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Are failures to suppress obsessive-intrusive thoughts associated with working memory?

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ABSTRACT

Background and objectives: Obsessive compulsive disorder (OCD) is characterised by repeated attempts to suppress obsessive-intrusive thoughts (OITs). Nonclinical individuals also regularly engage in thought suppression. Attempts to suppress OITs are often unsuccessful and there is wide variation in suppression abilities across nonclinical and clinical samples. Understanding the mechanisms that explain variations in suppression abilities could enhance our understanding of OCD. This study aimed to investigate one potential mechanism – working memory – using a comprehensive thought suppression task.

Methods: Eighty-three nonclinical participants completed a computerized thought dismissibility task (in which they replaced an obsessive-intrusive thought with a neutral thought), and a computerized working memory task. Participants also completed measures of OCD and negative mood.

Results: None of the suppression variables (OIT frequency, mean OIT duration, mean latency to return, total OIT duration) were correlated with working memory capacity. Obsessive-compulsive symptoms were correlated with total OIT duration, but the relationship was not significant after controlling for negative mood.

Limitations: The thought dismissibility task does not account for differences in motivation to suppress OITs. The sample was non-clinical and mostly female.

Conclusion: An individual's ability to suppress OITs is not associated with their working memory capacity, suggesting poor working memory does not explain persistent OITs in individuals with OCD.

1. Introduction

A key feature in the development and maintenance of obsessive-compulsive disorder (OCD) is difficulty in controlling intrusive thoughts (Rachman, 1997, 1998; Clark & Purdon, 2016). Obsessive-intrusive thoughts (OITs) are spontaneous thoughts, images or impulses that are unwanted, repetitive, and difficult to control (Rachman, 1981). These thoughts exist on a continuum: most individuals experience OITs in their everyday life (Radomsky et al., 2014), but individuals with OCD experience more frequent and distressing thoughts (Clark & Rhyno, 2005; Berry & Laskey, 2012). Individuals with OCD are also more likely to endorse problematic appraisals – for example, by thinking the thought is an indication that something bad will happen which they must prevent (Salkovskis, 1985, 1999; Salkovskis & Millar, 2016). Such maladaptive appraisals of OITs motivate individuals to attempt to control their thoughts to try to reduce distress and prevent negative outcomes (Rachman, 1997, 1998).

Thought suppression – the effortful process of attempting to remove a thought or prevent it from occurring in the first place – is a thought control strategy used both by nonclinical individuals and, more commonly, by individuals with OCD (Belloch, Morillo, & García-Soriano, 2009; Purdon, Rowa, & Antony, 2007). Early studies indicated that thought suppression led, counterintuitively, to an *increase* in thoughts (Wegner, Schneider, Carter, & White, 1987), but this finding has not been reliably replicated with OITs specifically (Purdon, 2004, 2020). Previous research has shown that attempts to suppress thoughts are often unsuccessful and individuals vary in their suppression ability, as demonstrated by OIT frequency means and standard deviations of more than zero in suppression studies (e.g. with nonclinical participants: Purdon & Clark, 2001; with individuals diagnosed with OCD: Abramowitz, Tolin, Street, 2001). Understanding the mechanisms behind these individual differences in suppression success would reveal important

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information about how OITs persist, and ultimately, about the maintenance and development of OCD. This information could inform the improvement of cognitive models of OCD (for example, perhaps suppression is more likely to lead to persistent OITs in individuals with particular neuropsychological characteristics) and point toward targets for intervention and support (for example, by encouraging individuals with particular neuropsychological characteristics to use thought suppression but only in short bursts when thoughts are particularly troublesome, Gorlin, Lambert, & Teachman, 2016).

One potentially important factor that may contribute to the success of thought suppression is working memory — the temporary storage system where verbal and visual information are manipulated (Baddeley, 2000; Baddeley & Hitch, 1974). Working memory is made up of three components: one for dealing with acoustic and speech-based information (the phonological loop), one for dealing with visual and spatial information (the visuospatial sketchpad), and a central attentional control system (the central executive). The central executive is responsible for selectively maintaining and manipulating goal-relevant information, and for excluding irrelevant or unwanted material (Baddeley & Hitch, 1974; Rosen & Engle, 1998). Therefore, a poorly functioning central executive may prevent an individual from removing OITs from consciousness, or from maintaining focus on the task at hand. In addition, OITs may more readily capture an individual's attention if the capacity of their phonological loop and visuospatial sketchpad is low. Indeed, individuals with OCD have poorer working memory than nonclinical individuals, which may explain the persistence of OITs (Abramovitch, Abramowitz, & Mittleman, 2013). Previous research has sought to determine whether working memory is associated with experiences of OITs in both individuals with OCD (Grisham & Williams, 2013) and nonclinical individuals (Gorlin et al., 2016; Brewin & Smart, 2005), with mixed findings. In an influential study, Brewin and Smart (2005) reported that nonclinical participants with greater working memory capacity reported experiencing fewer OITs whilst suppressing them, than participants with poorer working memory capacity, and this relationship was not explained by negative mood. In other words, individuals with better working memory were more successful at suppressing OITs.

The majority of previous studies on thought suppression have used a problematic paradigm that assesses thought *frequency,* but not thought *duration* (for reviews see: Purdon, 2004, 2020). Thus, participants who experience one OIT for the *entire* duration of the study will appear to have more suppression success than participants who experienced two OITs *briefly*, before quickly suppressing them (Purdon, 2004). Thought frequency and thought duration represent different thought suppression abilities. Thought frequency is a measure of proactive suppression – the ability to prevent a thought from occurring; whereas average thought duration is measure of reactive suppression – the ability to remove a thought once it has occurred. Tasks which measure both proactive and reactive suppression abilities are vital in providing a more comprehensive and fine-grained picture of suppression.

Purdon, Gifford, McCabe, and Antony (2011) developed one such task – a computerized thought dismissibility task. Participants who had been diagnosed with OCD or panic disorder were instructed to indicate, using a computer keyboard, when they experienced an upsetting thought (OIT or panic-related thought) and when they successfully replaced it with a neutral thought. Proactive suppression was assessed by thought frequency and time taken for thoughts to return after suppression. Reactive suppression was assessed by average duration of thoughts. Total thought duration was also measured, as a combined measure proactive and reactive suppression abilities. However, this variable can only be accurately interpreted alongside the other suppression variables. For example, an individual could experience one OIT for the total duration of the task, demonstrating poor suppression abilities that are explained by poor reactive suppression alone. The study showed that individuals with OCD demonstrated poorer proactive, but not reactive, thought suppression abilities than individuals with panic disorder. This task shows promise in revealing the mechanisms that explain suppression success.

The current study aimed to investigate whether thought suppression of OITs is associated with working memory capacity in a nonclinical sample, using the task developed by Purdon et al. (2011). We predicted that working memory capacity would be related to both proactive and reactive suppression failures; that is, OIT frequency, mean OIT duration, latency for the OIT to return, and total OIT duration – as captured by the thought dismissibility task. We also measured negative mood due to its proposed role in suppression failures (e.g. Brewin & Smart, 2005).

2. Materials and methods

2.1. Participants

Ninety participants were recruited, via e-mail, from a staff/student pool at a UK university. Seven participants were excluded from the study for not completing all tasks relevant to this study.[3] Of the remaining 83 participants 16 were male (19.3%) and 67 female (80.7%) (mean age = 20 years; age range = 18–40 years). Individuals who reported they had received a diagnosis of OCD were not eligible to participate. Participants received either course credits or £5 cash reimbursement for their time. The study was granted ethical approval by The University of Sheffield's ethics committee.

2.2. Materials and procedure

All participants attended the laboratory, provided informed consent, and completed the following on a computer: the Obsessive-Compulsive Inventory – Revised (OCI-R; Foa et al., 2002) and the Depression Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995), followed by the thought dismissibility task (to measure thought suppression failures) and the Operation Span task (OSPAN, Unsworth, Heitz, Schrock, & Engle, 2005; to measure their working memory capacity).

OCI-R (Foa et al. 2002): The OCI-R is an 18-item questionnaire that was used to assess obsessive-compulsive symptoms. Total scores could range from 0 to 72. Cronbach's α in the current sample was .90.

DASS-21 (Lovibond & Lovibond, 1995): The 7-item depression subscale of the 21-item DASS (DASS-21; Lovibond & Lovibond, 1995) was used to assess negative mood. Total scores could range from 0 to 21. Cronbach's α in the current sample was .91.

Obsessional Intrusive Thoughts Inventory (Original Spanish Version: "Inventario de Pensamientos Intrusos Obsesivos", INPIOS; García- Soriano, Belloch, Morillo & Clark, 2011): Part one of the INPIOS was used to identify participants most upsetting OIT. This OIT was then primed during the thought dismissibility task.

Thought dismissibility task: A shorter version of the thought dismissibility task used by Purdon et al. (2011) was used to assess thought suppression failures. For this task, participants were required to indicate when they were successful in replacing an OIT with a neutral thought, by pressing a computer key. Participants first practiced by replacing a neutral thought (*basket*) with another neutral thought *(houseplant)*. Following the practice, participants were primed with their most upsetting OIT (taken from the INPIOS; García-Soriano, Belloch, Morillo, & Clark, 2011) by writing about a scene involving their most upsetting OIT for 2 min (see Appendix B for more details on OITs selected). Participants then rated the vividness, difficulty imagining, and distress associated with the OIT using 101-point visual analogue scales immediately following the prime.

Next, participants began the main phase of the thought dismissibility task where they were asked to monitor their consciousness for 5 min and indicate i) when they had experienced their most upsetting OIT and ii)

[3] The main analyses were also conducted by including these participants and imputing missing data – the key findings remained (see Appendix C).

when they had successfully replaced the OIT with the neutral thought of *a houseplant*. This task produced four variables, which were recorded by the computer: the number of times the OIT occurred (OIT frequency); the mean latency to replace the OIT (mean OIT duration); the mean latency with which the OIT returned (mean latency to return), and the total amount of time spent thinking about the OIT (total OIT duration).

OSPAN task (Unsworth et al., 2005): A computerized version of the OSPAN was used to assess working memory capacity. The OSPAN requires participants remember a sequence of letters which are separated by math problems. Participants are required to continuously update their working memory capacity (e.g. exclude irrelevant letters, include relevant letters) whilst resisting interference (e.g. from the math problems). The total number of letters recalled in the correct position was used as the main predictor variable for working memory capacity (OSPAN partial score).

2.3. Statistical analysis

Data analyses were conducted using IBM SPSS (version 23). Outlier scores (>3.3 SD) on the thought dismissibility and working memory tasks were assigned a value of one more than the most extreme non-outlier (as suggested by Tabachnick & Fidell, 1996). For the mean OIT duration, mean latency to return, and total OIT duration, this meant 1 s was added (rather than 1 ms). Participants who scored below 80% accuracy on the OSPAN math problems were excluded from the correlational analyses. Only participants who experienced at least one OIT during the dismissibility task were included in the analyses for thought frequency, mean OIT duration, and total OIT duration; and only those who experienced at least two OITs were included in the analyses for mean latency to return.

3. Results

3.1. Preliminary analysis

Logarithmic transformation was applied to mean OIT duration, mean latency to return, and total OIT duration data to reduce positive skew.

3.2. Descriptive statistics and bivariate correlations

Participants scored a mean of 17.20 ($SD = 11.06$) on the OCI-R (OCI-R clinical cut off ≥21). Participants scored in the mild range for depression ($M = 5.57$, $SD = 4.81$).

Following the OIT prime, the mean vividness rating for OITs was 64.61 ($SD = 23.30$), the mean difficulty imagining the OIT was 36.75 ($SD = 30.82$), and the mean distress rating of the OIT was 57.51 ($SD = 27.80$). For the thought dismissibility task, participants reported a mean of 7.33 OITs ($SD = 5.46$). Mean OIT duration was 6.60 s ($SD = 7.50$), and it took a mean of 38.67 s ($SD = 32.33$) for the OITs to return after dismissal. Participants spent a mean total duration of 39.00 s ($SD = 40.49$) thinking about OITs.

Correlations showed that there were no significant relationships between working memory capacity and any of the thought suppression variables. Obsessive-compulsive symptoms correlated significantly with total OIT duration[4] but not with any of the other suppression variables. Negative mood correlated significantly with mean OIT duration, but not the other suppression variables (see Table 1).

Table 1
Correlations between obsessive-compulsive symptoms (OCI-R), negative mood (DASS depression), working memory capacity (OSPAN), and OIT frequency, mean OIT duration (log transformed), mean latency to return (log transformed), and total OIT duration (log transformed).

	Working memory capacity	Obsessive-Compulsive symptoms	Negative mood
OIT frequency	.14	.17	.10
Mean OIT duration	-.11	.17	.25*
Mean latency to return	.001	-.16	-.10
Total OIT duration	-.02	.24*	.22

*p ≤ .05.
**p ≤ .01.
**p ≤ .001.

4. Discussion

We aimed to investigate whether working memory capacity is related to thought suppression failures, using a comprehensive measure of thought suppression – a thought dismissibility task (Purdon et al., 2011). Contrary to our predictions, working memory capacity was not associated with either proactive or reactive suppression failures. This finding is surprising when considering the role of the working memory system in excluding irrelevant information, which OITs are often experienced as. Though the finding conflicts with some earlier research suggesting a relationship between working memory and suppression success (Brewin & Smart, 2005), it aligns with other research suggesting that working memory is unrelated to the suppression of OITs (in nonclinical participants: Gorlin et al., 2016; in individuals with OCD: Grisham & Williams, 2013), and the suppression of other negative thoughts (e.g. intrusive traumatic thoughts: Nixon et al., 2008; Nixon & Rackebrandt, 2016). Our findings, therefore, contribute to a growing body of literature suggesting working memory is unrelated to the suppression of unwanted thoughts.

When considered alongside Purdon et al. (2011), the current findings suggest that nonclinical individuals are more successful at suppressing OITs than individuals with OCD. Individuals with OCD spent almost three times longer thinking about OITs than nonclinical individuals (22 s per minute vs 7.8 s per minute) and took almost three times as long to dismiss OITs (16.71 s vs 6.6 s, a statistically significant difference: see Supplementary materials), despite there being no difference between thought distress ratings following the prime (on a 101-point scale: 57.5 vs 59.9). There were also small differences between the groups in measures of proactive suppression: nonclinical individuals experienced fewer OITs than those with OCD (1.5 per minute vs 1.8 per minute), and the thoughts took longer to return after suppression, though this was not a statistically significant difference (38.7 s vs 34.9 s). Overall, these findings conflict with research suggesting individuals with OCD are more successful at suppressing OITs than nonclinical individuals (Magee, Harden, & Teachman, 2012). The findings suggest that like OIT frequency and distress, suppression abilities may exist on a continuum from nonclinical individuals who successfully suppress most OITs at one end, to individuals with OCD who regularly struggle to suppress OITs at the other end (Berry & Laskey, 2012).

4.1. Limitations and future studies

Individuals experiencing more obsessive-compulsive symptoms also experienced OITs for a longer total duration during the task, but this relationship was not significant after controlling for negative mood. Longer OIT duration may partially reflect elaborative processing that occurs after the experience of the OIT, such as rumination, which is driven by negative mood (Kavanagh, Andrade, & May 2005; Williams et al., 2007). However, this conclusion is beyond the scope of the current study and the difficulty differentiating between OITs and further elaborative processing represents a general difficulty with measuring OITs in the lab. Future studies should investigate the relationship between

[4] This relationship was no longer significant after controlling for negative mood; $r(75) = 0.07$; $p = .53$.

elaboration and affect in the context of OITs, and also attempt to delineate the experience of OITs from further elaboration. Ultimately, understanding how an ineffective strategy, such as thought suppression, maintains distress could point toward specific targets for intervention. For example, thought suppression may be more likely to maintain distress in situations with fewer distractions, where rumination is more likely (Nolen-Hoeksema & Morrow, 1993). Thought suppression may therefore be an effective strategy in situations with more distractions, whereas alternative methods of responding may be more effective in situations with fewer distractions (e.g. mindfulness, Broderick, 2005).

The thought dismissibility task used was a more comprehensive measure of thought suppression than is typically used. However, participants' motivation to suppress OITs may have varied. Some participants may have appraised OITs as needing attention and thus attempted to suppress them more often and with more intensity (Purdon, 2020). This may be particularly true for the proactive suppression variables (thought frequency and latency to return), as participants were instructed to think of anything and then remove the thought if experienced, rather than to keep the thought from entering consciousness in the first place.

The use of an idiosyncratically primed OIT was a strength of the current study, in that it increased the ecological validity of the suppression task. However, there are downsides to this method, as participants' variable history of experiencing the thought likely had differential impacts upon their ability to dismiss the thought. Priming a novel OIT in all participants would have controlled for this variation but at the cost of ecological validity.

The current findings suggest working memory deficits may not fully explain persistent OITs in individuals with OCD. However, participants in the current study were mostly female and all were nonclinical; caution should therefore be taken when generalising these findings. Nonclinical participants are relevant for research into OCD due to the dimensional nature of obsessive-compulsive experiences (Abramowitz et al., 2014). However, as working memory deficits have been found in individuals with OCD, the relationship between suppression and working memory may differ from that found in nonclinical samples (Abramovitch, Abramowitz, & Mittelman, 2013). A large-scale study directly comparing reactive and proactive suppression across nonclinical and OCD samples, whilst controlling for participants motivation to suppress, would add much needed clarity to this area of complexity and inconsistent findings.

Author statement

Connor Heapy: conceptualization; methodology; formal analysis; investigation; data curation; writing-original draft; project administration.

Lisa-Marie Emerson: conceptualization; methodology; writing – review and editing; supervision.

Daniel Carroll: conceptualization; methodology; writing – review and editing; supervision.

Declaration of competing interest

The authors declare no known conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbtep.2022.101724.

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