., 2005; Patel, Flisher, Hetrick, & McGorry, 2007). Researchers recruiting adolescents and young adults should therefore be striving to address the dearth of effective early interventions and preventative strategies needed to promote better mental health and reduce the global burden of psychological distress (McGorry, Bates, & Birchwood, 2013; McGorry, Purcell, & Goldstone, 2011; Topper, Emmelkamp, & Ehring, 2010). Indeed, criticisms have been made of mental health services in the UK, where strict divisions are imposed between paediatric and adult services, resulting in the needs of young adults, as a distinctly vulnerable population, being overlooked (Singh et al., 2010). However, there is increasing optimism among researchers following the publication of a number of public policy documents that emphasise the need for preventative strategies and early interventions targeting mental health disorders of which depression is most prevalent (e.g., Department of Health Division of Mental Health, 2011).

Current research has been seeking to unpick the mechanisms influencing the development and maintenance of long-term psychological distress by targeting populations of young adults as a period with peak age of onset and need for initial care (Hankin et al., 1998; Michl, McLaughlin, Sheperd, & Nolen-Hoeksema, 2013). Emerging from this research is the finding that a complex interplay exists between biological, psychological, environmental factors alongside stressful life events, increasing individual susceptibility to depression (Costello, Foley, & Angold, 2006; Sullivan, Neale, & Kendler, 2014). The psychological processes of ruminative response styles and internal attributional styles for negative events are indicated as critical in determining why some individuals with increased vulnerability develop depression and others do not (Kinderman, Schwannauer, Pontin, & Tai, 2013).

Repetitive negative thinking and psychological distress

Repetitive negative thinking (RNT) is the process of repetitive, passive or relatively uncontrollable negative thoughts (Ehring & Watkins, 2008). Worry and depressive rumination (DR) are examples of RNT where DR is the process of "repetitively and passively thinking about one's symptoms of depression and the possible causes and consequences of these symptoms" (Nolen-Hoeksema, 2004, p. 107). Worry is future orientated and is usually a stream of negatively affective-laden thoughts and images.

Response style theory posits that DR, as an example of RNT, is a trait-like response style to distress (e.g., focusing on the meanings and consequences of depressive symptoms), interfering with adaptive coping responses (e.g., problem-solving) and emotional regulation during stressful periods (Lyubomirsky & Nolen-Hoeksema, 1995; Watkins, 2008). DR increases the likelihood of developing depression in non-clinical samples and intensifies and prolongs depressive symptoms in clinical samples (Just & Alloy, 1997; Kuehner & Webber, 1999; Nolen-Hoeksema, 1991, 2000). Subtypes of rumination have also been identified including reflective pondering (active attempts to gain insight into one's problems) and brooding (the propensity to passively focus on one's symptoms), where self-reflective pondering predicts reduced depressive symptoms at one year follow-up while brooding predicts increased depressive symptoms, controlling for baseline depression (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). RNT can be conceptualised as trait-like characteristics that vary between people, presenting across clinical and non-clinical samples (Watkins, 2009). Rumination also has a state component that varies within-person such that it may increase during times of stress (Nolen-Hoeksema, 2004).

RNT is a transdiagnostic process common across Axis I mental health disorders (e.g., Harvey, 2004; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). A person's habitual tendency to engage in RNT (trait RNT) emerges during late childhood and is stable across adolescence and young adulthood (Abela,

Brozina, & Haigh, 2002; Topper et al., 2010). Longitudinal research conducted with young adults including university students has found that RNT is a strong predictor of both depressive and anxious symptoms and MDD (Ehring & Watkins, 2008; Segerstrom, Tsao, Alden, & Craske, 2000; Watkins, 2008). RNT is also a mediator of the relationship between common depressive risk factors (e.g., perfectionism) and depression (Macedo et al., 2015) and exacerbates depressive symptoms when manipulated under experimental conditions (e.g., McLaughlin, Borkovec, & Sibrava, 2007). A recent study by Topper and colleagues (Topper, Emmelkamp, Watkins, & Ehring, 2017) found that a six-week intervention targeting RNT and utilising a modified version of rumination-focused cognitive behavioural therapy (RFCBT) with undergraduate students vulnerable to depressive symptoms (RNT scores above 75th percentile range) was effective in reducing RNT and symptoms of anxiety and depression at 12-month follow-up compared with waiting list controls. Taken together, evidence suggests that RNT has a critical role in the onset, maintenance and relapse of psychological distress, particularly depression and anxiety in young adults.

Executive functioning and depression

Executive functioning (EF) as a form of cognitive control is an important feature of MDD with individuals showing significantly impaired performances on attention tasks compared with non-clinical controls (Davidson, Pizzagalli, Nitschke, & Putnam, 2002; Levin, Heller, Mohanty, Herrington, & Miller, 2007). Recently, research has indicated that EF impairments may play a key role in contributing to impaired emotion regulation, rumination and subsequent negative affect rather than being a correlate of negative mood in those suffering with depression (Millan et al., 2012; Siegle, Ghinassi, & Thase, 2007). As a result, researchers have been exploring whether EF may be a causal risk factor for depressive symptomology such that interventions targeting EF in vulnerable populations (e.g., individuals with high levels of RNT) may act as a preventative strategy against the development of psychopathology (e.g., Joormann Yoon, & Zetsche, 2007; Onraedt & Koster, 2014).

The executive functions (EFs) are made up of separable yet interrelated cognitive processes that are employed to focus our attention while performing complex cognitive tasks and in situations when performing on automatic or instinct is unhelpful (Miyake et al., 2000; Miyake & Friedman, 2012). According to Miyake and colleagues, executive functioning (EF) includes the distinct functions of inhibitory control (IC; deliberate overriding of prepotent responses), cognitive shifting (switching flexibly between tasks or mental sets), and updating (monitoring, addition and/or deletion of working memory [WM] contents). Mirroring the protracted development of the prefrontal cortex (PFC) that is activated while performing EF tasks, EFs continue to develop into early adulthood with evidence suggesting that development continues until approximately 25 years of age (e.g., Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001; Best & Miller, 2010; Luna, Padmanabhan, & O' Hearn, 2010). Although broad EF deficits are associated with MDD, the largest performance deficits by depressed individuals have been found for IC with small- to medium-sized deficits found on tasks of switching (e.g., Joormann et al., 2007; Snyder, 2013; Vilgis, Silk, & Vance, 2015). Contrastingly, a number of studies have not found such effects and some have suggested that other factors may contribute to potential deficits, such as psychotropic medications, alertness or motivation (see Snyder, 2013 for a review). The lack of crossover between the clinical and cognitive fields further limits generalizability, where cognitive assessments sensitive enough to detect inter-individual differences are rarely utilised by clinical researchers (Snyder, Miyake, & Hankin, 2015). Furthermore, an insufficient number of studies move beyond correlational designs with young adult samples, resulting in a dearth of causal and developmental models exploring associations between EFs and psychopathology in this population.

Repetitive negative thinking, executive functions and depression

Researchers hypothesise that individuals who display high ruminative tendencies are characterised by IC and switching deficits when negative information is in focal attention (De Lissnyder, Koster, & De Raedt, 2012; Joormann & Gotlib, 2008). Impaired switching skills have also been found to

prospectively predict elevated RNT upon encountering stressful events (De Lissnyder, Koster, Goubert, Onraedt, Vanderhasselt, & De Raedt, 2012). Contrastingly, increased RNT has predicted poorer IC performance in tasks using non-emotional stimuli, controlling for depression (Whitmer & Banich, 2007). In a rumination-induction paradigm with depressed individuals, Whitmer and Gotlib (2012) found that state RNT impaired cognitive switching performance but not IC performance, while trait RNT was associated with IC rather than switching deficits, implicating dissociable cognitive deficits associated with state and trait RNT. As RNT is strongly associated with and is a risk factor for depressive symptoms, it is possible that EF and, in particular, skills of IC and/or switching may moderate the association between trait RNT and depression during stressful events, although few have explored these links using prospective designs. Furthermore, the strong overlap between depression and RNT makes it difficult to ascertain the causal mechanisms underlying potential associations between the RNT, depression and EF (Wagner, Alloy, & Abramson, 2015). Although associations between RNT and executive dysfunction have been found, it is still unclear whether EF deficits increase vulnerability to trait RNT/state RNT under stress, whether trait RNT and/or state RNT results in executive dysfunction or whether another mechanism independently related to each of these variables may explain the association between them, such as motivation, alertness or psychomotor speed (Gotlib & Joormann, 2010).

A small number of studies have attempted to identify underlying mechanisms that may result in associations between EF, RNT and depression using prospective designs. Demeyer and colleagues (Demeyer, De Lissnyder, Koster, & De Raedt, 2012) found that poor EF skills for emotional stimuli predicted later RNT. In a second study, RNT mediated the association between EF and depressive symptoms in a sample of remitted adult depressed patients (Demeyer et al., 2012). Snyder and Hankin (2016) examined a process model linking EF to psychopathology (depression and anxiety symptoms) through dependent stressful life events (e.g., achievement failures, interpersonal conflict) and subsequent rumination in adolescents and young adults aged 11-

20 years. The study indicated that self-reported EF skills prospectively predicted anxiety and depression at three-year follow-up, mediated by stressful events and subsequent RNT. Controlling for stressful life events, RNT did not directly mediate the relationship between EF deficits and psychopathology. The authors suggest that future longitudinal studies are required, utilising neutral versus affect-laden behavioural measures of EF to explore mechanisms by which EF may contribute to psychopathology. They also suggest that future research should pay closer attention to the role of natural stressors in the generation of RNT and subsequent psychopathology (see also McIntyre et al., 2013).

A number of theories have been proposed to explain potential associations between RNT, depression and cognitive performance. For instance, the resource allocation hypothesis (RAH; Ellis & Ashbrook, 1988) posits that state RNT depletes cognitive resources directed towards task-relevant processes resulting in irrelevant depressive thoughts (Gotlib & Joormann, 2010), supported by RNT induction studies (e.g., Watkins & Brown, 2002). Alternatively, the impaired disengagement hypothesis (IDH) proposes that stressors (e.g., exam stress) create discrepancies with individuals' internal goals, cueing RNT and resulting in cognitive conflict (Koster, De Lissnyder, Derakshan, & De Raedt, 2011). Here, individuals with reduced cognitive processing skills such as poorer EF performance may be triggered to engage in RNT upon encountering stressful events and/or negative mood states. Joormann (2010) proposed that IC is a critical mechanism for regulating emotions in the face of a stressor. However, in contrast to the RAH, evidence for the IDH is only beginning to emerge (De Lissnyder, Koster, & De Raedt, 2012).

Repetitive negative thinking, executive functions and stress

Understanding the nature of the associations between trait RNT as a common risk factor for depression, environmental stressors and depressive symptomology is crucial to inform preventative strategies and early interventions in young adults (Joorman & Gotlib, 2008; Nolen-Hoeksema,

2000). In a brief prospective study with students (between 17-24 years of age) prior to and in the lead up to their first examination period at university, De Lissnyder and colleagues (De Lissnyder, Koster, Goubert, Onraedt, Vanderhasselt, & De Raedt, 2012) investigated whether inter-individual differences in task switching moderated the differential types of rumination (brooding and reflective pondering) in response to stress. The study found that cognitive switching only moderated the association between stress and increased rumination for emotionally-laden material and that switching impairments were associated with depressive brooding rather than reflective pondering following the occurrence of a stressor (examinations). The study was unable to replicate findings using neutral EF stimuli and the cognitive switching task also lacked construct validity. The study also failed to differentiate between state and trait RNT in response to stress making it difficult to interpret whether findings were context or person dependent.

Taken together, cognitive theories recognise that psychological vulnerability (e.g., certain cognitions or processing of information in particular ways) coupled with a precipitating stressor (e.g., negative life event or environmental stressor) often precedes the onset of RNT and depression (Gotlib & Joormann, 2010). A person's inherent propensity to engage in RNT (trait RNT) is negatively associated with their ability to disengage negative material in the face of stressors, which in turn may be associated with negative affect and later depression (Davis & Nolen-Hoeksema, 2000). Under conditions of stress, cognitive control skills may be critical to disengage from RNT. However, the causal nature of the associations between stress, RNT and depression have only been examined in a small number of studies with an increased need for prospective designs with populations vulnerable to developing psychologically distressing symptoms, such as adolescents and young adults (Joormann et al., 2007).

Current study

This study attempts to address current gaps in the literature, building on the work of Snyder and Hankin (2016) and De Lissnyder, Koster, Goubert, Onraedt, Vanderhasselt, and De Raedt (2012) by exploring a process model linking neutral behavioural measures of EFs (IC and switching), trait and state RNT, depressive, and anxious symptoms during a known period of increased stress in young adulthood (students' formal examinations; Bosch, de Geus, Ring, Amerongen, & Stowell, 2004). By utilising behavioural measures of EF with young adults, the study aims to more robustly assess EF in a population whose age places them at increased risk of developing psychopathology. By testing participants prospectively, at baseline and during formal examinations, the study hopes to understand how stress may be linked with depressive and anxious symptoms as well as the ability of EFs and RNT to predict who may be vulnerable to increased distress during stressful periods. The study also examines whether behavioural EF measures of IC and switching predict changes in state RNT, depressive and anxious symptoms between baseline and a period of naturally induced stress (two to three months from baseline).

The first research questions (RQs) explore whether there is any association between measures of cognitive switching, inhibitory control and measures of state RNT, trait RNT, depression, anxiety and stress at baseline (T1). Models of RNT detail how trait RNT is often closely linked to participants' experience of stressful situations such that a person's propensity to RNT (trait RNT) may affect responses during stressful situations (state RNT). It is anticipated that individuals who have a higher tendency to RNT (trait RNT) will show more of a change in state RNT about a recent situation under conditions of stress compared with those with lower trait RNT. As a result, the third RQ explores whether trait RNT at T1 predicts changes in state RNT, depression and anxiety under stress and what influence EF may have on this relationship. The final set of RQs explores whether EF predicts changes in state RNT, depression and anxiety during a stressful period.

Hypotheses

Hypothesis 1 (H1): EF measures of switching and IC will be negatively associated with T1 trait RNT, state RNT, depression, anxiety and stress.

Hypothesis 2 (H2): State RNT, depression, anxiety and stress will significantly increase between baseline (T1) and during the period of formal university examinations (T2; 9th-11th of January), between two and three months after baseline.

Hypothesis 3a (H3a): Trait RNT at T1 will predict changes in state RNT under stress such that higher levels of trait RNT will predict higher levels of state RNT at T2, controlling for state RNT, negative life events and gender at T1.

Hypothesis 3b (H3b): EF measures of switching and IC will predict state RNT at T2, controlling for state RNT, trait RNT, negative life events and gender at T1. Better performance on EF measures at T1 will predict lower levels of state RNT at T2, controlling for state RNT at T1.

Hypothesis 3c (H3c): Trait RNT at T1 will predict greater increases in state RNT at T2 for individuals with poorer EF performance, controlling for state RNT, negative life events and gender at T1.

Hypothesis 4a (H4a): Trait RNT at T1 will predict changes in depression at T2, controlling for depression, negative life events and gender at T1. Higher levels of trait RNT will predict higher levels of depression at T2.

Hypothesis 4b (H4b): EF measures of switching and IC will predict changes in depression at T2 controlling for depression at T1, trait RNT, negative life events and gender at T1. Better performance on EF measures at T1 will predict lower levels of depression at T2.

Hypothesis 5a (H5a): Trait RNT at T1 will predict changes in anxiety under stress such that higher levels of trait RNT will predict higher levels

of anxiety at T2, controlling for anxiety, negative life events and gender at T1.

Hypothesis 5b (H5b): EFs measures of switching and IC will predict changes in anxiety at T2 controlling for anxiety, trait RNT, negative life events and gender at T1. Better performance on EF measures at T1 will predict lower levels of anxiety at T2.

Method

Design

This prospective cohort study explored the relationships between trait and state RNT, depressive and anxious symptoms and stress at two time points. Baseline (T1; 3rd-30th of October, 2016) was a period of no known general stress for the cohort of students while the second time point (T2; 9th-11th January, 2017) was two to three months later, hypothesised to be a period of naturally elevated stress, during participants' formal university examinations. Questionnaire measures assessed young adults' reported levels of state RNT, depression, anxiety, adverse life events and experience of a natural stressor (exams) at both T1 and T2 while EFs (IC and switching) and trait RNT were assessed at baseline (T1) only. EFs were assessed using computer-based behavioural measures.

Participants

A power analysis was performed a priori using G* Power (Faul, Erdfelder, Lang, & Buchner, 2007) and can be viewed in Appendix L. This indicated that 150 participants would need to be recruited in order to detect small-medium effects with an 80% power at a .05 significance level, accounting for a 20% attrition rate expected between T1 and T2. One hundred and eight participants were recruited into the study using printed and online advertisements within the University of Exeter. All participants were first year undergraduate psychology students scheduled to sit their first set of university

examinations in January 2016. One hundred and two participants were eligible for inclusion at T1 with reasons for exclusion detailed below.

Participants were included if they were planning to sit their university exams in January 2016. Participants also had to be fluent in English. Participants were excluded if they reported having a learning disability, head injury (loss of consciousness >2 minutes; *n* = 2), currently using psychoactive medication (*n* = 3) or were over 25 years of age (*n* = 1). A proportion of the sample identified as bilingual (*n* = 36; 35%, most of whom had English as their first language and Chinese as their second language).

At T1, 102 participants completed baseline assessments and 84 participants completed the T2 follow-up questionnaires with an 18% dropout rate between T1 and T2 (see Table 1). As is typical for psychology courses (Trapp et al., 2011), the majority of the sample was female (*n* = 82; 79%) and reflecting the demographics of the recruitment area, were White British (*n* = 66; 65%). Data at T1 was collected over a four-week period (3rd-30th October 2016) with T2 collected within a three-day period (9th-11th January 2017), approximately two to three months after T1 (minimum = 74 days; maximum= 102 days) and during participants' formal university exam period.

The University of Exeter Ethics Review Board approved the study (Appendix A). All participants were entered into a prize draw at each time point for a chance to win £60 Amazon vouchers as well as receiving course credits for their participation at each time point.

Measures

Baseline only measures.

Category switch task (Lavric, Mizon, & Monsell, 2008). Based on the Wisconsin Card Sort Test (Heaton, Chelune, Curtiss, Kay, & Talley, 1993) this modified task-switching test involved participants switching their attention

between cognitive tasks. Stimuli were made up of one of four shapes (circle, triangle, square, pentagon), presented in one of four colours (red, orange, green, blue), centred on a computer screen with white background. Participants must identify with a key-press either the colour or shape of the stimulus, depending on which task-cue was presented, either the word 'COLOUR' or 'SHAPE'. Subjects responded using one of four keys on the keyboard (v, b, n, or m). Cues preceded the stimulus by a 200 ms or 800 ms interval, varied between blocks. For repeat trials, the task repeats from previous trials and for switch trials, the task differs from the previous trial. Cognitive switching is required to alter responses from one task to another where the difference between repeat- and switch-trials offers an index of such processes in action (Monsell, 2003).

Participants completed 64 practice trials on each task without switching, followed by three blocks of 97 practice trials. Following this, participants completed six blocks of 97 trials that included switch trials. There were equal numbers of trials for each combination of task, stimulus and cue and each combination had a one: two ratio of task-switch and repeat trials where the order of trials was randomised for each participant. Mean reaction times (RTs) for trials following correct responses only were analysed (Lavric, Mizon, & Monsell, 2008). Switch-costs were calculated by subtracting mean RTs for repeat trials from mean RTs for switch trials collapsed across both time intervals.

Demographic questionnaires. Self-report questionnaires gathered key demographic information including dates of birth, gender and socioeconomic status (SES; Appendix E). SES was assessed using parents/guardians' occupation and highest level of academic attainment (Sirin, 2005).

The Eriksen arrow flanker task (Eriksen & Eriksen, 1974). In this task of inhibitory control (IC), participants must quickly respond to a target stimulus that is flanked by several distractor stimuli on each side. Right- or left-pointing distractor arrows surround right- or left-pointing central arrows. During

congruent trials, the central or target stimuli are associated with the same response as the flanked arrows (e.g., <<<<<<<). During incongruent trials, target stimuli the flanker arrows are associated with a competing response, such that participants have to inhibit the response tendency associated with the flanker arrows (e.g., <<<><<<). Participants must resolve the conflict and ignore flanker arrows, responding with the key corresponding to target stimuli using the arrow keys on their computer keyboards. RTs are faster for congruent than incongruent trials. The dominant explanation for this is that automatic activation of the response channel associated with flanker stimuli is activated where incongruent trials require participants to engage inhibitory control to overrule automatic activation, resulting in slower correct responses (Eriksen & Schultz, 1979).

Stimuli were presented in black font (28) on white background. A practice block of 40 trials followed instructions. Feedback was provided for accuracy and average RTs following the practice block and after each experimental block. Following the practice block, participants completed 12 experimental blocks of 40 trials. The flanker effect or IC variable was calculated by subtracting mean RTs for congruent from incongruent trials. The data preparation procedure proposed by Friedman and Miyake (2004) was applied. Only correct trials were included in the RT analyses. Values below 200 ms and over 1500 ms were eliminated, as they are likely to represent errors or inattention.

Perseverative thinking questionnaire (PTQ; Ehring et al., 2011). The PTQ, typically used with adults is a measure of trait RNT. Questions assess features of RNT including thinking that is repetitive, intrusive and unproductive (see Appendix H). Lead author, Thomas Ehring (Ludwig Maximilian University, Munich) was contacted and suggested the task was appropriate to use with this late adolescent and young adult sample (see Appendix I). Participants were asked to rate 15 statements (based on RNT process characteristics) on a four-point scale from ‘0’ (*never*) to ‘4’ (*almost always*). Internal consistency for the measure was excellent (α = .92). Test-retest reliability over a four-week interval for total scores were good (r = .69; Ehring et al., 2011).

Baseline and time 2 measures.

Child and adolescent survey of experience: child version (CASE; Allen, Rapee & Sandberg, 2012). Adapted for children and adolescents from the Psychosocial Assessment of Child Experiences (PACE; Sandberg et al., 1993), the CASE is a 38-item checklist of life events with additional space to add life events by respondents (Appendix G). Respondents indicated whether each event had occurred within the previous 12 months, rating each event on a six-point scale from positive to negative in relation to how it made them feel where '1 = *really good'* and '6 = *really bad'* with no neutral point. Units of measurement yielded by the CASE include total number of positive and negative events as well as a weighted total impact of positive and negative events. The CASE has demonstrated good test-retest reliability, with estimates comparable to other life events checklists (e.g., *rs* = .75 in one week follow-up of child ratings; Allen et al., 2012). As the number of life events and impact of life events correlated so highly (r = .96, p < .01), impact of negative life events was used as the predictor in the model for analyses. Although this measure is originally intended for children and adolescents, the items included closely resemble other life events checklists used for adults (e.g., the Life Events and Difficulties Checklist; Brown & Harris, 1989). Part of the rationale for the use of this measure was also so that the data could be linked with an ongoing collaborative developmental study investigating the effects of exam stress in mid- to late-adolescents and young adults of school and university ages. For school-specific questions participants were advised to respond by contemplating the effects based on their experience (if relevant) of leaving home, transitioning from school to university and/or between universities and/or being at university (e.g., items 1, 9 and 23). Items three and 10 were not included in the analysis due to their specificity to school-age students and the assumption that most participants were living away from home at time of testing. It helped that most participants who completed the questionnaires were in their first year, first semester of university and therefore many could draw on their experiences of leaving home and transitioning from school to university for

the first time. Furthermore, as the questionnaire relates to the last 12 months participants were instructed that they could draw on either their experience(s) during their last semester at secondary school so long as it was within the last 12 months and/or their experience(s) at university as this measure aimed to capture the impact of significant life events on participants during the course of the last 12 months.

Perceived stress check. To assess the ecological validity of T2 as a period of naturally elevated stress (Treuba, Smith, Auchus, & Ritz, 2013), participants completed questionnaires consisting of a four item measure, scored on a 10-point scale from '0' (*no stress*) to '10' (*highest levels of stress*; e.g., "*How stressed are you feeling about your upcoming exams?*", see Appendix F). Questions were included at both time points to explore changes in stress between T1 and T2. Internal consistency was good at T1 (α = .80) and T2 (α = .71).

Repetitive thinking questionnaire (RTQ; McEvoy, Mahoney, & Moulds, 2010). The RTQ was used to assess RNT in relation to a specific event (in this case, exams) using 31 items. The RTQ can be used to assess state RNT or how much someone is currently ruminating about a stressful situation (either a past or future event). The questionnaire was adapted to future-orientated thoughts and feelings about participants' upcoming exams. Participants rated how true each statement was across using a five-point response scale from '1' (Not true at all) to '5' (Very true; see Appendix J). Items were adapted from the Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990), the Ruminative Response Scale of the Response Style Questionnaire (RSQ; Nolen-Hoeksema & Morrow, 1991) and the Post-Event Processing Questionnaire-Revised (McEvoy & Kingsep, 2006). Two subscales of RNT and absence of RNT were measured, where the RNT subscale used in the analyses of results for this study includes the majority of items (n = 27). Internal consistency was excellent at T1 (α = .91) and T2 (α = .94).

Revised child anxiety and depression scale (RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000). The RCADS is a self-report measure including 47 items (see Appendix K) assessing symptoms of anxiety and depression in adolescents (eight to eighteen years of age). Using a four-point scale, participants rate how often each item applies to them from '0' (*Never*) to '3' (*Always*). Scales include separation anxiety, generalised anxiety disorder, panic disorder, obsessive-compulsive disorder and major depressive disorder (MDD). For the purposes of this study, subcomponents of depression and anxiety only were analysed. Internal consistency for the RCADS was good at T1 (α = .94) and T2 (α = .96). Two-week test-retest reliability coefficients were found to be favourable (r = .65-.86; Ebesutani et al., 2011). Although this measure is only standardised up to 18 years of age and originally intended for use with mid- to late-adolescents it was felt that the measure would be adequate to assess a slightly older cohort of young adults' general levels of depressive and anxious symptoms. Furthermore, the data from this study form part of a collaborative developmental study examining the effects of exam stress in mid- to late-adolescents and young adults of school and university ages. Researchers have also argued that adolescence is a fluid period, continuing through to the early twenties with the World Health Organization (2005) defining the period of adolescents between 12-19 years. Recently, a number of child and adolescent mental health services in the UK have broadened their remit to include referrals from individuals below the age of 25 years of age to account for the transitional phase between childhood and adulthood (National Health Service England, 2016). As with the CASE measure of life events, participants were instructed to answer school-specific questions in relation to their experience of university (e.g., item 12).

Procedure

Participants were told that participation was voluntary and would require completion of three parts. Part one involved completion of questionnaires and one behavioural task of cognitive switching performed on computers in the lab (category switch task). For part two, participants were requested to complete an

online task of IC (arrow flanker task) within 24 hours of completing the lab component. Part three involved completing online questionnaires sent via a secure link (Lime survey) during participants' exam period. Participants had a two-day window in which to complete part three in order to coincide with the exam timetable. Any data submitted following the exam period (e.g., 12th of January 2017) was not included in the analysis. Debriefing information was sent to participants following completion of all three parts as well as to those who did not complete all three elements prior to the deadline.

Analysis

For power analysis and further details regarding the analysis plan for the study see Appendix L and Appendix M respectively.

Outliers and influential statistics. A number of missing data points were present in the sample across time points. A dummy variable was created to assess the randomness of missing data, indicating a significant difference for depression scores $t(100) = 2.41$; $p = .02$ between participants who completed all tasks at both time points ($n = 67$) of the study and those who did not ($n = 35$). Participants who completed all elements had lower depression scores ($M = 7.22$; $SD = 4.37$) than those who had missing data ($M = 9.66$; $SD = 5.16$). For Time 1 data only, mean substitution was used to estimate values of missing items on particular scales ($n = 5$). Z-scores and boxplots were used to check for outliers. Univariate outliers were found for depression and anxiety subscale scores at Time 1 (z-scores > 3.29, $p < .001$; Tabachnik & Fidell, 2007). Square root transformations were performed for both measures at T1 and T2, reducing the impact of outliers and skewness. Cook's distance was used to check for the influence of single cases (<1) in the model as part of the regression analyses (Cook & Weisberg, 1982). Mahalanobis distances were used to measure leverage using recommended cut-off <15.6 (Barnet & Lewis, 1978) and DFBeta to measure the influence of a single case on regression parameter (< +/-0.33; Field, 2005). No influential cases were identified following outlier analyses.

Parametric assumptions. Residuals of the regression model were approximately normally distributed. Standardized residuals were plotted against range of predicted values of the outcomes in the regression (*ZResX*XPred) to examine linearity and homogeneity of variances. A nonlinear/curvilinear pattern was not observed (linearity assumption met) and no change in dispersion of the residuals at different predicted values of the outcome (no heteroscedasticity). Partial plots were linear and homoscedastic (plotting predictors against outcome following partialling out for the other predictors). Correlations between predictor variables did not exceed >.7 suggesting low levels of collinearity and allowing determination of individual predictors (Field, 2005).

Results

Descriptive Statistics

A summary of demographic statistics for the sample is presented in Table 1. A series of one-way ANOVAs found no differences between monolingual and bilingual participants on all measures. Participants reported a number of significant negative life events at T1 (e.g., losing a family member, failing an important exam) and 23 participants reported events occurring between T1 and T2.

Relationships among measures

To examine the H1 and explore correlations among variables, a series of Pearson's *r* correlations were conducted (see Table 2). Findings indicated that neither switching (switch cost) nor IC (flanker) correlated with one another or with any other measure utilised in the study. These non-significant correlations meant that H1 was not supported: IC and switching did not correlate negatively with trait RNT, state RNT, depression or anxiety at T1.

The flanker task of IC did correlate significantly with gender, such that males showed a reduced flanker effect (*M* = 75.63 ms; *SD* = 25.80) than

females (*M* = 98.20 ms; *SD* = 30.62). Impact of negative life events at T1 correlated significantly with both measures of rumination and depression at T1 but not measures of stress and only with state RNT at T2. Impact of negative life events at T2 was not significantly associated with life events at T1 and only correlated with depression at T2.

Measures of trait (PTQ) and state RNT (RTQ) correlated positively with most other measures as well as with each other at T1. Depression and anxiety scores were also highly correlated with one another at both T1 and T2. Depression and anxiety scores also correlated highly with trait RNT at T1 and state RNT at T1 and T2. Reported current stress at T1 correlated with both measures of RNT and depression at T1 and T2.

Table 1

Descriptive Statistics at Baseline (T1) and During the Exam Period (T2)

	Time 1 ***n* = 102**			**Time 2** ***n* = 84**		
Demographics	*M*	*SD*	Range	*M*	*SD*	Range
Age (months)	229.9 (19 years, 1 month)	11.7	215 – 282 (17 years, 11 months – 23 years, 6 months)	230.5** (19 years, 2 months)	10.8	217 – 284 (18 years, 1 month – 23 years, 8 months)
CASE Tot	4.5	2.6	0 – 13	1.4**	0.7	1 - 3
CASE Imp	8.8	5.7	0 – 25	3.2**	2.0	1 - 9
Rumination						
PTQ (Trait RNT)	27.5	9.9	7 – 55	-	-	
RTQ (State RNT)	68.7	19.7	37 – 123	76.3**	21.8	33 – 124
Executive Functions						
Flanker RT (IC; *n* = 77)	92.9ms	30.9ms	27.1ms – 184.6ms	-	-	
Switch RT (Switching; *n* = 102)	108.6ms	74.8ms	- 23.7ms – 342.2ms	-	-	
Clinical Measures						
RCADS Dep	8.1	4.8	1 – 24	10.9*	8.6	0 – 35
RCADS Anx	30.9	13.9	5 – 74	41.5**	24.5	6 – 104
Stress						
General Stress	4.9	2.8	0 – 10	6.6	1.6	2 – 10
Exam Stress	4.9	2.6	0 – 10	7.4**	1.6	2 – 10
Other Stress	5.1	2.3	0 – 9	4.3**	2.6	0 – 10
Time Spent Stressing	3.5	2.4	0 – 9	5.7**	2.1	2 – 10

Note. CASE Imp = Child and Adolescent Survey of Experience Total Impact of Negative Life Events; CASE Tot = Child and Adolescent Survey of Experience Total Number of Negative Life Events Reported; FlankerRT = Flanker Task of Inhibitory Control Reaction Times; M = Mean; PTQ = Perseverative Thinking Questionnaire; RCADSAnx = Revised Child Anxiety and Depression Scale, Anxiety Subscale Total (aggregate score); RCADSDep = Revised Child Anxiety and Depression Scale, Depression Subscale Total (aggregate score); RTQ = Repetitive Thinking Questionnaire; SD = Standard Deviation; SwitchRT = Switch Task Reaction Times.
*$p < .05$. **$p < .01$ (significant difference between T1 and T2 scores).

Table 2

Correlations Among Variables Across Time Points

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Gender	-	-.06	.18	.23*	.16	.22*	.31**	-.02	.22*	.26*	-.47*	.13	.14	.18	.26*	.18
2 T1CASE		-	.32**	.41**	.39**	.31**	-.15	.05	.18	.18	.15	.25**	.21	.19	.13	.15
3 T1PTQ			-	.61**	.64**	.72**	.12	.17	.30**	.29**	-.10	.38**	.32**	.32**	.20	.24*
4 T1RTQ				-	.59**	.70**	.11	.00	.43**	.59**	-.01	.53**	.36**	.44**	.34**	.46**
5T1Depress					-	.73**	.02	.12	.42**	.38**	-.20	.35**	.50**	.37**	.12	.24*
6 T1Anx						-	.08	.18	.44**	.47**	-.27	.46**	.42**	.52**	.25*	.31**
7 FlankerIC							-	.05	.18	.22	-.38	-.06	-.09	-.07	-.07	.08
8 Switching	.							-	.03	-.03	-.26	-.11	-.13	-.06	-.07	.06
9 T1Stress									-	.60**	-.19	.32**	.39**	.29**	.20	.36**
10 T1ExamStr										-	.16	.22*	.40**	.29**	.23*	.43**
11 T2CASE											-	.40	.30	.26	.17	.21
12 T2RTQ												-	.68**	.80**	.48**	.47**
13 T2Depress													-	.79**	.39**	44**
14 T2Anx														-	.40**	.46**
15 T2Stress															-	.63**
16 T2ExamStr																-

Note. Anx = Revised Children's Anxiety Subscale (aggregated score); CASE = Child and Adolescent Survey of Experience (impact of negative life events subscale); Depress = Revised Children's Depression Subscale; FlankerIC = Flanker Task Inhibitory Control Reaction Times; ExamStr = Exam Stress Validity Check Question; PTQ = Perseverative Thinking Questionnaire; RTQ = Repetitive Thinking Questionnaire; Stress = Stress Validity Check Question; Switching = Cognitive Switching Task Reaction Times; T1 = Time 1; T2 = Time 2.

*$p < .05$. **$p < .01$.

Changes from baseline to exam period

To explore H2, paired *t*-tests compared participants results across time to investigate whether, as hypothesised scores of state RNT, depression, anxiety and state RNT would be elevated during the exam period (T2) compared with baseline (T1). In line with H2, there was a significant rise in scores for all measures between T1 and T2. As predicted, scores for state RNT, $t(83) = -3.41$, $p < .01$, $d = 0.37$, depression $t(83) = -3.04$, $p < .01$, $d = 0.30$ and anxiety scores, $t(83) = -4.42$, $p < .01$, $d = 0.49$ all increased significantly during the exam period. Measures of reported stress also increased significantly between T1 and T2 indicating that participants were increasingly more stressed during the examination period compared to baseline. Stress about other life events was the only indicator of stress that significantly decreased between T1 and T2, $t(83) = 2.36$, $p = .02$, $d = .26$.

Regression analyses

To test H3a, H3b and H3c a hierarchical linear regression was conducted exploring whether T1 trait RNT (PTQ), EFs at T1 and the interaction between trait RNT and EF predicts state RNT at T2 controlling for state RNT, negative life events and gender at T1.

In the first step T1 state RNT, T1 trait RNT, T1 depression, CASE and gender were entered to explore whether they each predicted changes in the outcome measure, T2 state RNT. Together, the predictors explained significant variability in T2 state RNT, $F(5, 60) = 4.95$, $p = .001$ (see Table 3). Looking at the individual predictors, T1 state RNT was significantly positively associated with T2 state RNT but trait RNT did not explain significant unique variance, such that H3a was not supported. No other predictors were statistically significant.

In step two, predictors of switch cost and flanker[1] were entered to explore whether EF predicted additional unique variance in T2 state RNT. The EF variables did not explain significant additional variance in T2 state RNT, change in $F(2, 58) = 1.57$, $p = .22$. Neither switching nor inhibitory control (IC) predicted unique additional variance in T2 state RNT, therefore H3b was not supported. Otherwise, the pattern of significant results did not change.

In step 3, two centred interaction terms (switch cost X T1trait RNT and flanker X T1trait RNT) were entered as additional predictors into the model. The aim was to explore whether the interaction between EF and T1 trait RNT predicted additional unique variance in T2 state RNT. The interaction terms explained significant additional variance in T2 state RNT, change in $F(2, 56) = 10.76$, $p < .001$. The interaction between trait RNT and switching (switch cost X T1 trait RNT) was a significant predictor of additional variance in state RNT, in line with H3c. The interaction between trait RNT and flanker performance was not statistically significant. To examine the pattern of the interaction, predicted scores on T2 state RNT were calculated for people scoring one standard deviation above and below the mean on trait RNT and EF switching performance and plotted in Figure 1.

[1] *Note.* The number of participants who completed the online flanker task was less ($n = 77$) than those who completed the switching task ($n = 102$). This affected the sample size in the regression models and due to pairwise deletion the model only included participants who completed all three components of the study ($n = 67$). As a result, the regression analysis was re-run with those who had completed the switching task and T2 questionnaires ($n = 84$) but had not completed the flanker task at T1. This resulted in the model becoming significant for H4b and H5b where switch cost was a significant predictor of depression at T2 (controlling for trait RNT, CASE, gender and depression at T1) and the interaction between trait RNT and switching was a significant predictor of change in state RNT (H3c, see Appendix N). Switch cost did not predict changes in anxiety at T2 controlling for trait RNT, CASE, gender and anxiety at T1.

Table 3

Hierarchical Regression Analyses for Hypothesis 3a 3b and 3c

	B	SE B	β	p	Variance Explained
T2 State RNT					
Step 1					
T1 State RNT	.45	.18	.39	.02	
T1 Trait RNT	.27	.34	.12	.79	
T1 Depress	3.40	3.90	.13	.38	$R^2Change$ = .29,
T1 CASE	-.22	.49	-.06	-.44	$R^2_{adjusted}$ = .23, p <
Gender	.63	6.10	.01	.91	.001
Step 2					
T1 State RNT	.45	.18	.39	.02	
T1 Trait RNT	.36	.34	.16	.30	
T1 Depress	3.20	3.90	.12	.42	
T1 CASE	-.26	.49	-.07	.60	
Gender	-1.40	6.30	-.03	.82	$R^2Change$ = .04,
Switch Cost	-.05	.03	-.16	.16	$R^2_{adjusted}$ = .25, p =
Flanker	-.09	.08	-.12	.31	.22
Step 3					
T1 State RNT	.58	.16	.50	<.01	
T1 Trait RNT	.56	.30	.25	.07	
T1 Depress	.98	3.50	.04	.78	
T1 CASE	-.32	.45	-.08	.49	
Gender	.34	5.50	.01	.95	
Switch Cost	.01	.03	.03	.76	
Flanker	-.10	.07	-.14	.17	$R^2Change$ = .19,
Switch Cost X T1 Trait	-.01	.00	-.49	<.01	$R^2_{adjusted}$ = .44, p <
RNT	-.00	.01	-.02	.87	.001
Flanker X T1 Trait RNT					

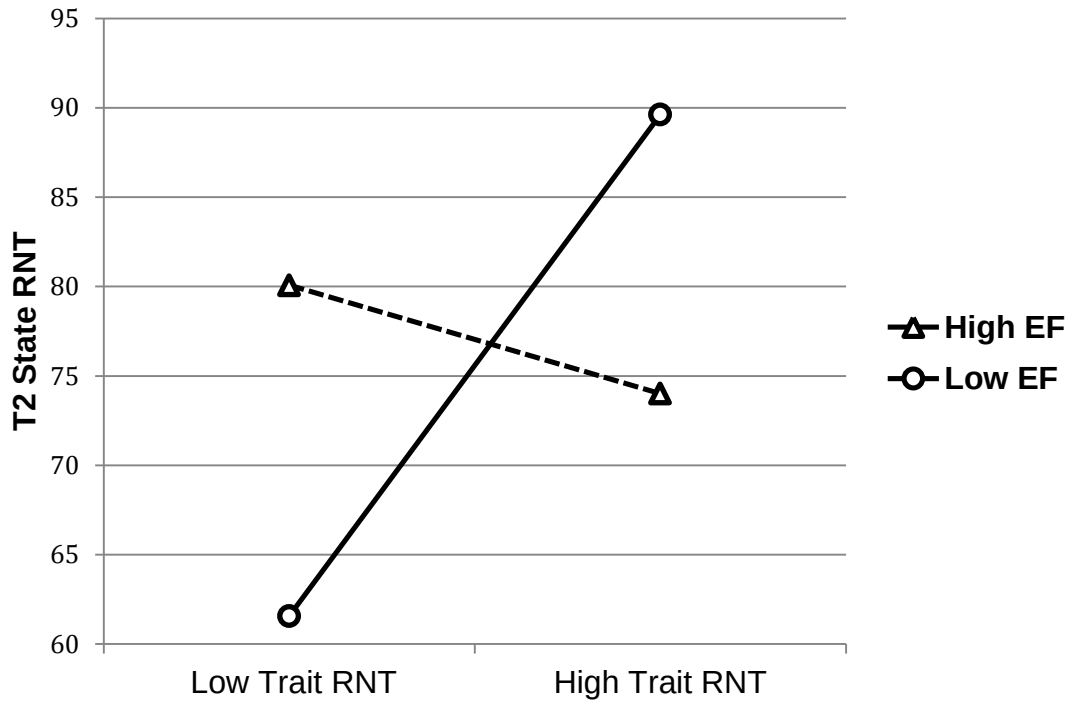

Figure 1 Plot of the interaction between trait RNT and EF on state RNT at T2

To test H4a and H4b, a second hierarchical linear regression was conducted exploring whether trait RNT and EF measures at T1 predicts depression at T2, controlling for depression at T1, negative life events and gender. In the first step, T1 depression, T1 trait RNT, T1 CASE and gender were entered to explore whether each variable uniquely predicted any change to the outcome measure, T2 depression. Together, the predictors explained significant variability in T2 depression, $F(4, 62) = 10.98$, $p < .001$ (see Table 4). Looking at the individual predictors, T1 depression was significantly positively associated with T2 depression but trait RNT did not explain significant unique variance, such that H4a was not supported. No other predictors were statistically significant.

Table 4

Hierarchical Regression Analyses for Hypotheses 4a and 4b

	B	SE B	β	p	Variance Explained
T2 Depression					
Step 1					
T1 Depress	1.10	.21	.68	<.01	
T1 Trait RNT	-.00	.02	-.03	.83	$R^2Change$ = .41,
T1 CASE	-.02	.03	-.08	.51	$R^2_{adjusted}$ = .37, *p*
Gender	-.19	.34	-.06	.57	< .001
Step 2					
T1 Depress	1.10	.21	.67	<.01	
T1 Trait RNT	.00	.02	.01	.91	
T1 CASE	-.02	.03	-.09	.45	
Gender	-.32	.35	-.10	.36	$R^2Change$ = .04,
Switch Cost	-.00	.00	-.17	.09	$R^2_{adjusted}$ = .39, *p*
Flanker	-.01	.00	-.12	.26	< .13

In step two, predictors of switch cost and flanker were entered to explore whether EFs predicted additional unique variance in T2 depression. The EF variables did not explain significant additional variance in T2 depression, change in $F(2, 60) = 2.34$, $p = .11$. Neither switching nor inhibitory control (IC) predicted unique additional variance in depression therefore H4b was not supported. T1 depression remained a significant predictor of T2 depression.

To test H5a and H5, a final hierarchical linear regression was conducted exploring whether trait RNT and EF measures at T1 predicts anxiety at T2, controlling for anxiety at T1, negative life events and gender. In the first step, T1 anxiety, T1 trait RNT, T1 CASE and gender were entered to explore whether they each predicted changes in the outcome measure, T2 anxiety. Together, the predictors explained significant variability in T2 anxiety, change in $F(4, 62) = 8.40$, $p < .001$ (see Table 5). Looking at the individual predictors, T1 anxiety was significantly positively associated with T2 anxiety but trait RNT did not

explain significant unique variance, such that H5a was not supported. No other predictors were statistically significant.

Table 5

Hierarchical Regression Analyses for Hypotheses 5a and 5b

	B	**SE B**	**β**	**p**	**Variance Explained**
T2 Anxiety					
Step 1					
T1 Anxiety	1.03	.23	.70	<.01	
T1 Trait RNT	-.04	.03	-.18	.25	R^2*Change* =
T1 CASE	-.01	.04	-.02	.84	.35, $R^2_{adjusted}$ =
Gender	-.25	.52	-.05	.63	.32, $p < .001$
Step 2					
T1 Anxiety	1.03	.23	.70	<.01	
T1 Trait RNT	-.03	.03	-.16	.32	
T1 CASE	-.01	.04	-.04	.72	
Gender	-.42	.54	-.09	.44	R^2*Change* =
Switch Cost	-.00	.00	-.11	.30	.03, $R^2_{adjusted}$ =
Flanker	-.01	.01	-.12	.29	.32, $p = .25$

In step two, predictors of switch cost and flanker were entered to explore whether EF predicted additional unique variance in T2 anxiety. The EF variables did not explain significant additional variance in T2 anxiety, change in $F(2, 60) = 1.42$, $p = .25$. Neither switching nor inhibitory control (IC) predicted unique additional variance in anxiety therefore H5b was not supported. T1 anxiety remained the only significant predictor in the model. Thus, unexpectedly, neither trait RNT nor EF predicted changes in depression or anxiety between baseline (T1) and during the formal university examination period (T2).

Discussion

This study investigated the associations between trait RNT, state RNT, EF and depressive, anxious and stress responses at two time points (baseline and during the examination period) in a non-clinical sample of young adults. The study also explored whether trait RNT and EF predicted changes in state RNT, depressive and anxious symptoms following a period of naturally elevated stress. Finally, the study explored whether the interaction between trait RNT and EF moderated changes in state RNT.

In relation to H1, neither cognitive switching nor IC, as components of EF, was associated with measures of RNT, stress, depressive or anxious symptoms at either time point. A failure to detect any associations between EF and clinical measures may reflect mixed findings within the literature. While some studies cite the association between depression and EF impairments (see Snyder, 2013 for review), others have failed to detect any association between measures of cognitive switching (Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, Lönnqvist, 2008) or IC (Joormann & Gotlib, 2010) and dysthymia or depression, particularly in non-clinical or sub-clinical samples of young adults (Bora, Harrison, Yücel, & Pantelis, 2013; Grant, Thase, & Sweeney, 2001). These results may contribute to this literature although it is worth noting that as this was a typical sample of young adults, the generalizability of these results to clinical populations is limited.

The study also failed to identify any associations between RNT and EF. These findings are in contrast with previous research, which has indicated through experimental manipulations and prospective research that increased rumination reduces EF task performance (e.g., Lyubomirsky & Nolen-Hoeksema, 1995; Watkins & Brown, 2002) and that cognitive control prospectively predicts rumination (Zetsche & Joormann, 2011), although prospective results are limited to a small number of studies (e.g., Demeyer et al., 2012).

While trait RNT (individual tendency to RNT) and state RNT (ruminating about particular life events under stress) were associated with depressive and anxiety symptoms neither trait nor state RNT predicted changes in depressive and anxious symptoms between T1 and T2 (H3a, H4a, H5a). This was a surprising finding given the wealth of prospective research indicating how those with higher tendency to ruminate are more likely to experience elevated depressive and anxious symptoms (e.g., Abela et al., 2002; Ehring & Watkins, 2008; Just & Alloy, 1997; Nolen-Hoeksema, Stice, Wade, & Bohon, 2007). Although the range of RNT scores varied within the sample, one explanation may be that by not using a clinical sample or selecting students with elevated RNT, the sample lacked variability to detect effects.

Previous research indicates that specific components of rumination, namely brooding as measured by the Ruminative Response Scale (RRS; Treynor et al., 2003), are more predictive of depressive symptoms compared with reflective pondering, which may act as a more adaptive form of RNT (Watkins, 2008). The study employed a measure of trait RNT (PTQ; Ehring et al., 2011), rather than the RRS to incorporate the highly correlated processes of rumination as part of the transdiagnostic process of RNT (Ehring & Watkins, 2008). Therefore, a methodological difference in this study from previous research is that the measure used was unable to further explore potential subcomponents of rumination as part of RNT, which may or may not have predicted subsequent changes in depressive/anxious symptoms. Another explanation for such findings is that state RNT, depressive and anxiety scores at T1 were used as a control variable within regression models. By controlling for symptoms, the variations within the sample is significantly reduced as measures are testing changes in symptomology rather than symptoms overall. This is particularly pertinent given the small, non-clinical sample, meaning that the power to predict small to medium effect sizes is limited.

One surprising finding was the lack of association between the cognitive shifting/switching and IC tasks. Researchers have highlighted how EF tasks are often moderately correlated yet separable based on their ability to detect unique

components of EF (see Huizinga, Dolan, & van der Molen, 2006; Miyake et al., 2000). However, these findings suggest that the cognitive switch task paradigm and flanker task shared little variance and were distinct from one another, although neither predicted changes in state RNT and clinical symptoms. Although EF task selection was carefully considered at the outset based on current cognitive rather than clinical research (Snyder et al., 2015), it is still possible that each of these tasks may have tapped functions other than switching and IC. Known as the task impurity problem, researchers often struggle to isolate specific functions in tasks which likely tap a number of cognitive processes related to EF (e.g., processing speed, psychomotor speed; Miyake & Friedman, 2012). Such processes may confound results in one or both of these keyed response, reaction time tasks (Snyder, 2013). While in the switching task, control conditions were included as part of the task paradigm in order to account for such factors, the flanker did not include such controls, limiting its validity. However, both the flanker and task switching paradigms are widely cited by cognitive researchers as being robust measures of IC and cognitive shifting respectively and it has been recommended that such measures be utilised in clinical research that traditionally utilise neurological measures, which often lack sensitivity to detect inter-individual differences within non-clinical samples (Snyder et al., 2015).

Findings indicated that in response to H3b, H4b, H5b, EF was unable to predict changes in state RNT, depressive and anxious symptoms controlling for trait RNT, gender and impact of negative life events at T1. This study was an attempt to address the lack of prospective research in the field using a naturalistic paradigm and behavioural EF tasks. The dominance of correlational designs utilising affective EF tasks have made it difficult to ascertain whether poorer EF performance may prospectively predict vulnerability to increased RNT, depressive and anxious symptoms under stress. Results suggested that EF alone was unable to predict changes in state RNT, depressive and anxious symptoms during a period of elevated stress. An inability to find a predictive relationship between EF and RNT and depression is inconsistent with some studies (e.g., DeLissnyder, Koster, & De Raedt, 2012; Snyder & Hankin, 2016)

but consistent with others (e.g., Connolly et al., 2014; Wagner et al., 2015). This is the first study that is known of which explored the predictive capabilities of EF using behavioural tasks.

One explanation for the lack of findings is that exam rumination may be a contextual phenomenon that is difficult to predict as measures that were hypothesised and widely cited as predicting future state RNT (e.g., trait RNT) were unable to do so here. Although the data indicated that the ecological validity of the study paradigm was good, evidenced by the naturally elevated and significantly increased stress responses during the examination period, the clinical significance of this difference may be less marked than the statistical difference. In other words, while the study found a statistically significant increase in state RNT scores, depressive and anxious symptoms between T1 and T2, the general levels of stress reported by participants at T2 may not have been clinically significant as scores did not rise to the very top of the scale (mean = 4.9 at T1 and 6.6 at T2). A mean score of 6.6 as the average at T2 does indicate that participants may not have been as stressed as might have been expected if this were a clinical sample. This may reflect the nature of the exams being sat, where first year, first semester exams may not be as stressful as alternative exams, for example, final year, final semester. However, at T2 the mean score for the item measuring how stressed participants felt about their exams was 7.4, indicating that participants were relatively concerned about their exams. While other studies have also utilised this paradigm, few have utilised measures of stress beyond a single-item measure, making it difficult to compare results in relation to this issue and also reducing the variability within these samples needed to detect individual differences across time (e.g., De Lissnyder, Koster, Goubert, Onraedt, Vanderhasselt, & De Raedt, 2012; Sherman et al., 2009).

In line with H3c, findings indicated that individuals high in RNT experienced higher levels of state RNT at T2 when they performed more poorly at switching, but there was no such interaction for IC skills. It may be the combination of both higher trait RNT and poorer EF, which predicts those who

may be vulnerable to increased state RNT under stress, although this was not true for depressive and anxious symptoms. These findings indicate that cognitive switching may be an important mechanism that interacts with high rumination to predict state rumination during times of stress. This is in line with models proposing that ruminative stress responses are the results of a complex interaction and reciprocal relationship between tendencies to ruminate as a psychological process and ability to employ EF skills under stress. For instance, the impaired disengagement hypothesis (e.g. Joormann & Gotlib, 2008; Koster et al., 2011) proposed a reciprocal relationship between EFs and rumination, linked to the development of depressive symptoms. Response style theory also posits that individual differences in how individuals respond to stressors are critical in determining those at risk of depression (e.g., Nolen-Hoeksema, 1991, 2000). The model suggests that rumination interferes with effective problem solving, making thinking more pessimistic and fatalistic and leading to instrumental behaviour increasing stressful circumstances (Nolen-Hoeksema et al., 2008). The lack of unique associations found between trait, RNT and depressive symptoms indicates that a complex interplay between these variables and other mechanisms that are not measured here (e.g., adaptive coping; Glasscock, Andersen, Labriola, Rasmussen, & Hansen, 2013) may also be critical in identifying vulnerable populations.

Several methodological differences may explain the null findings in this study. Firstly, the flanker task was performed online, following completion of the lab-based tasks. This made it difficult to ascertain whether or not participants' attention and focus were maintained while performing the task. The justification for using an online task paradigm was to increase participation in the study where participants were free to complete the task at home. However, the opposite was true as participants were less likely to complete tasks performed at home rather than in the laboratory. This reduction in participants meant that the study was likely to be underpowered to detect small to medium effects for trait RNT and EF predicting changes in state RNT, depressive and anxious symptoms. When the flanker was removed from the regression analysis, cognitive switching did become a significant predictor of changes to depressive

but not anxious symptoms. Given these results, a larger sample size is recommended to differentiate the unique contribution of EF where future studies should endeavour to recruit a larger sample size.

Stress has been proposed as an important link between cognitive control impairments and increased DR tendencies, undermining self-regulation strategies and self-control over behaviours (e.g., Baumeister, Gailliot, DeWall, & Oaten, 2006; Hankin, Stone, & Wright, 2010; McLaughlin & Nolen-Hoeksema, 2012; Snyder & Hankin, 2016). However, stress may be conceptualised in a number of ways including by normative, acute and chronic stressors, each of which may differentially be associated with vulnerability to associated psychological distress (Compas, Oroson, & Grand, 1993). Although these conceptualisations were not explored, a checklist of positive and negative life events occurring within the last 12 months and between T1 and T2 were assessed. Scores indicated that a higher incidence of negatively impactful life events was strongly associated with increased stress, trait and state RNT and clinical measures at Time 1 but not Time 2. These results are in line with previous research, which implicate a strong association between negative life events and depressive and anxious symptoms in adolescents and young adults (Hankin et al., 1998; Kessler, 1997). Impact of life events did not however, predict changes in RNT, depression or anxiety, indicating that further mechanisms are likely important in identifying depressive vulnerability within this sample of young adults as suggested by previous research (e.g., Abela & Hankin, 2011).

Limitations and future directions

A number of limitations of the study are outlined. First, the study utilised a non-clinical sample of undergraduate students. Previous research indicating EF deficits linked to RNT and subsequent depressive symptoms have tended to compare clinical and non-clinical groups (e.g., Nolen-Hoeksema et al., 2007). As the study recruited typically developing young adults, prior to and during a period of stress it is unclear how findings might generalize to clinical populations and further research may choose to target participants at increased risk or

vulnerable to psychopathology. However, a number of individuals at T1 and T2 scored above clinical cut-offs for depressive and anxious symptoms. At T2, 26% of males (*n* = 5) and 22% of females (*n* = 16) in the sample scored above clinical threshold for depression (*T*-scores >70) and 26% (*n* = 5) of males and 35% of females (*n* = 23) scored above clinical threshold for anxiety. These participants were contacted to discuss scores and signposted, where appropriate to support services. Such findings are perhaps unsurprising given the rates of anxiety and depression reported within the general population (Kessler et al., 2005) although it highlights a need to consider how exam stress may impact university students.

Second, as EF measures were only assessed at baseline, findings cannot confirm that EF impairments would be implicated during periods of increased stress. Future research may wish to utilise EF measures across time and at a later date to explore the impact of increased RNT, depressive and anxious symptoms on prospective EF performance. The justification for measuring EFs at T1 only was that the gap between testing periods was not sufficiently long to be able to rule out strong practice effects if EFs were tested at T2. Furthermore, as the flanker task was performed at home rather than in the lab, it was difficult to decipher how well participants engaged with the task. The flanker task data may also have been confounded by cognitive components aside from IC. While the cognitive switching task accounted for these processes where possible, the more simplistic flanker task paradigm was limited in its ability to control for such factors. Due to the on-going debate within the cognitive literature, future research may choose to select more complex EF tasks, which tap a unified component of EF to explore its effects on RNT and depressive symptoms. Indeed, researchers have emphasised the need to employ more unified tasks of EF as it is unlikely participants will isolate specific EFs during complex daily living tasks (Miyake & Friedman, 2012). In future, it is encouraged that all behavioural tasks are performed within the context of the lab so that researchers are able to ensure participants are engaged with tasks and can ask questions in a timely manner.

Third, the RCADS measure of clinical symptoms and the CASE checklist of life events are both measures that have been predominantly utilised with children and adolescents and are validated up to 18 years and 16 years respectively. The justification for the use of these measures was that the research suggests that late adolescence and young adulthood are fluid periods, distinct from adulthood, such that measures either based on child or adult cohorts may not capture the unique experiences of this age group (Arnett, 2007). Furthermore, it was intended that the data from this study would be linked with current research projects being conducted at the University of Exeter, assessing the developmental nature of exam stress in mid- to late-adolescents and young adults, where consistency of measures across studies is required. As a result, it was felt that these measures were adequate to assess participants' experience(s) of significant life events, anxiety and depressive symptoms. For items that were school- or adolescent-specific, participants were given instructions on how to respond in relation to their experience of first year university or in relation to life events, if they had attended school within the last 12 months, participants could relate the items to either their experience(s) during the school or university period. Despite these justifications, the CASE and RCADS measures may not have been idea for use with this age range of participants as they were not validated in a university population of young adults, limiting the generalizability of results based on these measures.

Although 85% of the sample were below the age of 19 years at T1 and could therefore still be classified as adolescents, the sample mean for this study was 19 years and 2 months with a range of 17-23 years. This significantly limits the generalizability of results based on these two measures for the young adults sampled as part of this study. Although clear instructions were given to participants indicating how they should respond to child-specific and/or school-specific questions, participants may have responded in atypical ways such that the results may not generalize to other measures of the same constructs. It would have been more appropriate that participants completed adult-based versions of these assessments, such as the Patient Health Questionnaire (Kroenke & Spitzer, 2002), the Generalized Anxiety Disorder scale (Spitzer et

al., 2006) and the Life Events and Difficulties Schedule (Brown & Harris, 1989). Young adulthood or emerging adulthood has now been classified as distinct from adolescence and adulthood (Arnett, 2007). As a result, young adults participating in research may often find themselves caught in the space between adolescence and adulthood as few questionnaires have been developed to address and capture this unique developmental period of transition (Santrock, 2010).

Fourth, the majority of the sample was female undergraduate students from high socioeconomic backgrounds. A predominance of female participants is a natural consequence of sampling psychology students although this may limit the generalizability of findings despite higher prevalence rates for rumination, depression and anxiety in females (Robichaud, Dugas, & Conway, 2003).

Finally, the power calculation conducted prior to recruiting participants indicated that in order for the study to meet adequate power to detect small to medium effect sizes using correlational analysis and multiple regression, 150 participants would need to be recruited, accounting for a 20% attrition rate between T1 and T2. Unfortunately, the study was unable to recruit this number as 84 participants completed both the lab-based measure (category switch) and questionnaires (Part 1) at T1 as well as follow-up questionnaires at T2 (Part 3; 18% attrition rate from T1 to T2). However, attrition was increased further as only 67 participants completed all three parts of this study including T1 measures (Part 1), the online task (arrow flanker; Part 2) and T2 questionnaires (Part 3), indicating that the attrition rate for all three components of the study was higher than expected at 34%. This high rate of attrition, coupled with the failure to recruit 150 participants at T1 resulted in the study only having power to detect large effects rather than the more realistic small-moderate effects that would be expected for a study of this kind (Cohen, 1992). Consequently, the null effects reported by the study may have occurred as a result of a lack of power rather than indicating a lack of association between variables and significantly limiting the generalizability of findings. Although analysis of the data

indicated that no significant differences were identified between the participants who completed all three parts and those who only completed part one of the study, it is possible that those who dropped out following completion of T1 measures were different from the rest of the sample in a way that the study was unable to identify based on the measures used. This potential common factor may further limit the generalizability of results. Therefore, future research should strive to recruit sufficient numbers of participants in order to be able to detect the small to medium effects anticipated in this kind of study using this type of analysis.

Clinical Implications

Although the clinical implications drawn from these findings should be tentative due to the nature of the sample, the high rate of attrition and subsequent reduced power to detect a small- to medium-sized effects as a result, the study highlights a number of potential areas that may be of interest to researchers particularly in the areas of preventative strategies and early interventions for young adults.

Clinical indicators and measures of stress indicated that during the exam period, rates of depressive, anxious and stress symptoms increase significantly for university students. In other words, this is a known period of elevated stress for young adults and therefore universities and colleges should make sure to have strategies and individuals in place to support students during such periods. However, it is also worth noting that although reported levels of stress, anxiety and depression increased significantly during the exam period compared with baseline, the actual increase in scores may not have been as high as would be expected for a clinical sample. This suggests that for most students, although stress increases during the exam period, this is to a moderate level from which most would be expected to recover naturally following the completion of exams.

Due to the previous associations identified within the literature between

executive dysfunction and increased RNT and subsequent depressive symptoms, a number of researchers have been investigating the use of cognitive control training methods and a strategy for early intervention and preventative methods in young adults (e.g., Hoorelbeke, Koster, Vanderhasselt, Callewaert, Demeyer, 2015). However, this study was unable to find a clear association between behavioural measures of cognitive shifting and IC and RNT and/or depressive and/or anxious symptoms. Instead, it was the combination of increased trait RNT and poorer cognitive switching that predicted those most likely to experience elevated RNT under stress. As a result, findings suggest that innovative methods and techniques are required to detect those most at risk of developing depressive and anxious symptoms where RNT and EF in combination are more indicative of vulnerability than either variable alone.

If current research and policy aims to target populations vulnerable to developing depressive and anxious symptoms, this research adds to the literature which suggests that a complex interplay likely exists between cognitive vulnerability and trait RNT, making certain individuals more susceptible to negative responses such as depressive rumination and anxiety, which may be triggered by stressful life events (Costello, Foley, & Angold, 2006; Sullivan, Neale, & Kendler, 2014). Therefore, researchers, policy-makers and clinicians enthusiastic about early intervention and preventative approaches should aim to target populations of vulnerable young adults. This may be done through the use of self-report questionnaires and/or behavioural assessments of cognitive functioning in places such as schools, colleges and universities to identify and support those who may be more vulnerable during predicted times of stress, such as exam periods and when known stressors emerge in the lives of those individuals. By identifying the students who may be more vulnerable to depressive and anxious symptoms in the future, preventative approaches may be targeted to assist these individuals in learning how to cope with stressful life events, where formal examinations may be utilised as a general example. By educating students in how to apply helpful coping strategies and processes to

manage during times of stress, vulnerable individuals may be further supported to generalize these strategies to other life events.

Adapting preventative interventions to incorporate elements that assist individuals in managing and reducing unhelpful RNT patterns may be an effective approach as well as assisting students in how they might disengage from such thought processes by practising strategies that utilise elements of EF. The challenge for researchers is to incorporate elements within preventative and early interventions that address and acknowledge the complex interplay that exist between social, environmental, cognitive and psychological factors that each may be an indicator of future depression and/or anxiety.

Conclusion

This study explored the prospective associations between trait RNT, state RNT, EF, depressive and anxiety symptoms in a sample of undergraduates during a period of naturally induced stress. In line with the field of research, findings were mixed where EF alone was not associated with measures of RNT, stress, depression or anxiety. Instead, a significant interaction was found where high RNT coupled with poor switching performance predicted changes in state RNT during stress. Future research is needed to explore these results within populations identified as being potentially at risk of developing psychopathology into adulthood.

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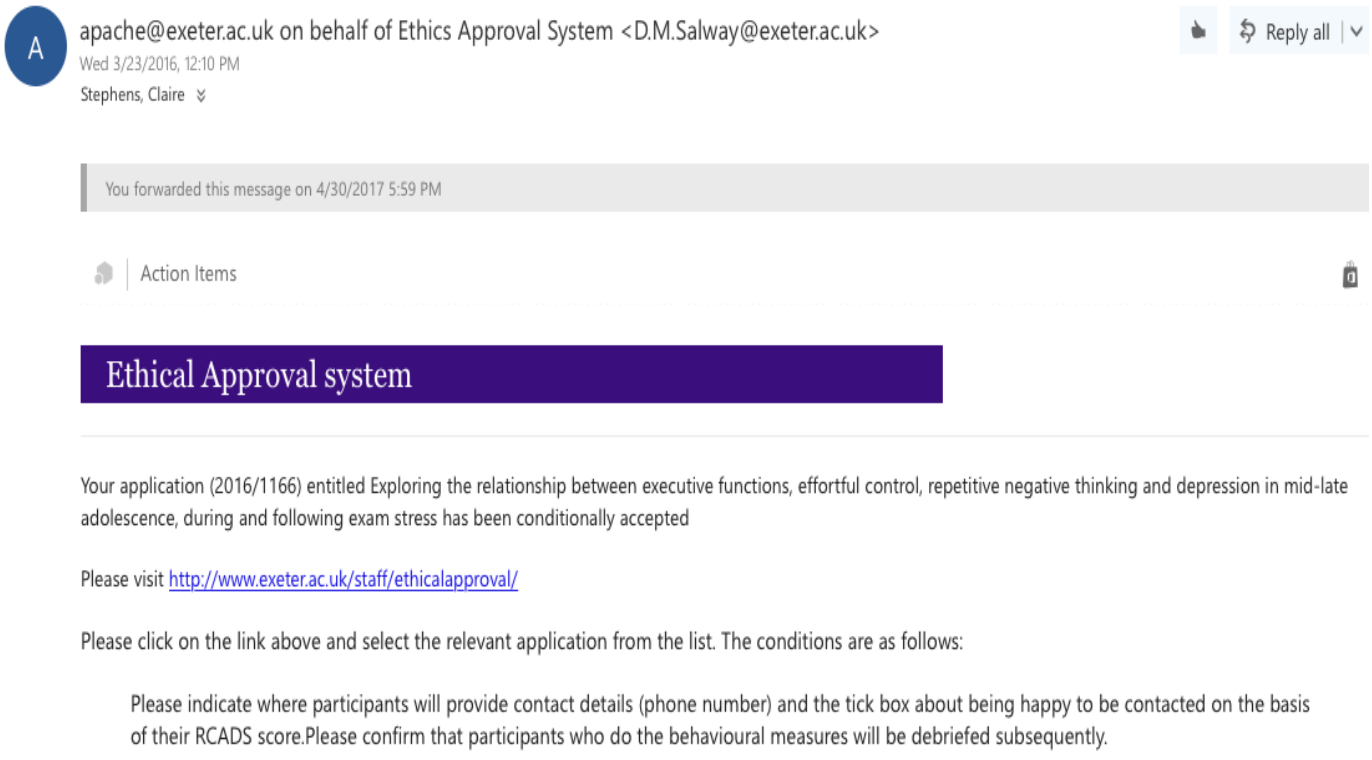
Appendices

Appendix A

University Ethical Approval



A

apache@exeter.ac.uk on behalf of Ethics Approval System <D.M.Salway@exeter.ac.uk>

Wed 3/23/2016, 12:10 PM

Stephens, Claire

Reply all

You forwarded this message on 4/30/2017 5:59 PM

Action Items

Ethical Approval system

Your application (2016/1166) entitled Exploring the relationship between executive functions, effortful control, repetitive negative thinking and depression in mid-late adolescence, during and following exam stress has been conditionally accepted

Please visit http://www.exeter.ac.uk/staff/ethicalapproval/

Please click on the link above and select the relevant application from the list. The conditions are as follows:

Please indicate where participants will provide contact details (phone number) and the tick box about being happy to be contacted on the basis of their RCADS score.Please confirm that participants who do the behavioural measures will be debriefed subsequently.

Appendix B

Participant Information Sheet

Adolescent coping methods during exam time

Researchers: Dr. Erika Baker, **Dr. Claire Stephens**, Dr. Anna Adlam, Dr. Nick Moberly, & Professor Ed Watkins

What is this study about?

In this study, we would like to find out how adolescents and young people cope during exam time. We want to find out about your thinking skills, and the effect exam stress might have on you.

Why am I being asked to take part?

We would like you to take part in this study because you are between 15 and 25 years old and will be sitting exams.

Do I have to take part?

No, it is up to you. If you want to take part, we will ask you to sign a form to say you are happy to do so. You can change your mind at any time if you decide you don't want to take part, and you do not need to give any reason.

What will happen during the study?

We would like you to be involved in the study 3 times. Each time we will ask you to fill in questionnaires and perform some tasks to find out how you think. The questionnaires will ask you to answer questions about yourself, how you think about things, how you feel, and how the exams are making you feel. We will ask you to complete the questionnaires and tasks on the computer, by yourself. The tasks should take you around an hour to complete and questionnaires between 20-25minutes.

The first time you will complete a number of tasks in the psychology lab under the supervision of Claire Stephens (approximately 1hour to complete). There will also be an online computer-based task that you can perform in your own time at home on the same day as the lab

component (approximately half an hour to complete). These tasks will take place a few months before you sis your exams. The second time will be during your exam period and the third time will a few weeks after your exams have finished.

The second and third time we will be collecting questionnaires only and you can do this from home online (20minutes approximately). We will send you a link to the questionnaires by email. We will let you know when it's time to complete them and all you need to do is click on the link to complete them and send them back.

What is good, and not so good, about taking part?

A good thing about taking part is that you will be helping us to find out how adolescents and young people think and feel when they have exams, which we hope will be helpful for learning more about how young people cope during exam stress. As a thank you for taking part, everyone will be entered into a draw to win Amazon vouchers, every time we ask you to complete questionnaires. You will also receive course credits at each time point for taking part.

One of the not so good things about taking part is that the questionnaires and tasks will take up some of your time (approximately hour and a half for the first time and 25minutes at the second and third time point). We have tried to make the questionnaires as short as possible so we don't take up too much of your time.

Is the research safe?

Yes, the research is safe. Although the questions and tasks are not designed to be upsetting, if you do feel upset at any point, we can give you information on where to get support and you are free to drop out at any point.

Who will know how I did?

Only we (the researchers) will see your answers and we will not be allowed to tell anyone what we heard or saw. The answers that you give will be kept safely locked away in a filing cabinet at the University or on a password protected data stick. Your name will be on each questionnaire so that we can keep your answers across the 3 times together. However, as soon as we receive your answers we will swap your name for a number, so that no one else will know they are your answers. If you tell us something that worries us, then we might have to share it with someone else. We will let you know if we plan to do this.

The study findings might appear in magazines for doctors and scientists to read. Your name will not be included. We can also send you a short letter to tell you what we found out from the research study.

Further information and contact details

For further information about the project please contact the researchers by email: **Claire Stephens cs556@exeter.ac.uk**. Alternatively, if Claire is unavailable or if you would like to make a complaint, please contact Dr Nicholas Moberly (N.J.Moberly@exeter.ac.uk) at the University of Exeter, College of Life and Environmental Sciences, Psychology, Exeter, EX4 4QG. We will be happy to answer any questions that you might have. The University of Exeter Research Ethics Committee (REC) approved this research (ref: 16/1166). Should you have ethical queries in relation to the study please contact the REC chair, Lisa Leaver at L.A.Leaver@exeter.ac.uk.

Thank you for reading this information sheet!

Appendix C

Participant Consent Form

Participant Study ID……. (For office use only)
Researchers: Erika Baker, Claire Stephens, Dr. Anna Adlam, Dr. Nick Moberly, & Professor Ed Watkins

Participant Consent Form

Adolescents coping methods during exam time

Please initial boxes

1. I confirm that I have read and understood the information sheet for the above study. I have been given the time and opportunity to consider the information presented, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I can withdraw from the study at any time without consequence or giving a reason. ☐

3. I understand that all information and data provided by me will be anonymised and treated as confidential by the research team. ☐

4. I agree to take part in the above study. ☐

_____	_____	_____
Name of **participant**	Date	Signature
_____	_____	_____
Name of **researcher**	Date	Signature

Appendix D

Participant Debrief Sheet

Adolescents coping methods during exam time

Researchers: Erika Baker, Claire Stephens, Dr. Anna Adlam, Dr. Nick Moberly, & Professor Ed Watkins

What was the study about?

In this study, we wanted to find out how adolescents cope during exam time. We wanted to find out about your thinking skills, and the effect exam stress might have on you. We asked questions to all adolescents taking part a few months before their exams started, just before exams, and again after you had your exams. We wanted to see whether different people had different ways of coping with the exams. Some participants also took part in some extra tasks on the computer. These tasks also looked at how adolescents think and cope with exams. We also asked all adolescents about their levels of anxiety and depression throughout the study, to see whether this changed because of the effect of the exams.

The results that we have from the research aims to find ways to better understand how adolescents think about, and cope with exams and stress in general. We hope that by better understanding this, we can find ways to support adolescents during stressful times.

We would like to thank you for taking part in this research and we hope that you found taking part interesting. We also wish you all the best in the coming months and for the future.

What happens if I still feel stressed?

Firstly, feeling stressed can be a normal process that is experienced by most individuals in the lead up stressful events such as exams and in anticipation of exam results. However, if you are finding it difficult to cope with feelings of stress, or other feelings, there is support available through your university and/or community (see below).

Where can I access support?

Friends and family: Some individuals find that speaking to a close friend or family member that you trust can be helpful in reducing stressful symptoms.

Support in university: If you would like to speak to somebody in university, specialist support is available through the wellbeing centre: http://www.exeter.ac.uk/wellbeing/ . Here support is available for students throughout the hours of 9am-5pm Monday to Friday however, they also have links to out of hours services. The team specialise in issues relating to students as well as general concerns about mental health and other personal issues.

Specific supported related to mental health and talking therapy is also available through the wellbeing centre: http://www.exeter.ac.uk/wellbeing/mental_health/ where you can make an appointment online or by phone on: 01392 724381.

Support outside of university: Your GP can let you know about services that are available to you, and refer you to them if they feel this is helpful. There are also a number of support outlets available in your community that are set up to support young people who are feeling stressed, anxious or depressed. They are usually organised by trained professionals who are there to listen or else can guide you on where to find further support.

For a list of where to access support by phone or online see the list below:

CHILDLINE:

- Freephone **0800 1111** (24 hours)
- www.childline.org.uk

Childline is the UK's free helpline for children and young people. It provides confidential telephone counselling service for any child with a problem. It comforts, advises and protects.

GET CONNECTED

- Freephone **0808 808 4994** (7 days a week 1pm-11pm)
- www.getconnected.org.uk

Free, confidential telephone and email helpline finding young people the best help whatever the problem. Provides free connections to local or national services, and can text information to callers' mobile phones.

FRANK

- **Freephone 0800 77 66 00** (24 hour service, free if call from a landline and won't show up on the phone bill, provides translation for non-English speakers)
- www.talktofrank.com

Confidential information and advice for anyone concerned about their own or someone else's drug or solvent misuse.

THESITE.ORG

- TheSite.org

The Site is an online guide to life for 16 to 25 year-olds. It provides non-judgmental support and information on everything from sex and exam stress to debt and drugs.

Interested in the study or have further questions?

If you have any further queries in relation to the study you can contact the researchers by email: Erika Baker at ecb217@exeter.ac.uk and/or Claire Stephens at cs556@exeter.ac.uk. This project is supervised by Dr. Nick Moberly who will also be happy to answer any questions you might have or if you would like to make a complaint please contact him at N.J.Moberley@exeter.ac.uk.

The University of Exeter Research Ethics Committee (REC) approved this research (ref: 16/1166). Should you have ethical queries in relation to the study please contact the REC chair, Lisa Leaver at L.A.Leaver@exeter.ac.uk.

Appendix E

Demographic Questionnaire

Consent to Contact You

One of the questionnaires is interested in how you think and feel (RCADS). Sometimes people can score high on this questionnaire indicating they may be particularly stressed, worried or depressed. Although this can be very normal, we may feel it would be helpful to briefly check in with you, should you score high on this questionnaire using a telephone call. Please indicate below whether or not you would like someone to telephone you under these circumstances:

Tick appropriately

Yes, I would like someone to contact me if my scores are high ☐

No, I would rather not be contacted if my scores are high ☐

If you ticked 'yes', please leave your contact details below:

Tel:

_____

Best time of day to contact:

_____

Email:

_____

Please tick boxes where appropriate

Below are 4 questions (a-d) that ask whether you are able to take part in the study. It will say below the questions whether you are able to take part.

a) Do you have a diagnosed mental health difficulty (e.g. depression, anxiety. Diagnosis given by a trained professional, e.g. CAMHS, your GP)?

Yes ☐ No ☐

If you answered yes to this question, you may still take part although we may not be able to include your information in the study.

b) Do you have a learning difficulty? (not including dyslexia)

Yes ☐ No ☐

If you answered yes to this question, your information may not be included in the study.

c) Have you had a head injury (in sports, or a car crash etc.) that made you dizzy and confused, or left you knocked out?

Dazed/confused ☐ Knocked out ☐

If you answered yes to this question, your information may not be included in the study.

d) Is your first language English?

Yes ☐ No ☐

If you answered no to this question, what is your first language?

If you answered no to this question, your information may not be included in the study.

If any of your answers suggest that we might not be able to use your data, you can stop taking part in the study now. However, if you would still like to continue taking part for any reason, please do, but be aware that your information may not be included in the final study.

If your answers suggest you can take part in the study, please continue answering our questions below.

1) Date of birth (dd/mm/yy):

.....

2) Sex:

Female ☐ Male ☐

3) Year of school:

.....

4) Marital status- Mother

Single ☐ Married ☐ Separated ☐

Divorced ☐ Remarried ☐ Widowed ☐

Other (please state)

.....

5) Marital status- Father

Single ☐ Married ☐ Separated ☐

Divorced ☐ Remarried ☐ Widowed ☐

Other (please state)

.....

6) Number of people living in your home:

.....

7) People living in your home (e.g. brother, sister etc.):

.....

.....

.....

.....

8) Highest level of education completed- Mother:

Primary school ☐ Secondary school ☐ College (16-18) ☐

Further training ☐ (E.g. NVQ) Undergraduate degree ☐ Postgraduate degree ☐

Other (Please state)

.....

9) Highest level of education completed- Father:

Primary school ☐ Secondary school ☐ College (16-18) ☐

Further training ☐ (E.g. NVQ) Undergraduate degree ☐ Postgraduate degree ☐

Other (Please state)

.....

10) Current employment status-Mother:

Self-employed ☐ Homemaker ☐ Student ☐

Retired ☐ Unable to work ☐ Employed for wages ☐

Unemployed ☐ Volunteer ☐

Other (Please state)

.....

11) Current employment status- Father:

Self-employed ☐ Homemaker ☐ Student ☐

Retired ☐ Unable to work ☐ Employed for wages ☐

Unemployed ☐ Volunteer ☐

Other (Please state)

.....

12) Current occupation- Mother (only if employed):

.....

13) Current occupation- Father (only if employed):

.....

Appendix F

Perceived Stress Check

How are you currently feeling about your upcoming exams?

Question 1: *How stressed have you been feeling over the last couple of days?* (0= no stress, 10= highest levels of stress)

_____

0 1 2 3 4 5 6 7 8 9 10

Question 2: *How stressed are you feeling about your exams?*
(0= no stress, 10= highest levels of stress)

_____

0 1 2 3 4 5 6 7 8 9 10

Question 3: *How stressed are you currently feeling about other aspects of your life (not exam related)?*
(0= no stress, 10= highest levels of stress)

_____

0 1 2 3 4 5 6 7 8 9 10

Question 4: *How much time do you currently spend worrying/feeling stressed about your exams?* (0= no time, 10= all of my time)

_____

0 1 2 3 4 5 6 7 8 9 10

Appendix G

Child and Adolescent Survey of Experience

CENTRE FOR EMOTIONAL HEALTH

MACQUARIE University

Child and Adolescent Survey of Experiences: Child Version (CASE)

Your name:	Your date of birth:

This questionnaire asks about events people may find bad or upsetting, as well as events people may find good or enjoyable. If an event **DID** happen to you in the **LAST 12 MONTHS**, **tick the box** under the word **'YES'**. You also need to tick a box to say **HOW GOOD or HOW BAD** the event was for you. If the event **DID NOT** happen to you, tick the box under **'NO'** and just skip to the next question. If you make a mistake, just cross out your answer and tick the correct box. DO NOT use a pencil or liquid paper.

	Remember: if "Yes", the event did happen to you, also tick a box to show *how good or how bad* the event was for you. **Write down the date 12 months ago:_____** **In the last 12 months ...**	**Yes**	**No**	**Really good**	**Quite good**	**A little good**	**A little bad**	**Quite bad**	**Really bad**
1.	We moved house	☐	☐	☐	☐	☐	☐	☐	☐
2.	I (or my team) won a prize, award or contest (e.g., school, sports, music, dance)	☐	☐	☐	☐	☐	☐	☐	☐
3.	My parent(s) stayed away from home overnight (e.g., hospital, holiday, work)	☐	☐	☐	☐	☐	☐	☐	☐
4.	I got a new boyfriend or girlfriend	☐	☐	☐	☐	☐	☐	☐	☐
5.	My parent(s) started a new job	☐	☐	☐	☐	☐	☐	☐	☐
6.	Someone special to me moved away (who is not in your family)	☐	☐	☐	☐	☐	☐	☐	☐
7.	Someone in my family was really sick or injured	☐	☐	☐	☐	☐	☐	☐	☐
8.	My parent(s) had a baby / found out they are going to have a baby	☐	☐	☐	☐	☐	☐	☐	☐
9.	My parent(s) had to see my school principal	☐	☐	☐	☐	☐	☐	☐	☐
10.	I stayed away from home overnight (e.g., camp, trip, hospital)	☐	☐	☐	☐	☐	☐	☐	☐
11.	Someone came to live with our family	☐	☐	☐	☐	☐	☐	☐	☐
12.	I was teased or bullied	☐	☐	☐	☐	☐	☐	☐	☐
13.	My pet died, got sick, lost or injured	☐	☐	☐	☐	☐	☐	☐	☐
14.	I had a big argument with someone in our family	☐	☐	☐	☐	☐	☐	☐	☐
15.	I was really sick or injured	☐	☐	☐	☐	☐	☐	☐	☐
16.	My parent(s) split up	☐	☐	☐	☐	☐	☐	☐	☐
17.	I did well in an important test or exam	☐	☐	☐	☐	☐	☐	☐	☐
18.	My parent(s) lost their job	☐	☐	☐	☐	☐	☐	☐	☐
19.	I broke up with a boyfriend or girlfriend	☐	☐	☐	☐	☐	☐	☐	☐

CENTRE FOR EMOTIONAL HEALTH

MACQUARIE University

Child and Adolescent Survey of Experiences: Child Version (CASE)

Your name:	Your date of birth:

	Write down the date 12 months ago:_____ In the last 12 months ...	Yes	No	Really good	Quite good	A little good	A little bad	Quite bad	Really bad
20.	I had a big argument with someone special to me (who is not in your family)	☐	☐	☐	☐	☐	☐	☐	☐
21.	I made a new special friend	☐	☐	☐	☐	☐	☐	☐	☐
22.	I saw something bad happen (e.g., car accident, someone being robbed)	☐	☐	☐	☐	☐	☐	☐	☐
23.	I changed schools	☐	☐	☐	☐	☐	☐	☐	☐
24.	Someone in my family died	☐	☐	☐	☐	☐	☐	☐	☐
25.	People in my family had a big fight or argument (not including me)	☐	☐	☐	☐	☐	☐	☐	☐
26.	My mum got married, engaged or began seeing someone else	☐	☐	☐	☐	☐	☐	☐	☐
27.	Someone broke into my house	☐	☐	☐	☐	☐	☐	☐	☐
28.	Someone in my family left home	☐	☐	☐	☐	☐	☐	☐	☐
29.	I was in a fight (not with people in my family)	☐	☐	☐	☐	☐	☐	☐	☐
30.	I did badly in an important test or exam	☐	☐	☐	☐	☐	☐	☐	☐
31.	Someone special to me died (who is not in your family)	☐	☐	☐	☐	☐	☐	☐	☐
32.	I was chosen to be class monitor, prefect or school captain	☐	☐	☐	☐	☐	☐	☐	☐
33.	I was seriously told off or punished by a teacher	☐	☐	☐	☐	☐	☐	☐	☐
34.	I took up a new hobby / sport / activity	☐	☐	☐	☐	☐	☐	☐	☐
35.	I found out that I had to repeat a grade in school	☐	☐	☐	☐	☐	☐	☐	☐
36.	Someone special to me was really sick or injured (who is not in your family)	☐	☐	☐	☐	☐	☐	☐	☐
37.	My dad got married, engaged, or began seeing someone else	☐	☐	☐	☐	☐	☐	☐	☐
38.	I went on a special holiday (e.g., overseas, around Australia)	☐	☐	☐	☐	☐	☐	☐	☐
	Other upsetting or good events (please list):								
39.		☐	☐	☐	☐	☐	☐	☐	☐
40.		☐	☐	☐	☐	☐	☐	☐	☐

Appendix H

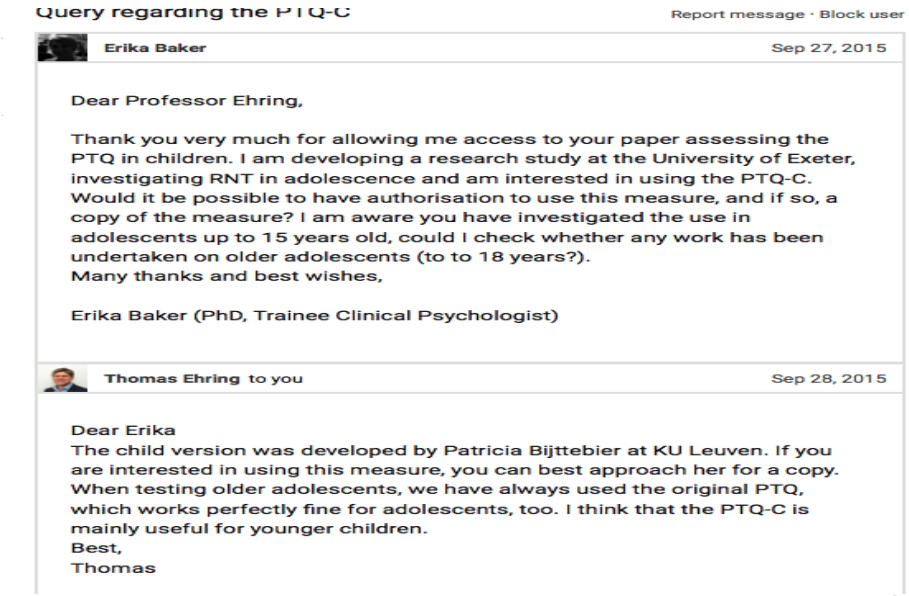
Perseverate Thinking Questionnaire

Instruction: In this questionnaire, you will be asked to describe how you typically think about negative experiences or problems. Please read the following statements and rate the extent to which they apply to you when you think about negative experiences or problems.

		never	rarely	some-times	often	almost always
1.	The same thoughts keep going through my mind again and again.	0	1	2	3	4
2.	Thoughts intrude into my mind.	0	1	2	3	4
3.	I can't stop dwelling on them.	0	1	2	3	4
4.	I think about many problems without solving any of them.	0	1	2	3	4
5.	I can't do anything else while thinking about my problems.	0	1	2	3	4
6.	My thoughts repeat themselves.	0	1	2	3	4
7.	Thoughts come to my mind without me wanting them to.	0	1	2	3	4
8.	I get stuck on certain issues and can't move on.	0	1	2	3	4
9.	I keep asking myself questions without finding an answer.	0	1	2	3	4
10.	My thoughts prevent me from focusing on other things.	0	1	2	3	4
11.	I keep thinking about the same issue all the time.	0	1	2	3	4
12.	Thoughts just pop into my mind.	0	1	2	3	4
13.	I feel driven to continue dwelling on the same issue.	0	1	2	3	4
14.	My thoughts are not much help to me.	0	1	2	3	4
15.	My thoughts take up all my attention.	0	1	2	3	4

Appendix I

Email Conversations with Erika Baker and Professor Ehring



Query regarding the PTQ-C

Report message · Block user

Erika Baker Sep 27, 2015

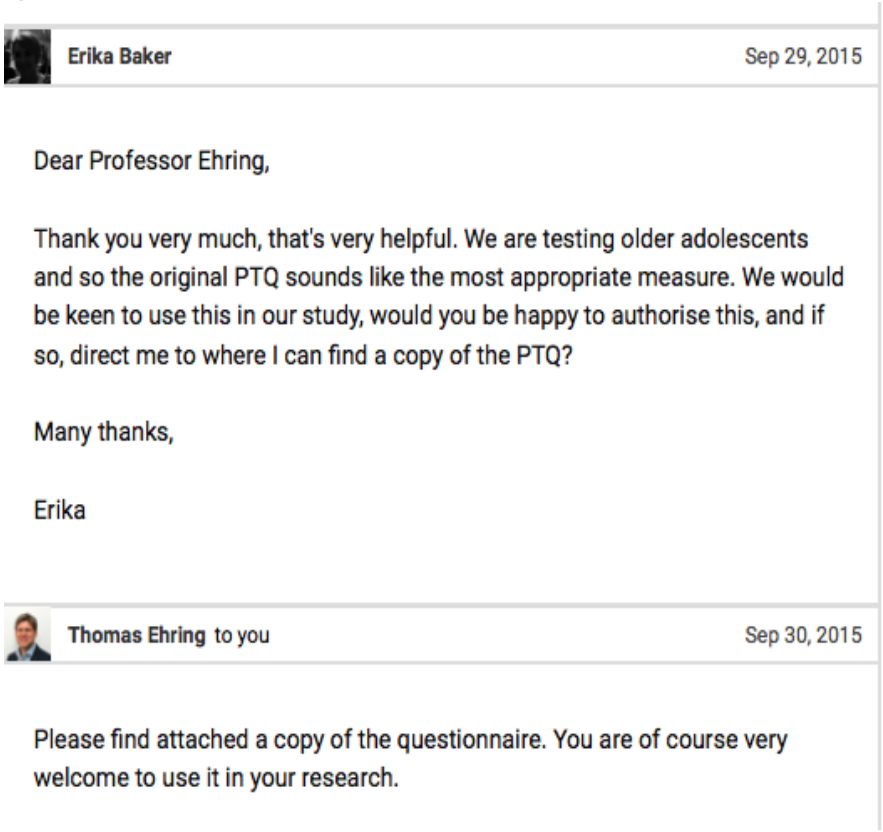
Dear Professor Ehring,

Thank you very much for allowing me access to your paper assessing the PTQ in children. I am developing a research study at the University of Exeter, investigating RNT in adolescence and am interested in using the PTQ-C. Would it be possible to have authorisation to use this measure, and if so, a copy of the measure? I am aware you have investigated the use in adolescents up to 15 years old, could I check whether any work has been undertaken on older adolescents (to to 18 years?).
Many thanks and best wishes,

Erika Baker (PhD, Trainee Clinical Psychologist)

Thomas Ehring to you Sep 28, 2015

Dear Erika
The child version was developed by Patricia Bijttebier at KU Leuven. If you are interested in using this measure, you can best approach her for a copy. When testing older adolescents, we have always used the original PTQ, which works perfectly fine for adolescents, too. I think that the PTQ-C is mainly useful for younger children.
Best,
Thomas



Erika Baker Sep 29, 2015

Dear Professor Ehring,

Thank you very much, that's very helpful. We are testing older adolescents and so the original PTQ sounds like the most appropriate measure. We would be keen to use this in our study, would you be happy to authorise this, and if so, direct me to where I can find a copy of the PTQ?

Many thanks,

Erika

Thomas Ehring to you Sep 30, 2015

Please find attached a copy of the questionnaire. You are of course very welcome to use it in your research.

Appendix J

Repetitive Thinking Questionnaire (future orientated)

Please answer the following questions in relation to how you are currently feeling about your upcoming exams. How true (1-5) are each of these statements with respect to your thoughts/feelings towards your January exams?

1 **2** **3** **4** **5**

Not true at all Somewhat true Very true

1. I have thoughts or images about the exams that occurred over and over again, that resulted in my feelings getting worse and worse.	1	2	3	4	5
2. There is nothing more I can do about the exams, so I don't think about it anymore.	1	2	3	4	5
3. I listen to sad music	1	2	3	4	5
4. I have thoughts or images about turning the clock back to do something again, but doing it better.	1	2	3	4	5
5. I have thoughts or images about all my shortcomings, failings, faults, mistakes.	1	2	3	4	5
6. I go some place alone to think about my feelings.	1	2	3	4	5
7. My thoughts overwhelm me	1	2	3	4	5
8. I have thoughts or images like "*Why do I have problems other people don't have?"*	1	2	3	4	5
9. When I am under pressure, I think a lot about the situation	1	2	3	4	5
10. I have thoughts or images about a future event that come into my head even when I do not wish to think about it	1	2	3	4	5
11. I have thoughts or images that "*I won't be able to do my job/work because I feel so badly."*	1	2	3	4	5
12. I go away by myself and think about why I feel this way.	1	2	3	4	5
13. I have thoughts or images about the situation that result in me avoiding similar situations and that reinforce a decision to avoid similar situations.	1	2	3	4	5
14. I find it easy to dismiss distressing thoughts about the situation	1	2	3	4	5
15. I have thoughts or images like "*Why can't I get going*?"	1	2	3	4	5
16. I have thoughts or images of the exams that are difficult to get rid of.	1	2	3	4	5
17. I am always thinking about something.	1	2	3	4	5
18. I don't tend to think about the exams	1	2	3	4	5
19. Once I start thinking about the exams, I can't stop.	1	2	3	4	5
20. I don't have enough time to do everything, so I don't think about it	1	2	3	4	5

21.I have thoughts or images about how alone I feel.	1	2	3	4	5
22.I have a lot of thoughts or images about the exams.	1	2	3	4	5
23.I notice that I have been thinking about the exams.	1	2	3	4	5
24.I have thoughts or images about the exams that I try to resist thinking about.	1	2	3	4	5
	Not true at all		Some-what true		Very true
25.I have thoughts or images about how angry I am with myself.	1	2	3	4	5
26.I think about the exams all the time.	1	2	3	4	5
27.I will think about the exams until the are all done.	1	2	3	4	5
28.I know I shouldn't have thought about the exams, but I can't help it.	1	2	3	4	5
29.I have thoughts or images asking "*Why do I always react this way?*"	1	2	3	4	5
30.I have thoughts or images about the exams and hoping they will go well.	1	2	3	4	5
31.The exams really made me think	1	2	3	4	5

Appendix K

Revised Child Anxiety and Depression Scale

RCADS

NHS ID: .....

Child/ Young Person's NAME:

.....

Date: ☐☐/☐☐/20☐☐ **Time:** ☐☐h☐☐

Please put a circle around the word that shows how often each of these things happens to you. There are no right or wrong answers.

1	I worry about things	Never	Sometimes	Often	Always
2	I feel sad or empty	Never	Sometimes	Often	Always
3	When I have a problem, I get a funny feeling in my stomach	Never	Sometimes	Often	Always
4	I worry when I think I have done poorly at something	Never	Sometimes	Often	Always
5	I would feel afraid of being on my own at home	Never	Sometimes	Often	Always
6	Nothing is much fun anymore	Never	Sometimes	Often	Always
7	I feel scared when I have to take a test	Never	Sometimes	Often	Always
8	I feel worried when I think someone is angry with me	Never	Sometimes	Often	Always
9	I worry about being away from my parent	Never	Sometimes	Often	Always
10	I am bothered by bad or silly thoughts or pictures in my mind	Never	Sometimes	Often	Always
11	I have trouble sleeping	Never	Sometimes	Often	Always
12	I worry that I will do badly at my school work	Never	Sometimes	Often	Always
13	I worry that something awful will happen to someone in my family	Never	Sometimes	Often	Always
14	I suddenly feel as if I can't breathe when there is no reason for this	Never	Sometimes	Often	Always
15	I have problems with my appetite	Never	Sometimes	Often	Always
16	I have to keep checking that I have done things right (like the switch is off, or the door is locked)	Never	Sometimes	Often	Always
17	I feel scared if I have to sleep on my own	Never	Sometimes	Often	Always
18	I have trouble going to school in the mornings because I feel nervous or afraid	Never	Sometimes	Often	Always
19	I have no energy for things	Never	Sometimes	Often	Always
20	I worry I might look foolish	Never	Sometimes	Often	Always

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21	I am tired a lot	Never	Sometimes	Often	Always
22	I worry that bad things will happen to me	Never	Sometimes	Often	Always
23	I can't seem to get bad or silly thoughts out of my head	Never	Sometimes	Often	Always
24	When I have a problem, my heart beats really fast	Never	Sometimes	Often	Always
25	I cannot think clearly	Never	Sometimes	Often	Always
26	I suddenly start to tremble or shake when there is no reason for this	Never	Sometimes	Often	Always
27	I worry that something bad will happen to me	Never	Sometimes	Often	Always
28	When I have a problem, I feel shaky	Never	Sometimes	Often	Always
29	I feel worthless	Never	Sometimes	Often	Always
30	I worry about making mistakes	Never	Sometimes	Often	Always
31	I have to think of special thoughts (like numbers or words) to stop bad things from happening	Never	Sometimes	Often	Always
32	I worry what other people think of me	Never	Sometimes	Often	Always
33	I am afraid of being in crowded places (like shopping centers, the movies, buses, busy playgrounds)	Never	Sometimes	Often	Always
34	All of a sudden I feel really scared for no reason at all	Never	Sometimes	Often	Always
35	I worry about what is going to happen	Never	Sometimes	Often	Always
36	I suddenly become dizzy or faint when there is no reason for this	Never	Sometimes	Often	Always
37	I think about death	Never	Sometimes	Often	Always
38	I feel afraid if I have to talk in front of my class	Never	Sometimes	Often	Always
39	My heart suddenly starts to beat too quickly for no reason	Never	Sometimes	Often	Always
40	I feel like I don't want to move	Never	Sometimes	Often	Always
41	I worry that I will suddenly get a scared feeling when there is nothing to be afraid of	Never	Sometimes	Often	Always
42	I have to do some things over and over again (like washing my hands, cleaning or putting things in a certain order)	Never	Sometimes	Often	Always
43	I feel afraid that I will make a fool of myself in front of people	Never	Sometimes	Often	Always
44	I have to do some things in just the right way to stop bad things from happening	Never	Sometimes	Often	Always
45	I worry when I go to bed at night	Never	Sometimes	Often	Always
46	I would feel scared if I had to stay away from home overnight	Never	Sometimes	Often	Always
47	I feel restless	Never	Sometimes	Often	Always

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Appendix L

Power Analysis for Study

The sample size was calculated a priori using G* Power (Faul et al., 2007) for both a correlational analysis and a multiple regression (fixed model, R^2 increase). Assuming a Type I error rate (α) of .05 and Type II error rate (β) of .20, desired power was set at .80. Previous studies investigating relevant hypotheses have found a range of effect sizes in their results and most employ correlational designs. In their 15-month prospective study, Connolly and colleagues (2014) found that increased rumination predicted decreases in cognitive switching at T2 (R^2change = .05, $p < .001$; $f^2 = .10$). Using a cross-sectional design, Wagner and colleagues (2015) found that rumination did not predict EF performance, controlling for depressive symptoms (R^2 change = 0.06, $p > .05$, $f^2 = .06$). Controlling for rumination, depression scores were marginally negatively associated with poorer cognitive switching performance on a task of selective attention (R^2 change = 0.07, $p = .05$, $f^2 = .07$). Using an interaction term of depression X rumination, the study found that current depression significantly moderated the association between rumination and sustained attention ($R^2 = 0.026$, $p < .01$, $f^2 = .03$). Taking these findings into account as well as the assumption that interactions are generally small to medium in size, calculations were based on the studies' ability to detect a small-medium effect size ($r = .20$ for correlation, $f^2 = .066$ for regression) with 80% power at a .05 significance level and for a maximum number of predictors in the model (6). The maximum sample size for achieving power of .80 was determined to be 120. However due to the prospective design, a conservative estimate of attrition from T1-T2 of 20% (Chatfield, Brayne, & Matthews, 2005), the sample size is adapted to 150, reflecting attrition.

Appendix M

Analysis Plan For Study

ANOVAs. One-way ANOVAs were completed to explore differences between monolingual and bilingual as well as males and female participants on all measures at both time points.

Correlations. Pearson's *rank* correlations were performed across time points to examine associations between variables and across time points. Correlations were also performed to explore the associations between demographic factors and variables across time.

T-Tests. Paired independent t-tests were performed to examine changes in scores for variables between T1 and T2.

Hierarchical Linear Regression. Separate hierarchical linear regression analyses were run to test hypotheses regarding the ability of variables (e.g., trait RNT, EFs) to predict changes in outcome variables (e.g., state RNT, depression, anxiety) during a period of stress.

Moderation Analysis. Moderation analysis explored the interaction between trait RNT and EF as a moderator of the changes in state RNT from T1 to T2.

Appendix N

Additional Analysis With Flanker Removed

Table N1

Hierarchical Regression Analyses for Hypothesis 3a 3b and 3c with Flanker Removed

	B	**SE B**	**β**	**p**	**Variance Explained**
T2 State RNT					
Step 1					
T1 State RNT	.54	.16	.48	<.01	
T1 Trait RNT	.11	.30	.05	.73	
T1 Depress	.47	3.56	.02	.90	R^2*Change* = .29,
T1 CASE	.09	.41	.02	.84	$R^2_{adjusted}$ = .24, *p*
Gender	-.17	5.30	-.00	.98	< .001
Step 2					
T1 State RNT	.51	.16	.46	<.01	
T1 Trait RNT	.18	.31	.08	.56	
T1 Depress	.62	3.54	.02	.86	
T1 CASE	.11	.41	.03	.79	R^2*Change* = .02,
Gender	-.07	5.26	-.00	.99	$R^2_{adjusted}$ = .25, *p*
Switch Cost	-.04	.03	-.14	.15	= .15
Step 3					
T1 State RNT	.54	.14	.49	<.01	
T1 Trait RNT	.45	.28	.21	.11	
T1 Depress	-.53	3.21	-.06	.64	
T1 CASE	.19	.37	.05	.61	
Gender	-2.12	4.73	-.04	.66	R^2*Change* = .15,
Switch Cost	-.01	.03	-.02	.80	$R^2_{adjusted}$ = .40, *p*
Switch Cost X T1 Trait RNT	-.01	.00	-.42	<.001	< .001

Table N2

Hierarchical Regression Analyses for Hypotheses 4a and 4b with Flanker Removed

	B	SE B	β	p	Variance Explained
T2 Depression					
Step 1					
T1 Depress	.81	.22	.49	<.01	
T1 TraitRNT	.00	.02	.00	.99	R^2*Change* = .25,
T1 CASE	.00	.03	.01	.96	$R^2_{adjusted}$ = .22, *p* <
Gender	.18	.33	.06	.58	.001
Step 2					
T1 Depress	.82	.21	.49	<.01	
T1 TraitRNT	.01	.02	.03.	.79	
T1 CASE	.00	.03	.01	.94	R^2*Change* = .04,
Gender	.18	.33	.06	.58	$R^2_{adjusted}$ = .25, *p* =
Switch Cost	-.04	.00	-.19	.05	.05

Table N3

Hierarchical Regression Analyses for Hypotheses 5a and 5b with Flanker Removed

	B	SE B	β	p	Variance Explained
T2 Anxiety					
Step 1					
T1 Anxiety	.90	.22	.59	<.01	
T1 Trait RNT	-.03	.03	-.15	.31	R^2*Change* = .28,
T1 CASE	.02	.03	.06	.58	$R^2_{adjusted}$ = .25, *p* <
Gender	.32	.46	.07	.49	.001
Step 2					
T1 Anxiety	.92	.22	.60	<.01	
T1 Trait RNT	-.03	.03	-.13	.37	
T1 CASE	.02	.03	.06	.57	R^2*Change* = .30,
Gender	.31	.46	.07	.50	$R^2_{adjusted}$ = .26, *p* =
Switch Cost	-.00	.00	-.14	.15	.15

Appendix O

Preparation and Submission Requirements for *Cognitive Therapy and Research*

Instructions for Authors

General Inquries
Inquiries regarding journal policy and other general topics should be sent to the Editor:

Stefan G. Hofmann e-mail: shofmann@bu.edu
Department of Psychology
Boston University
648 Beacon Street, 6th Fl
Boston, MA 02215

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