Johnman, M. L., & Boschen, M. (2023). The Impact of Ruminative Thinking on Verbal and Visual Task Performance. *Psychotherapy and Counselling Journal of Australia*, *11*(1). https://doi.org/10.59158/001c.73835

ARTICLES

The Impact of Ruminative Thinking on Verbal and Visual Task Performance

Melissa L. Johnman, BPsych (Hons), DipCouns[1][a], Mark Boschen, PhD, FAPS, FCCLP[2][b]

[1] Brave Minds Blossom, [2] School of Applied Psychology, Griffith University

Keywords: rumination, cognition, memory recall, task performance, interference, Baddeley's model of working memory, Borkovec's avoidance theory of worry, verbal cognition task, visual cognition task, depression

https://doi.org/10.59158/001c.73835

Psychotherapy and Counselling Journal of Australia

Vol. 11, Issue 1, 2023

Research shows the detrimental effects of rumination on individuals' cognitive performance. However, there is limited research regarding rumination interference on task performance. The aim of this study was to investigate the link between rumination and cognition and explore if its impact is better described by Baddeley's working memory model or Borkovec's cognitive avoidance theory of worry. A laboratory experiment was conducted comparing three ruminative valence groups (negative, neutral, and positive). The aim was to explore individuals' performance on a verbal and visual free-recall task and determine interference effects. Task scores pre- and post-rumination were collected from 69 university student participants and two 3 × 2 ANOVAs were conducted. The results suggest rumination may not interfere with individuals' verbal and visual task performance, indicating the link between rumination and cognition may not be as significant as previously suggested. Furthermore, the results suggest that Baddeley's model is a better description of rumination impacts on task performance compared to Borkovec's theoretical model.

Rumination is repetitive thinking about negative information (Whitmer & Gotlib, 2013) and involves predominantly verbal/linguistic cognition (Ehring & Watkins, 2008). Typically reported ruminative content includes current concerns and problems, past experiences, or worries about the future (Ehring & Watkins, 2008). Rumination is increasingly becoming a problematic worldwide phenomenon, adversely impacting individuals' cognition and wellbeing (De Raedt et al., 2015). Individuals are increasingly experiencing maladaptive psychological consequences informed by various global societal changes and concerns, such as the COVID-19 pandemic (Satici et al., 2020). The COVID-19 pandemic has impacted individuals' mental wellbeing, with research indicating increased rumination specifically relating to the epidemic (Ye et al., 2020) and when focused on perceived threats and potential losses

a Melissa L. Johnman attained a Bachelor of Psychology (Honours) from Griffith University and a Diploma of Counselling from the Australian Institute of Professional Counsellors. She has experience working with children, youth, and adults in professional workplaces and the church community. Johnman currently practises as a counsellor. She strives to empower individuals to bravely embrace challenges and to grow into all they are uniquely called to be. She can be contacted at melissa.johnman@gmail.com

b Dr. Mark Boschen (PhD, FAPS, FCCLP) is a clinical psychologist and senior lecturer within the School of Applied Psychology at Griffith University. His research and clinical interests centre on adult anxiety disorders, with a focus on obsessive compulsive disorder and social anxiety disorders. His research has also investigated basic processes in fear acquisition, as well as the effects of repetitive behaviour (e.g., compulsions) on memory and other cognitive variables. Dr. Boschen has worked in the public health sector, private practice, and tertiary education, and has provided supervision and training to numerous psychologists and other mental health professionals. He can be contacted at m.boschen@griffith.edu.au

(Shigemoto, 2022). With worldwide impacts on individuals' mental health, it is important to further explore rumination and its link to cognition. This will inform mental health practitioners and researchers on the interference effects of rumination and broaden insight into strategies to combat it.

Rumination has previously been associated with a negative impact on cognitive performance, particularly executive functioning, including attentional control and cognitive flexibility during task performance (Brinker et al., 2013). Rumination may lead to various forms of psychopathology (De Raedt et al., 2015) with literature highlighting rumination to be a crucial cognitive risk factor for depression (Koster et al., 2011). It has been found to maintain and exacerbate depressed mood and depressive and anxiety symptoms. It can also reduce an individual's willingness to engage in activities and sense of mastery over one's life (Papageorgiou & Wells, 2003). Depression and anxiety can cause significant human, social, and financial costs (Seligman et al., 2007), with affected individuals experiencing greater life stress and impaired performance (Ruscio et al., 2016).

Just and Alloy (1997) discussed the link between rumination and depression where individuals typically respond to depressive symptoms with ruminative responses, such as behaviours and thoughts focusing on symptoms and potential implications (e.g., thinking about why they feel so badly). Research suggests individuals often engage in rumination as they believe it will help them better understand themselves, situations, and events. However, it might lead to depressed and further negative thinking as they attend to their current depressive mood (Koster et al., 2011). This can than impair task performance by impacting an individual's focus or their cognitive or emotional inhibition (DeJong et al., 2019).

This study examined two competing theoretical models regarding rumination and its relationship to verbal/linguistic cognition. Specifically, it explored whether presented rumination stimuli interfere with participants' abilities on a verbal cognition task (model one) compared to a visual cognition task (model two). The two competing theoretical models were chosen due to their extensive discussion of verbal and visual cognition. This research is imperative to add to existing literature and further equip practitioners and researchers with valuable insight into the link between rumination and cognition. This study reports on the results of a laboratory-based experimental study in which the impact of rumination on a verbal and visual free-recall task was examined. We inspected the theoretical implications of these results for the understanding of rumination and worry.

Baddeley's Model of Working Memory

A proposed theoretical model of the relationship between visual and verbal cognition is provided by Baddeley's model of working memory (Baddeley & Hitch, 1974). This model of working memory includes two subsystems: the articulatory or phonological loop that processes acoustic and verbal information, and the visuospatial sketchpad that processes visual and spatial information (Baddeley, 2002). The phonological loop subsystem comprises

a phonological store, which holds memory traces for a few seconds before fading and can be refreshed through retrieval and rearticulation, and also an articulatory rehearsal process system likened to subvocal speech (Baddeley, 2003). The visuospatial sketchpad temporarily maintains and manipulates visuospatial information, an important role in spatial orientation and solving visuospatial problems. It is believed to form an interface between visual and spatial information which is accessed via the senses or from long-term memory. This allows visual and similar motor or tactile-like-nature information to be linked together (Baddeley, 2002).

Individuals' performance of simultaneous tasks has been found to differ depending on which subsystems the tasks are processed by. Tasks processed by different subsystems (e.g., articulatory loop or visuospatial sketchpad) are thought to be processed without interference. However, tasks processed by the same subsystem are thought to compete and interfere with each other (Ikeda et al., 1996). For example, one study by Farmer et al. (1986) explored the nature of the working memory system in relation to Baddeley's model (Baddeley & Hitch, 1974). Their findings showed articulatory suppression (continuous recital of digits) disrupted and interfered with individuals' verbal reasoning task performance. However, the suppression had no reliable effect on individuals' spatial reasoning task performance. Furthermore, their results highlighted spatial suppression (continuous sequential tapping) interfered with individuals' spatial reasoning performance only, not their verbal reasoning performance (Farmer et al., 1986).

Additionally, research by Nitschke et al. (1999) suggests that verbalisation of task-irrelevant information likely interferes with the articulatory loop (involved in verbal working memory), whilst the visuospatial sketchpad (involved in nonverbal working memory) is unaffected. This indicates and supports Baddeley's model which posits that verbally presented information will likely interfere only with other verbal information (Kensinger & Corkin, 2003). Thus, it is hypothesised that the presence of verbal rumination will impact individuals' abilities to perform tasks by specifically interfering with a verbal cognition task.

Borkovec's Model of Rumination and Worry

An alternative proposed theoretical model of rumination and worry is the cognitive avoidance theory of worry described by Borkovec et al. (1998). This model conceptualises rumination as a verbal/linguistic cognitive process that serves to reduce the number of aversive mental images associated with emotional concerns, thereby minimising physiological and emotional responses, and inhibiting emotional processing (Harvey et al., 2004). Rumination is conceived as primarily verbal rather than visual (Borkovec et al., 1998). For example, research by Borkovec and Inz (1990) suggests worrying thoughts predominate individuals' minds compared to imagery. Freeston et al. (1996) also found that worry is typically experienced as primarily negative verbal and linguistic activity, as opposed to imagery activity (Borkovec et al., 2004), further supporting Borkovec and Inz's (1990) findings. According to

Borkovec's theory (1998), an individual's exposure to negative valence-type verbal information will likely lead to worse performance on visual imagery tasks, as the negative verbal information serves to reduce the individual's exposure to the visual imagery.

Current Study and Hypotheses

Both Baddeley's working memory model (Baddeley & Hitch, 1974) and Borkovec's cognitive avoidance theory of worry (Borkovec et al., 1998) have been researched through investigating individuals' task performance and rumination (Harvey et al., 2004; Ikeda et al., 1996; Kensinger & Corkin, 2003). Each model predicts different impacts on memory performance, with research evidence supporting each prediction. Specifically, Baddeley suggests verbally presented information interferes with verbal information (Kensinger & Corkin, 2003), whilst Borkovec suggests verbal information, in particular negative valence information, interferes with visual task performance (Borkovec et al., 1998).

The current study utilised two free-recall tasks to further examine the association between rumination and task performance: the Rey Auditory Verbal Learning Test (RAVLT; Geffen et al., 1990; Rey, 1964) and the Rey-Osterrieth Complex Figure Test (ROCFT; Kolb & Whishaw, 1985; Osterrieth, 1944; Rey, 1941). The ruminative statements constructed for this study consisted of personally relevant and meaningful statements, based on existing research evidence. Five hypotheses were formed as the basis for this study:

- Hypothesis 1: Participants in the negative ruminative statement group will decrease performance on the verbal and visual memory tasks.
- Hypothesis 2: Participants in the positive ruminative statement group will maintain performance (or there will be a smaller negative impact on performance) on the verbal and visual memory tasks.
- Hypothesis 3: Participants in the neutral ruminative statement (control) group will maintain performance on the verbal and visual memory tasks.
- Hypothesis 4: A greater performance decrease on the verbal task compared to the visual task will be in line with Baddeley's model.
- Hypothesis 5: A greater performance decrease on the visual task compared to the verbal task will be in line with Borkovec's model.

Method

Participants

Participants were 69 current university students (19 men, 50 women), who nominated themselves to partake in this study to earn partial course credit in exchange for participation. Each valence group (negative, neutral [control], and positive) comprised 23 participants. Participants' ages ranged from 17 to 55

years, with a mean age of 23.86 (*SD* = 8.27). Ethnicity included Australian (*n* = 44), Asian (*n* = 10), Australian/Mixed (*n* = 4), European (*n* = 4), African (*n* = 3), New Zealander (*n* = 3), and Brazilian (*n* = 1). Participants' primary language was either English (*n* = 61), a European language (*n* = 4), or an Asian language (*n* = 4).

Measures

Depression Anxiety Stress Scales

The Depression, Anxiety and Stress Scales (DASS-21; Lovibond & Lovibond, 1995) was used to measure core symptoms of depression, anxiety, and stress experienced over the past week. Reliability for this study was assessed through Cronbach's alpha and reported as acceptable for each subscale: .87 for depression, .81 for anxiety, and .82 for stress. Prior research has demonstrated the reliability and validity of the DASS-21 in assessing depression, anxiety, and stress symptoms (Antony et al., 1998; Henry & Crawford, 2005).

Generalised Anxiety Disorder

The 7-item Generalized Anxiety Disorder Assessment (GAD-7; Spitzer et al., 2006) was used as a secondary reliable and valid measure for symptoms of generalised anxiety disorder experienced over the past two weeks. Reliability for this study was assessed through Cronbach's alpha and is reported as high, α = .91 (Spitzer et al., 2006).

Ruminative Statement Groups

A list of the utilised ruminative statements can be seen in Appendix A, Table A1. This list was recorded by the researcher and generated by taking all statement items from the Repetitive Thinking Questionnaire (McEvoy et al., 2010), developed specifically to measure individuals' rumination. The negative valence statements comprised 15 items transformed into personal statements for consistency. Similarly, the positive valence statements comprised 15 items, being the same statements used in the negative but transformed to positive meanings. The neutral statements were 15 newly created items.

Rey Auditory Verbal Learning Test

The Rey Auditory Verbal Learning Test (RAVLT; Geffen et al., 1990; Rey, 1964) was used as the verbal free-recall task, specifically assessing verbal learning. Only List A was used, comprising 15 words, and participants only completed trial one. List A was initially read aloud to participants, and they immediately recalled as many of the words as possible and wrote them on paper provided. After exposure to the ruminative statements, participants were again asked to recall as many words from the initial List A as possible. The RAVLT total score was calculated by summing the number of correct words participants recalled.

Rey-Osterrieth Complex Figure Test

The Rey-Osterrieth Complex Figure Test (ROCFT; Kolb & Whishaw, 1985; Osterrieth, 1944; Rey, 1941) was used as the visual free-recall task, specifically assessing visuospatial memory and constructional ability.

Participants were shown a complete figure design on a slide and asked to copy it by drawing onto a sheet of paper. They were then asked to replicate the complete design from memory immediately afterwards. After exposure to the ruminative statements, participants were asked again to recall the design from memory, drawing it onto another sheet of paper. The ROCFT total score was the participants' accuracy for each of the figures' unit and relative positions within the whole design.

Materials and Procedure

Each session, three participants entered the laboratory and chose a number (1, 2, or 3) to determine which valence group they would be assigned to. They then sat at their designated numbered seat according to the number they drew. Once seated, participants completed a basic demographic questionnaire and the DASS-21 and GAD-7 on their computers via an online Google Forms survey.

Secondly, participants completed a single trial of the RAVLT, recalling as many of the words as they could. Thirdly, participants completed the ROCFT. The figure was presented on a slide and participants copied it onto a piece of paper whilst looking at it as many times as needed. The papers were collected. Participants then attempted to recall the figure by drawing it on another piece of paper, this time without having the figure displayed. Next, the rumination manipulation was presented. Participants put on provided headphones and listened to their respective auditory ruminative recordings, each lasting approximately 5 minutes.

Finally, after the auditory recordings had finished, participants completed the RAVLT and ROCFT again (in the same order as initially completed) to reassess memory recall after exposure to the manipulated ruminative statements to assess and determine interference effects, if any.

Design

The experiment was a 3 × 2 factorial independent groups design. The dependent variable was participants' change in memory recall score from baseline (i.e., before and after listening to the ruminative statements). The first (between-subjects) independent variable was rumination valence, which varied across three levels: (a) negative, (b) neutral, and (c) positive. The second (within-subjects) independent variable was the free-recall change score, which varied across two levels in each rumination group: verbal and visual.

Data Analysis

To examine the effects of rumination on the verbal and visual tasks, two separate 3 (ruminative valence group: negative, neutral, and positive) × 2 (time: before and after) ANOVAs were conducted. The ANOVAs were run separately as the visual and verbal tasks were scored using different scales.

Appropriate assessment of the assumptions for inferential statistics was conducted and are only reported here when violations were detected.

Table 1. Baseline Measurements and Tests of Equivalence

Variable	Negative group (n = 23)		Neutral (control) group (n = 23)		Positive group (n = 23)		Significance test
	M	*SD*	*M*	*SD*	*M*	*SD*	
Gender							χ^2 (2, N = 69) = 8.86, p < .01
Ethnicity							χ^2 (12, N = 69) = 11.19, p = .52
Primary language							χ^2 (4, N = 69) = 4.23, p = .38
Age	22.22	8.30	25.22	9.35	24.13	7.08	F(2, 68) = 0.77, p = .47
DASS – Depression subscale score	8.35	7.71	6.96	5.75	9.39	8.43	F(2, 68) = 0.63, p = .54
DASS – Anxiety subscale score	9.13	7.95	10.96	8.78	10.09	8.01	F(2, 68) = 0.28, p = .76
DASS – Stress subscale score	14.87	9.16	12.87	5.59	14.26	8.16	F(2, 68) = 0.40, p = .67
GAD-7 score	6.83	6.27	5.91	4.40	6.00	3.73	F(2, 68) = 0.24, p = .79
ROCFT accuracy	35.70	.64	35.74	.69	35.61	.78	F(2, 68) = 0.20, p = .82

Note. DASS = Depression Anxiety Stress Scales; GAD-7 = Generalized Anxiety Disorder Assessment 7; ROCFT = Rey-Osterrieth Complex Figure Test.

Results

Tests of Assumptions

Sphericity was found to be violated (p < .05), as tested with Mauchly's test, for both verbal and visual memory tasks, and as such a Huynh-Feldt correction was applied.

The group baseline measurements and tests of equivalence were examined (see Table 1). Groups were equivalent, and there was a larger proportion of women in all groups.

ANOVA Results

In the verbal free-recall task (see Figure 1), there was no significant main effect for valence group, F(2, 66) = .19, p = .83, η^2_p = .01, indicating no difference between the negative, neutral, and positive valence groups. However, there was a significant main effect for time, F(1, 66) = 96.53, p < .001, η^2_p = .59, indicating participants' performance declined from pre- to post-rumination exposure. In the visual free-recall task (see Figure 2), there was no significant main effect for valence group, F(2, 66) = .97, p = .38, η^2_p = .03, indicating no difference between the negative, neutral, and positive valence groups. There was also no significant main effect for time, F(1, 66) = .49, p = .49, η^2_p = .01, indicating participants' performance did not differ from pre- to post-rumination. There were no significant two-way interactions for either the verbal free-recall task, F(2, 66) = 1.08, p = .35, η^2_p = .03, or the visual free-recall task, F(2, 66) = .29, p = .75, η^2_p = .01. This indicates that in both tasks, there was no association between valence group type and pre- and post-rumination scores.

Consequently, Hypothesis 1, which stated participants in the negative ruminative statement group will decrease in performance on the verbal and visual memory tasks, was not supported. Whilst there was a decline in words

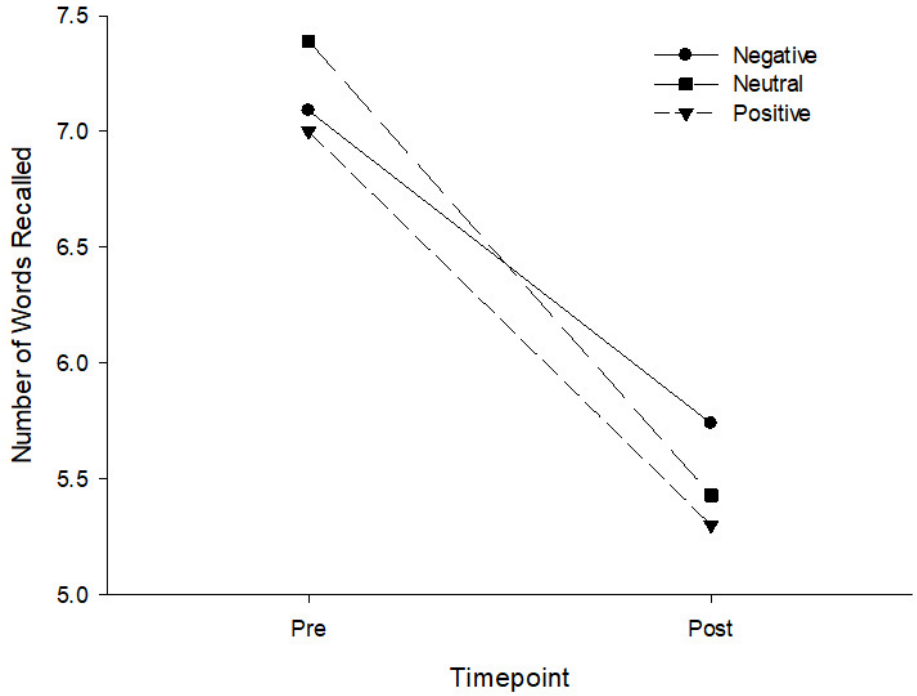

Figure 1. Mean Number of Words Recalled in Verbal Free-Recall Task Across Timepoints

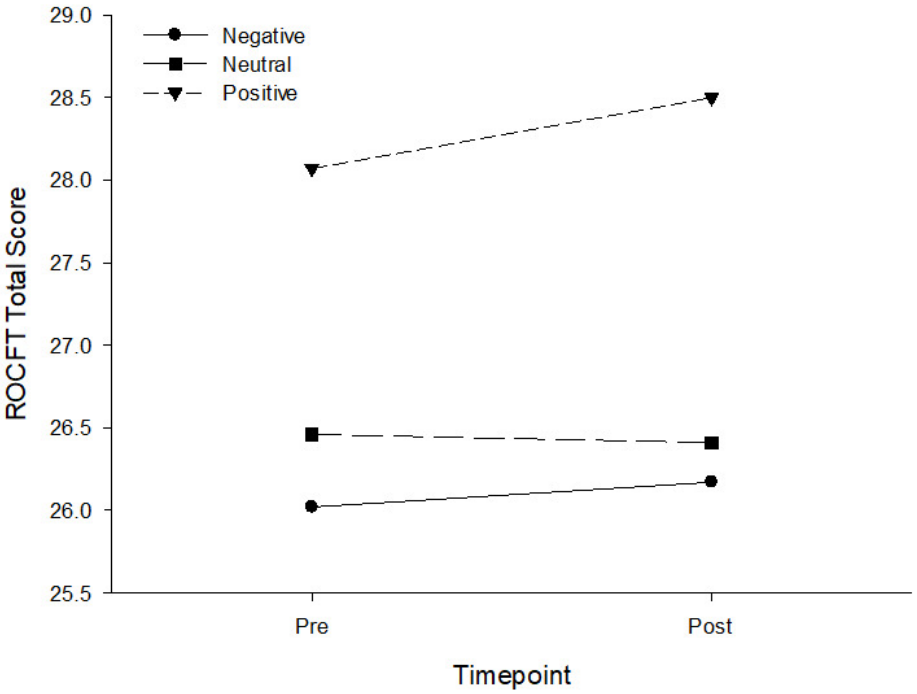

Figure 2. Mean Pre- and Post-Rumination Scores of Visual Free-Recall Task

recalled, no significant interaction was found between time and valence group on either of the two tasks. That is, the effect of time (pre- and post-rumination exposure) and valence group did not interact to impact task scores.

Hypothesis 2, that participants in the positive ruminative statement group would maintain performance (or there would be a smaller negative impact on performance) on the verbal and visual memory tasks, was not supported either as no significant interaction was found.

Hypothesis 3, that participants in the neutral ruminative statement (control) group would maintain performance on the verbal and visual memory tasks, was also not supported as no significant interaction was found.

Hypothesis 4, that there would be a greater performance decrease on the verbal task compared to the visual task, in line with Baddeley's model, was supported as the decrease in participants' post-rumination verbal task scores from their pre-rumination verbal task scores was greater compared to participants' pre- and post-rumination scores on the visual task. Consequently, Hypothesis 5, that there would be a greater performance decrease on the visual task compared to the verbal task, in line with Borkovec's model, was not supported. This was evident in the significant main effect found for time only on the verbal task, not on the visual task, indicating participants' pre- and post-rumination test scores only significantly decreased on the verbal task.

Additionally, a one-way ANCOVA was conducted to determine whether there was a statistically significant difference between the ruminative valence groups on verbal and visual memory recall whilst controlling for the DASS-21 Depression, Anxiety, and Stress subscales and GAD score. In the verbal and visual tasks, there were no significant effects (all $p > .05$) of ruminative valence group on recall whilst controlling for the covariates (see Appendix B, Table B1, for statistical values). These findings indicated no differences between valence groups whilst controlling for each covariate.

Discussion

This study investigated the link between rumination and cognition. It also examined two competing theoretical models: Baddeley's working memory model (Baddeley & Hitch, 1974) and Borkovec's cognitive avoidance theory of worry (Borkovec et al., 1998) regarding rumination and specifically recall task performance. The study investigated whether three different ruminative valence groups (negative, neutral, and positive) had different impacts on individuals' task performance. Specifically, it examined the interference effects of ruminative statements on participants' ability to accurately recall verbal and visual material from free-recall tasks. The two models were then explored in relation to the impact rumination had on participants' memory to determine which model better described the impact that rumination had on individuals' verbal and visual free-recall task performance.

Valence Groups Results

Contrary to what was hypothesised, the results did not support Hypotheses 1, 2, and 3, suggesting rumination may not have had an impact on individuals' verbal and visual task performance. In both the verbal and visual free-recall tasks, the results showed no significant effect for valence group type (i.e., negative, neutral, or positive), suggesting the type of rumination participants were exposed to had no significant impact on verbal or visual task performance.

These findings are inconsistent with previous research which has found rumination to impact individuals' cognitive performance, particularly executive functioning, including attentional control and cognitive flexibility

(Brinker et al., 2013). Specifically, poorer attentional control has been correlated with rumination (Hsu et al., 2015; Mills et al., 2016), indicating attentional control to be a key component in memory tasks (DeJong et al., 2019).

Furthermore, research by Hsu et al. (2015) and Mills et al. (2016) has shown poorer attentional control to be associated with higher levels of rumination, suggesting that once exposed to rumination, attentional control should decrease when completing memory tasks. However, no significant results were found in this study, suggesting that rumination did not interfere with participants' attentional control and therefore did not impact their ability to complete the verbal and visual free-recall tasks after exposure to elicited rumination.

A potential reason for the non-significant findings in this study is that after completing both tasks initially, participants focused their attention on the task stimuli, rather than switching focus to the ruminative auditory recordings. DeJong et al. (2019) did propose a narrowed focus of attention could be advantageous for some tasks by avoiding distraction from stimuli deemed irrelevant. Whilst participants completed both tasks, their working memory would be active and engaged in absorbing relevant information (i.e., the presented words and visual figure), knowing their need to recall it. When participants were asked to listen and pay attention to the ruminative recordings, participants may have had difficulties disengaging from the previous, now irrelevant, verbal and visual tasks, leading to difficulties updating their working memory with the new information. Ultimately, this may have impacted participants' ability to actively engage in the ruminative statements as they did not have the capacity to properly absorb the new incoming information, a potential explanation for the non-significant results found.

A further possible explanation for the non-significant findings not supporting the proposed hypotheses is participants may have had difficulty disengaging from the verbal and visual tasks, therefore struggling to mentally switch focus towards the auditory recording of the ruminative statements. Altamirano et al.'s (2010) research suggests ruminative tendencies may lead to mental inflexibility by facilitating active cognitive maintenance amongst distraction, which facilitates improvement in the performance of certain tasks. If participants were still largely focused on previous tasks, it is likely full attention would not have been directed on the ruminative statements, potentially impacting participants' capacity to hear and comprehend the statements and affecting their exposure to rumination and any interference effects that may have resulted.

Decline in Verbal and Visual Memory Performance

The rumination period was associated with a decline in free recall of verbal information, but not visual information, regardless of the valence of the rumination stimuli. Introducing another (verbal) task may have affected participants' ability to rehearse and recall information from the previous task they were completing (Bennet, 1965). These results are consistent with

Baddeley's working memory model (Baddeley & Hitch, 1974) which proposes that tasks processed by the same subsystem (e.g., articulatory loop) are likely to compete and interfere with one another, whilst tasks processed by different subsystems are not likely to interfere with one another (Ikeda et al., 1996).

Conversely, in the visual free-recall task, no significant effect for time was found, suggesting no decline in participants' pre- and post-rumination visual task scores. This is also consistent with Baddeley's working memory model (Baddeley & Hitch, 1974) where participants' exposure to the verbally presented ruminative statements may not have interfered with their visual task performance as they were processed via different subsystems. Further, it appears at odds with Borkovec's model (Borkovec et al., 1998) of worry in which verbal-linguistic rumination serves to inhibit processing of visual stimuli.

Theoretical Integration

This study examined two competing theoretical models, Baddeley's working memory model (Baddeley & Hitch, 1974) and Borkovec's cognitive avoidance theory of worry (Borkovec et al., 1998), against the findings to determine which model best described the impact rumination had on individuals' verbal and visual task performance.

Evidently, the findings from this study support Baddeley's working memory model (Baddeley & Hitch, 1974), suggesting this model better describes the impact rumination may have on individuals' verbal and visual task performance. This is in line with Hypothesis 4 which predicted a greater performance decrease on the verbal task compared to the visual task, in line with Baddeley's model. Consequently, Hypothesis 5, which stated a greater performance decrease on the visual task compared to the verbal task, in line with Borkovec's model, was not supported.

These findings are in line with other research supporting this model, where articulatory suppression (continuous recital of digits) disrupted and interfered with individuals' performance on a verbal reasoning task, but not on a visual-spatial reasoning task (Farmer et al., 1986). Conversely, spatial suppression (continuous sequential tapping) produced interference only with individuals' spatial reasoning performance, and not verbal reasoning performance (Farmer et al., 1986). Additionally, other research by Nitschke et al. (1999) found verbalisation of task-irrelevant information interfered with participants' articulatory loop (a key component involved in verbal working memory), whilst the visuospatial sketchpad (a key component involved in nonverbal working memory) was unaffected. Further research is needed to continue examining these theoretical models in the area of rumination and task performance to determine which model is a better fit and if that varies in different circumstances (e.g., indoor or outdoor environment) or demographics (e.g., gender).

Implications

This study's results have several implications including adding to pre-existing literature, highlighting rumination impacts on individuals' verbal and visual task performance, and demonstrating potential impacts on other life aspects.

Firstly, these results expanded upon existing literature regarding rumination effects on task performance by specifically investigating the effects on verbal and visual free-recall tasks. This assisted in indicating whether rumination interferes with verbal tasks, visual tasks, or both.

Secondly, these results identified which of the investigated theoretical models, Baddeley's or Borkovec's (Baddeley & Hitch, 1974; Borkovec et al., 1998), was more accurate in relation to rumination interferences on visual and verbal tasks. This allows for a deeper insight and understanding into the two presented models and key aspects that may be important in rumination and task performance.

These contributions suggest that rumination does not have a significant impact on verbal and visual task performance, indicating the link between rumination and cognition may not be as significant as earlier studies have shown, at least on recall tasks. Furthermore, this new research may further equip practitioners with knowledge into what tasks or parts of the brain rumination may typically interfere with and impact. This may help practitioners and researchers identify and further develop research strategies and tools to target and help decrease individuals' rumination patterns.

Limitations

One limitation of this study was the use of a non-clinical student sample. Students are likely to already be under stress from their own studies and personal commitments, with literature indicating university as a high-stress period for individuals (Ribeiro et al., 2018). Therefore, it is possible that if participants were experiencing high levels of stress, it impacted task performance. Whilst participants' stress levels were tested and controlled for and results indicated stress did not significantly affect participants' task performance, it would still be worth investigating in future research as an individual factor. Examining stress as an individual factor (compared to using a subscale) may allow researchers to gain a more accurate and broader understanding of individuals' stress levels. It would be expected that individuals experiencing greater personal stress would result in poorer task performance as research suggests the greater stress an individual is experiencing, the poorer they perform on memory tasks (Jelici et al., 2009).

A further limitation of this study, worth exploring in future research, would be assessment of participants' attention on the rumination stimuli. This was not controlled for or measured and would be a valuable aspect to examine. This could be done by asking participants to recall as many of the ruminative statements they were exposed to as possible, prior to completing both tasks for the second time. It would be expected that participants who did not pay

attention to the presented rumination would not differ in task performance and those who did pay attention to the rumination would differ in task performance.

Future Research

Further additional research topics to consider could be duration of rumination exposure and participants' self-evaluated task confidence. Investigating whether the duration of the ruminative statement recordings impacts individuals' task performance could be studied by splitting participants into groups where each group listens to the recordings for a different length of time (e.g., 2, 5, or 10 minutes). Researchers could then determine if differences in task performance between the three groups exist. If an individual is exposed to negative stimuli for a longer period of time, then it may be expected that the impact on the individual would be greater, compared to being exposed to positive stimuli. If future research was conducted in an extension to this study, the greater impact may suggest poorer task performance.

Finally, adding in a self-report questionnaire for participants to complete at the end of the experiment to explore how they think they performed would be beneficial in understanding participants' own perspective on their performance. This could be done after the initial verbal and visual task and then again after completing both tasks after the rumination exposure. It may be interesting to investigate if participants' personal perceptions of their performance differ at pre- and post-rumination exposure and also if differences in confidence exist between the valence groups participants are assigned to.

Conclusion

This study examined and determined whether rumination impacted individuals' verbal and visual task performance. More specifically, it explored whether three different ruminative valence groups (negative, neutral, and positive) differed in impact on participants' verbal and visual free-recall task performance. This was investigated by inspecting the interference effects that rumination had on participants' ability to recall stimuli information from both verbal and visual tasks. Contrary to what was hypothesised, these findings suggest rumination may not have an impact and may not interfere with individuals' verbal and visual task performance. Additionally, this study also examined Baddeley's working memory model (Baddeley & Hitch, 1974) and Borkovec's cognitive avoidance theory of worry model (Borkovec et al., 1998) to determine which better described the impact rumination had on individuals' task performance. These findings show support for Baddeley's model in that the presentation of the rumination statements aligns better with Baddeley's model theory compared to Borkovec's model.

This study has highlighted several implications, including adding to pre-existing literature, demonstrating the impacts rumination may have on individuals' verbal and visual task performance, and informing health practitioners about the link between rumination and cognition. This research

provides insight into the types of strategies and tools that may be beneficial in combatting and decreasing individuals' rumination tendencies, noting the differences between verbal and written task strategies in comparison to imagery and visual task strategies. Furthermore, this report has highlighted the limitations of this study and encouraged and identified areas for future research. Those areas include investigation into potential gender differences, age differences, duration of rumination recordings, and further exploration of the two theoretical models. These are imperative research topics to be investigated in order to deepen our understanding of rumination and task performance.

Submitted: March 23, 2023 AEST, Accepted: March 23, 2023 AEST

References

Altamirano, L. J., Miyake, A., & Whitmer, A. J. (2010). When mental inflexibility facilitates executive control: Beneficial side effects of ruminative tendencies on goal maintenance. *Psychological Science*, *21*(10), 1377–1382. https://doi.org/10.1177/0956797610381505

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment*, *10*(2), 176–181. https://doi.org/10.1037/1040-3590.10.2.176

Baddeley, A. D. (2002). Is working memory still working? *European Psychologist*, *7*(2), 85–97. https://doi.org/10.1027//1016-9040.7.2.85

Baddeley, A. D. (2003). Working memory: Looking back and looking forward. *Nature Reviews Neuroscience*, *4*(10), 829–839. https://doi.org/10.1038/nrn1201

Baddeley, A. D., & Hitch, G. (1974). Working memory. *Psychology of Learning and Motivation*, *8*, 47–89. https://doi.org/10.1016/s0079-7421(08)60452-1

Bennet, B. M., Jr. (1965). Effects of a subsidiary task on short-term memory. *British Journal of Psychology*, *56*(4), 413–419. https://doi.org/10.1111/j.2044-8295.1965.tb00983.x

Borkovec, T. D., Alcaine, O. M., & Behar, E. (2004). Avoidance theory of worry and generalized anxiety disorder. In R. Heimberg, C. Turk, & D. Mennin (Eds.), *Generalised anxiety disorder: Advances in research and practice* (pp. 77–108). Guilford Press.

Borkovec, T. D., & Inz, J. (1990). The nature of worry in generalized anxiety disorder: A predominance of thought activity. *Behaviour Research and Therapy*, *28*(2), 153–158. https://doi.org/10.1016/0005-7967(90)90027-g

Borkovec, T. D., Ray, W. J., & Stober, J. (1998). Worry: A cognitive phenomenon intimately linked to affective, physiological, and interpersonal behavioural processes. *Cognitive Therapy and Research*, *22*(6), 561–576. https://doi.org/10.1023/a:1018790003416

Brinker, J. K., Campisi, M., Gibbs, L., & Izzard, R. (2013). Rumination, mood and cognitive performance. *Psychology*, *4*, 224–231. https://doi.org/10.4236/psych.2013.43AD34

De Raedt, R., Hertel, P. T., & Watkins, E. R. (2015). Mechanisms of repetitive thinking: Introduction to the special series. *Clinical Psychological Science*, *3*(4), 568–573. https://doi.org/10.1177/2167702615584309

DeJong, H., Fox, E., & Stein, A. (2019). Does rumination mediate the relationship between attentional control and symptoms of depression? *Journal of Behavior Therapy and Experimental Psychiatry*, *63*, 28–35. https://doi.org/10.1016/j.jbtep.2018.12.007

Ehring, T., & Watkins, E. R. (2008). Repetitive negative thinking as a transdiagnostic process. *International Journal of Cognitive Therapy*, *1*(3), 192–205. https://doi.org/10.1521/ijct.2008.1.3.192

Farmer, E. W., Berman, J. V. F., & Fletcher, Y. L. (1986). Evidence for a visuo-spatial scratch-pad in working memory. *The Quarterly Journal of Experimental Psychology*, *38*(4), 675–688. https://doi.org/10.1080/14640748608401620

Freeston, M. H., Dugas, M. J., & Ladouceur, R. (1996). Thoughts, images, worry, and anxiety. *Cognitive Therapy and Research*, *20*(3), 265–273. https://doi.org/10.1007/bf02229237

Geffen, G., Moar, K. J., O'Hanlon, A. P., Clark, C. R., & Geffen, L. B. (1990). Performance measures of 16– to 86-year-old males and females on the auditory verbal learning test. *Clinical Neuropsychologist*, *4*(1), 45–63. https://doi.org/10.1080/13854049008401496

Harvey, A. G., Watkins, E., Mansell, W., & Shafran, R. (2004). *Cognitive behavioural processes across psychological disorders: A transdiagnostic approach to research and treatment*. Oxford University Press.

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, *44*(2), 227–239. https://doi.org/10.1348/014466505x29657

Hsu, K. J., Beard, C., Rifkin, L., Dillon, D. G., Pizzagalli, D. A., & Björgvinsson, T. (2015). Transdiagnostic mechanisms in depression and anxiety: The role of rumination and attentional control. *Journal of Affective Disorders*, *188*, 22–27. https://doi.org/10.1016/j.jad.2015.08.008

Ikeda, M., Iwanaga, M., & Seiwa, H. (1996). Test anxiety and working memory system. *Perceptual and Motor Skills*, *82*(3_suppl), 1223–1231. https://doi.org/10.2466/pms.1996.82.3c.1223

Jelici, M., Geraerts, E., Merckelbach, H., & Guerrieri, R. (2009). Acute stress enhances memory for emotional words, but impairs memory for neutral words. *International Journal of Neuroscience*, *114*(10), 1343–1351. https://doi.org/10.1080/00207450490476101

Just, N., & Alloy, L. B. (1997). The response styles theory of depression: Tests and an extension of the theory. *Journal of Abnormal Psychology*, *106*(2), 221–229. https://doi.org/10.1037/0021-843x.106.2.221

Kensinger, E. A., & Corkin, S. (2003). Effect of negative emotional content on working memory and long-term memory. *Emotion*, *3*(4), 378–393. https://doi.org/10.1037/1528-3542.3.4.378

Kolb, B., & Whishaw, I. (1985). *Fundamentals of Human Neuropsychology* (2nd ed.). W. H. Freeman.

Koster, E. H. W., De Lissnyder, E., Derakshan, N., & De Raedt, R. (2011). Understanding depressive rumination from a cognitive science perspective: The impaired disengagement hypothesis. *Clinical Psychology Review*, *31*(1), 138–145. https://doi.org/10.1016/j.cpr.2010.08.005

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-u

McEvoy, P. M., Mahoney, A. E. J., & Moulds, M. L. (2010). Are worry, rumination, and post-event processing one and the same? Development of the repetitive thinking questionnaire. *Journal of Anxiety Disorders*, *24*(5), 509–519. https://doi.org/10.1016/j.janxdis.2010.03.008

Mills, A. C., Grant, D. M., Judah, M. R., White, E. J., Taylor, D. L., & Frosio, K. E. (2016). Trait attentional control influences the relationship between repetitive negative thinking and psychopathology symptoms. *Psychiatry Research*, *238*, 277–283. https://doi.org/10.1016/j.psychres.2016.02.055

Nitschke, J. B., Heller, W., Palmieri, P. A., & Miller, G. A. (1999). Contrasting patterns of brain activity in anxious apprehension and anxious arousal. *Psychophysiology*, *36*(5), 628–637. https://doi.org/10.1111/1469-8986.3650628

Osterrieth, P. A. (1944). Le test de copie d'une figure complex: Contribution à l'étude de la perception et de la mémoire. *Archives de Psychologie*, *30*, 286–356.

Papageorgiou, C., & Wells, A. (2003). An empirical test of a clinical metacognitive model of rumination and depression. *Cognitive Therapy and Research*, *27*(3), 261–273. https://doi.org/10.1023/a:1023962332399

Rey, A. (1941). L'examen psycholigique dans les cas d'encéphalopathie traumatique. *Archives de Psychologie*, *28*, 286–340.

Rey, A. (1964). *L'examen Clinique en Psychologie*. Press Universitaire de France.

Ribeiro, Í. J. S., Pereira, R., Freire, I. V., de Oliveira, B. G., Casotti, C. A., & Boery, E. N. (2018). Stress and quality of life among university students: a systematic literature review. *Health Professions Education*, *4*(2), 70–77. https://doi.org/10.1016/j.hpe.2017.03.002

Ruscio, A. M., Gentes, E. L., Jones, J. D., Hallion, L. S., Coleman, E. S., & Swendsen, J. (2016). Rumination predicts heightened responding to stressful life events in major depressive disorder and generalized anxiety disorder. *Journal of Abnormal Psychology*, *124*, 17–26. https://doi.org/10.1037/abn0000025

Satici, B., Saricali, M., Ahmet Satici, S., & Griffiths, M. (2020). Intolerance of uncertainty and mental wellbeing: Serial mediation by rumination and fear of COVID-19. *International Journal of Mental Health and Addiction*, *20*(5), 2731–2742. https://doi.org/10.1007/s11469-020-00305-0

Seligman, M. E. P., Schulman, P., & Tryon, A. M. (2007). Group prevention of depression and anxiety symptoms. *Behaviour Research and Therapy*, *45*(6), 1111–1126. https://doi.org/10.1016/j.brat.2006.09.010

Shigemoto, Y. (2022). Association between daily rumination and posttraumatic growth during the COVID-19 pandemic: An experience sampling method. *Psychological Trauma: Theory, Research, Practice, and Policy*, *14*(2), 229–236. https://doi.org/10.1037/tra0001061

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder. *Archives of Internal Medicine*, *166*(10), 1092–1097. https://doi.org/10.1001/archinte.166.10.1092

Whitmer, A. J., & Gotlib, I. H. (2013). An attentional scope model of rumination. *Psychological Bulletin*, *139*(5), 1036–1061. https://doi.org/10.1037/a0030923

Ye, B., Zhou, X., Im, H., Liu, M., Wang, X. Q., & Yang, Q. (2020). Epidemic rumination and resilience on college students' depressive symptoms during the COVID-19 pandemic: The mediating role of fatigue. *Frontiers in Public Health*, *8*, 560983. https://doi.org/10.3389/fpubh.2020.560983

Appendices

Appendix A

Table A1. Ruminative Statements Used in Auditory Recordings

Ruminative valence	Statement number	Ruminative statement
Negative	1	I won't be able to do my work because I feel so badly
	2	I won't be able to do my job because I feel so badly
	3	I am a failure
	4	I have made so many mistakes
	5	It is all my fault
	6	I am so alone
	7	I always react this way
	8	I can never get going
	9	I wish I could go back and do better
	10	I have problems other people don't have
	11	I will always feel sad
	12	I will never feel up to doing anything
	13	I am so unmotivated
	14	I will always find it hard to concentrate
	15	I always lack motivation
Positive	1	I will be able to do my work
	2	I will be able to do my job
	3	I am not a failure
	4	I have not made many mistakes
	5	It is not all my fault
	6	I am not alone
	7	I never react this way
	8	I have no problem getting going
	9	I don't wish I could go back and do better
	10	I do not have problems other people have
	11	I will not always feel sad
	12	I will feel up to doing something
	13	I am not unmotivated
	14	I will always find it easy to concentrate
	15	I never lack motivation
Neutral	1	I eat every day
	2	I am wearing clothes
	3	I have a drink of water each day
	4	I will see someone today
	5	I will speak to someone today
	6	I own a phone
	7	I watch TV
	8	I am wearing shoes
	9	I am sitting down
	10	I am listening to an audio recording
	11	I am at University
	12	I am partaking in a research study
	13	I am writing with a pen
	14	I have talked today
	15	I have read something today

Appendix B

Table B1. ANCOVA Results for the Verbal Free-Recall Task

Covariate	*df*	*F*	*p*	η^2_p
Depression	1, 65	0.14	.71	< .01
Anxiety	1, 65	0.004	.95	<.01
Stress	1, 65	0.11	.74	< .01
Depression & Anxiety	1, 65	0.001	.98	< .01
GAD-7	1, 65	0.39	.53	< .01

Note. GAD-7 = Generalized Anxiety Disorder Assessment 7.

Table B2. ANCOVA Results for the Visual Free-Recall Task

Covariate	*df*	*F*	*p*	η^2_p
Depression	1, 65	1.37	.25	.02
Anxiety	1, 65	1.12	.30	.02
Stress	1, 65	1.60	.21	.02
Depression & Anxiety	1, 65	0.21	.65	< .01
GAD-7	1, 65	0.23	.63	< .01

Note. GAD-7 = Generalized Anxiety Disorder Assessment 7.