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Suppression-Induced Forgetting in Obsessive-Compulsive and Posttraumatic Stress Subclinical Samples

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Objective: Based on the executive deficit hypothesis, we examined if obsessive–compulsive or posttraumatic stress subclinical participants might exhibit impaired suppression-induced forgetting (SIF). ***Method:*** We screened 367 participants using the Yale–Brown Obsessive–Compulsive Scale (YBOCS) and the Posttraumatic Stress Disorder Checklist–Civilian Version (PCLC). Those with the highest ($n = 25$ in YBOCS, $n = 27$ in PCLC, $n = 21$ overlapping in both) and lowest ($n = 28$ in YBOCS, $n = 29$ in PCLC, $n = 18$ overlapping in both) scores, based on z scores, participated in the Think/No-Think experiment. ***Results:*** While low scorers showed a significant SIF effect, high scorers (subclinical groups) did not significantly differ between Baseline and No-Think recall. Further analysis indicated that the SIF effect was not moderated by low versus high scores, suggesting no strong evidence of impaired suppression in the subclinical groups. While the Think manipulation did not produce a significant facilitation effect, we demonstrated a robust SIF effect with the No-Think manipulation, replicating a finding that many other labs have struggled to reproduce. ***Conclusions:*** Our findings suggest that SIF occurs regardless of obsessive–compulsive or posttraumatic stress symptom severity, challenging the notion that proneness to these conditions necessarily impairs memory suppression despite potential executive deficit. Additionally, our study demonstrates a reliably replicable SIF effect, reinforcing its robustness under controlled conditions.

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Public Significance Statement
By deploying the Think/No-Think paradigm, this article presents evidence of a successful replication of the active suppression effect, commonly known as the Think/No-Think paradigm—a phenomenon that many research labs have struggled to replicate. We also investigated whether the active suppression of unwanted memories is impaired in subclinical obsessive–compulsive and/or posttraumatic stress populations. However, no such impairment was observed—our results suggest that these conditions may not necessarily impair the capacity for memory suppression at the subclinical level.

Keywords: suppression-induced forgetting, executive deficit, obsessive compulsive disorder, posttraumatic stress disorder, Think/No-Think

Supplemental materials: https://doi.org/10.1037/pne0000365.supp

Considerable research has taken place on passive mechanisms of forgetting, such as decay over time and changed associations between memory traces in the brain (Anderson et al., 2004; Anderson & Hanslmayr, 2014), and interference from the cluttering of many similar events in memory (Anderson, 2003) resulting in limited access to a certain memory over time. These mechanisms neglect active attempts of memory suppression employed to push unwanted memories from consciousness when reminded (Anderson & Hanslmayr, 2014). People might choose to engage in active forgetting when reminded of unpleasant experiences rather than waiting for passive forgetting to take place (Anderson, 2003; Anderson & Hanslmayr, 2014; Anderson & Hulbert, 2021; Benoit & Anderson, 2012; Fawcett et al., 2024). Such active suppression leads to difficulty accessing these memories in the future (Anderson, 2003; Anderson & Green, 2001; Benoit & Anderson, 2012; Levy & Anderson, 2008). These deliberate attempts form the basis of the Think/No-Think (TNT) paradigm.

In the TNT task, participants first learn cue–response word pairs (e.g., ORPHAN–LAMB). In the next stage, the word pairs are split evenly and manipulated in three conditions: Think (participants must recall the response word), No-Think (participants must not recall or think about response word), and a Baseline control set that is not presented during this critical phase. A decrease in recall for No-Think responses relative to Baseline suggests the presence of suppression-induced forgetting (SIF; Anderson & Green, 2001; Nardo & Anderson, 2024). The recall is tested in two ways: with the original cue initially introduced (known as the same-cue test or SCT) and independent-cue test (ICT; Anderson & Green, 2001; Anderson & Spellman, 1995; Nardo & Anderson, 2024), discussed later.

The No-Think manipulation involves brain areas responsible for stopping habitual motor responses and exerting control over cognitive tasks (Anderson et al., 2004; Apšvalka et al., 2022), thereby suggesting the presence of an active process that employs executive control centers in the brain (Anderson et al., 2004; Anderson & Hulbert, 2021; Levy & Anderson, 2008). Consequently, the No-Think manipulation can result in retrieval failure during a subsequent recall test even if recollection is desired, hence the term SIF (Anderson & Green, 2001; Levy & Anderson, 2008).

Individual differences in executive control ability might mediate the ability to actively suppress unwanted memories; thus, the executive deficit hypothesis can be a framework for the TNT task (Levy & Anderson, 2008). The

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executive deficit hypothesis suggests that people vary widely in suppression ability, and those with high levels of executive deficit would demonstrate less suppression ability and vice versa (Küpper et al., 2014; Levy & Anderson, 2008). These individual differences tend to generalize to factors that can affect executive function, such as neurotransmitters and sleep habits which could contribute to differences in suppression ability with No-Think manipulation (Harrington et al., 2021; Levy & Anderson, 2008).

Think/No-Think and Subclinical Conditions

Difficulties in suppressing unwanted memories are common in disorders that feature intrusive and ruminative thoughts, such as depression, post-traumatic stress disorder (PTSD), obsessive compulsive disorder (OCD), and attention-deficit hyperactivity disorder (ADHD). Research shows that clinical populations struggle with active forgetting; OCD patients are unable to overcome ruminative obsessions (Tolin et al., 2002), with meta-analyses confirming these impairments in different disorders (Pevie et al., 2023; Stramaccia et al., 2021). Neurobiological studies reveal that distinct cognitive and brain mechanisms underlie these deficits: Individuals with depression show altered brain activity in areas like the right middle frontal gyrus and hippocampus (Sacchet et al., 2017), while those with ADHD exhibit reduced prefrontal cortex activity (Depue et al., 2010). Subclinical depression shows dysfunctional prefrontal–hippocampal coupling (Yang et al., 2020), and working memory deficits contribute to poor memory control in dysphoria (Noreen et al., 2020). Additionally, biological factors, including neurotransmitter systems, play a role in active forgetting, with disruptions linked to early psychopathological changes (Costanzi et al., 2021). With intrusive thoughts, rumination, and failure in memory suppression being associated (Ryckman & Lambert, 2015), examining these mechanisms sheds light on cognitive vulnerabilities in mental health disorders. In this article, we focus on OCD and PTSD based on their potential comorbidity (de Silva & Marks, 2001; Medina Rodríguez & Solís Villegas, 2022) and their shared features of heightened level of recurrent intrusive thoughts (de Silva & Marks, 2001), rather than specifically addressing a clinical diagnosis or trauma exposure.

OCD is characterized by a display of continuous, anxiety-provoking, unwanted intrusive thoughts, known as obsessions, and a series of ritualistic compulsive behaviors to overcome these obsessive thoughts (Bernstein et al., 2021). Individuals with OCD may demonstrate impairment in executive function areas that involve thought inhibition and decision making (Bannon et al., 2008; Dittrich & Johansen, 2013; Ouimet et al., 2019), as well as abnormal prefrontal cortex functioning (Menzies et al., 2008; Remijnse et al., 2006). Considering the TNT paradigm employs executive function brain areas like the prefrontal cortex (Anderson et al., 2004; Anderson & Green, 2001; Anderson & Hanslmayr, 2014; Anderson & Hulbert, 2021; Benoit & Anderson, 2012; Hulbert et al., 2016; Levy & Anderson, 2008), with non-TNT techniques being ineffective (Janeck & Calamari, 1999), research addressing TNT in relation to OCD is valuable yet insufficiently explored.

A disorder that shares similar characteristics with OCD in terms of the inability to suppress intrusive thoughts is PTSD, which is characterized by intrusive memories, flashbacks, avoidance, negative mood changes, and heightened arousal following a traumatic event (American Psychiatric Association, 2022). Several studies have examined memory suppression deficits in PTSD using the TNT procedure. Research suggests that suppressing emotional memories requires greater cognitive control than nonemotional memories, as reflected in increased neural activity in relevant brain regions during No-Think trials (Depue et al., 2007). Deficits in retrieval suppression have been linked to greater PTSD symptom severity, with impairments in voluntary forgetting correlating with everyday memory intrusions (Waldhauser et al., 2018). The inability to suppress unwanted memories appears to stem from disruptions in prefrontal inhibitory control mechanisms, a deficit that may predispose individuals to PTSD by impairing their capacity to regulate memory reactivation (Catarino et al., 2015; Mary et al., 2020). Retrieval suppression deficits have also been implicated in the exacerbation of later traumatic experiences, suggesting a broader role for inhibitory dysfunction in PTSD development (Streb et al., 2016). These findings collectively indicate that impaired neural inhibitory control may underlie both the onset and persistence of PTSD symptoms.

PTSD shares similarities with OCD, particularly in the difficulty of suppressing intrusive thoughts and affecting the same brain areas (Anderson et al., 2004; Anderson & Green, 2001; Anderson & Hanslmayr, 2014; Anderson & Hulbert, 2021; Benoit & Anderson, 2012; Catarino et al., 2015; Hulbert et al., 2016; Levy & Anderson, 2008; Mary et al., 2020). Both disorders are linked to impaired memory suppression, with PTSD characterized by intrusive memories and heightened arousal following trauma (American Psychiatric Association, 2022). Studies using the TNT procedure have shown that emotional memories are harder to suppress than nonemotional ones (Depue et al., 2007), and deficits in suppression are linked to greater PTSD severity (Waldhauser et al., 2018). Notably, most PTSD studies use emotionally charged stimuli, whereas the original TNT study demonstrated the SIF effect with neutral word pairs (Anderson & Green, 2001). This aligns with the broader link between memory suppression and affective psychopathologies like PTSD (Engen & Anderson, 2018). Critically, some research suggests that memory suppression occurs with emotionally negative, but not positive, stimuli (Lambert et al., 2010). Our aim was to determine whether No-Think suppression deficits persist in PTSD-prone individuals even when using neutral word pairs and how these deficits compare to those in individuals with OCD proneness.

It is acceptable for researchers to use subclinical samples in psychopathology studies—that is, individuals who score high on the psychopathological scales and exhibit symptoms associated with a disorder but do not meet formal diagnostic criteria. While measures such as the Yale–Brown Obsessive–Compulsive Scale (YBOCS; Goodman et al., 1989) and the PTSD Checklist–Civilian Version (PCLC; Weathers et al., 1993) assess current symptom severity for OCD and PTSD, respectively, research suggests that individuals with subclinical symptoms are at a heightened risk of progressing to a clinical diagnosis (Maes et al., 1998; Mylle & Maes, 2004). Prior studies have also demonstrated that individuals with subclinical conditions show cognitive and neural differences compared to healthy controls. For example, Yang et al. (2020) found that individuals with subthreshold depression exhibited impaired memory suppression and abnormal prefrontal–hippocampal inhibitory pathways during a TNT task. Such findings suggest that even at a subclinical stage, individuals may already exhibit cognitive and neural deficits associated with clinical psychopathology. Similar research has used subclinical samples to investigate psychopathology (e.g., Depue et al., 2007, for ADHD; Kindt & van den Hout, 2003, for PTSD). These findings justify the use of a YBOCS and PCLC to screen participants and recruit individuals at both ends of the spectrum as two experimental groups for the TNT task.

Abramowitz et al. (2014) reported that while up to 90% of people from the general population reported OCD-like thoughts, only 26% meet the cutoff for OCD clinical diagnosis. Their findings, along with others (García-Soriano et al., 2011; Flament et al., 1988; Henderson & Pollard, 1988), suggest that OCD symptoms exist on a severity spectrum, with clinical and subclinical cases being similar that even trained clinicians struggle to distinguish between them (Rachman & de Silva, 1978). However, research indicates that many OCD-predisposed individuals do not seek clinical help (Grabe et al., 2000), and clinical samples may be confounded by treatment effects and comorbidities (Abramowitz et al., 2014). Given these factors, screening nonclinical populations may provide a more generalizable understanding of OCD symptoms. Additionally, students, who may be vulnerable to PTSD (Nixon et al., 2007), could also exhibit difficulty suppressing intrusive memories, similar to PTSD-prone individuals (Streb et al., 2016). Considering these findings, it seemed sensible to screen university students with YBOCS and PCLC to identify target participants: Those with the highest and the lowest scores on the YBOCS and on the PCLC (high [Hi] YBOCS, low [Lo] YBOCS, Hi PCLC, and Lo PCLC) would be recruited to examine differences in active memory suppression abilities using No-Think manipulation. Herein, the Hi groups represent subclinical OCD and PTST participants. The present study aimed to examine whether participants in the Hi YBOCS and Hi PCLC groups would show impairment in suppression capabilities compared to those at the other end of the continuum (Lo YBOCS and Lo PCLC).

The Present Study

Drawing on the executive deficit hypothesis (Levy & Anderson, 2008), the present study was

designed to examine if subclinical OCD and PTSD participants would demonstrate impaired active memory suppression abilities using the No-Think manipulation. We hypothesized that participants in the Hi YBOCS and Hi PCLC groups would show impaired suppression, with similar recall percentages for No-Think and Baseline items (Hypothesis 1). In contrast, those in the Lo YBOCS and Lo PCLC groups were expected to exhibit a SIF effect, showing significantly lower recall for No-Think items compared to Baseline items (Hypothesis 2).

Additionally, we anticipated that the Think manipulation would produce a diverging effect, similar to findings in our pilot study (reported later). Specifically, we hypothesized that, despite no significant overall increase in recall for Think items, test type (SCT and ICT) would result in diverging outcomes: increased recall with SCT and decreased recall with ICT (Hypothesis 3). Given that Hi YBOCS and Hi PCLC would not affect the facilitation effect due to Think manipulation, it was anticipated that the Think manipulation would produce similar results regardless of the Hi or Lo groups.

Method

The experiment was conducted in two stages. Stage 1 (screening) was conducted using YBOCS (Goodman et al., 1989) and PCLC (Weathers et al., 1993) to identify Hi and Lo groups. Those who scored at the higher end of scales were placed in the Hi YBOCS or Hi PCLC groups, and those who scored at the lower end of scales were placed in the Lo YBOCS and Lo PCLC groups. Both Hi and Lo groups were subsequently recruited for Stage 2 (the TNT study).

Participants

For Stage 1 (screening), 367 students from the University of Canterbury were screened using YBOCS and PCLC scales. The age of participants was 16–60 years ($M = 21.18$, $SD = 6.11$), of which 21% ($n = 76$) were male, 78% ($n = 286$) were female, $n = 4$ were nonbinary, and $n = 1$ wished not to declare their gender. Seventy-seven percent ($n = 284$) opted to participate in Stage 2. Ninety-nine participants showed up to participate in the TNT experiment. Two of them were excluded as they were not 18 years old, and $n = 22$ participants failed Phase 1 of the experiment, resulting in 75 participants who satisfactorily completed the TNT task. Participants either received research participation credits or a $20 gift voucher as gratuity. Exclusion criteria were an ADHD diagnosis (see Depue et al., 2010) and/or color blindness. No participants were excluded due to not meeting the required sleep criterion (at least 7 hr the night before testing) or deliberate attempts of deception (explained later). The study was approved by the Human Ethics Committee of the University of Canterbury (HEC 2020/45).

Materials and Apparatus

The TNT experimental protocol and stimuli were provided by the Medical Research Council Cognition and Brain Sciences Unit of the University of Cambridge and were used in accordance with Nardo and Anderson (2024). MATLAB (R2019b) was used for presenting all instructions and stimuli for TNT phases on a Windows PC Philips RGB SDR color monitor 24-inch display with a 1,920 × 1,080 resolution and 59.94 Hz refresh rate. The screen was positioned 65 cm away from participants. TNT stimuli consisted of 66 word pairs (48 for experimental manipulation and 18 filler pairs for practice purposes).

The OCD screening measure was YBOCS: a 10-item standard OCD screening scale (Goodman et al., 1989). It is scored based on a 5-point Likert scale from 0 (*none*) to 4 (*extreme*). The PTSD screening measure was PCLC scale (PCLC): a 17-item standard PTSD screening scale (Weathers et al., 1993). It is scored based on a 5-point Likert scale from 1 (*not at all*) to 5 (*extremely*).

Procedure

Stage 1 was advertised in the research participation pool for Introductory Psychology students and on social media for the rest of the participants. The questionnaire was provided on Qualtrics that consisted of YBOCS and PCLC scales, demographic data, as well as asking participants if they wanted to participate in Stage 2. The YBOCS and PCLC composite scores were calculated for all participants, but only those who opted to participate in Stage 2 were contacted to attend the next stage.

For Stage 2, the participants were reminded the day before to ensure they had at least 7 hr of sleep the night prior to testing. They granted informed consent to participate in the study. Upon arrival, they were asked to turn their mobile phones off to avoid distraction during the experiment. The design was similar to the standard TNT by Anderson and Green (2001), but consistent with Bergström et al. (2009), cues in the Think condition were typed in green text, and No-Think cues were typed in red text. In general, our procedure strictly adhered to the current standards in TNT research as laid out in Nardo and Anderson (2024).

The TNT task has three phases: Phase 1 (Learning Phase), Phase 2 (TNT Phase), and Phase 3 (Final Recall Phase).

Phase 1: Learning Phase

Participants were trained on 66 cue–response word pairs (48 experimental and 18 filler pairs) so they could recall the right-hand member of the pair (response) when presented with the left-hand member of the pair (cue). Filler pairs would later be used for training and practice purposes. At the start of a trial, a fixation point appeared on the screen for 1.0 s, followed by a word pair (e.g., ORPHAN–LAMB) displayed in the center of the screen. The pair stayed on screen for 3.0 s. This was followed by another fixation point for 1.0 s, followed by another cue–response pair. This phase continued until all 66 word pairs were presented. All stimuli were presented in white text on a gray background.

This was followed by the *Test-feedback Session-1* wherein a cue word (e.g., ORPHAN) was presented in the center of the screen in white text on a gray background, and the participant was asked to remember and say the response word (LAMB) aloud. These cues were presented for 4.0 s or until a participant could say the response word. Regardless of a correct or wrong response, the response word was displayed in blue text on a gray background following each cue word for 1.0 s so the participant could use it as feedback. If a participant could not recall responses to at least 24 (50%) of the critical word pairs (fillers excluded), this session was repeated in *Test-feedback Session-2*. If a participant could not recall 24 responses by the end of *Test-feedback Session-2*, they were excused and could not participate in the rest of the experiment. Those who could recall 50% responses, either at the end of the first or second test-feedback session, entered the *Criterion-feedback* session. In the *Criterion-feedback* session, only cues were presented (for 4.0 s), and the participant's task was to say the response word. They were not provided with any feedback in the *Criterion-feedback* session.

Before the actual TNT manipulation, participants practiced the task as follows. They were instructed that they would see cue words in one of two colors in a random order. For the cue words typed in red text on the background (displayed for 3.0 s), their task was to not allow the corresponding response word from coming to mind. If the response word was to automatically enter awareness, their task was to push it away from mind and keep doing that until the cue word disappeared from the screen. They were instructed not to think about another image, word, or idea during red trials and to focus only on pushing away the response word. The red trials were one third (16) of the memorized word pairs and constituted the No-Think condition.

For another one third of the trials (16 word pairs) that constituted the Think condition, cues were in green text on gray background and displayed for 3.0 s each. The participant's task was to retrieve the response and think about the response words to the cues. The final one third of cue–response pairs were not administered during this phase and served as the Baseline condition, so recall of Think and No-Think could be compared to this control after Phase 3. The Think and No-Think cue words were presented in randomly intermixed order. The Think, No-Think, and Baseline pairs were equally counterbalanced between all participants such that if 16 cue–response pairs were presented as Think for the first participant, they were presented as No-Think for the second participant and used as Baseline for the third participant. This cycle repeatedly continued until all participants were tested.

Participants practiced the task with filler cue words (*TNT Practice 1*). Before each trial, a fixation cross appeared for 1.0 s, followed by a cue for 3.0 s and a following fixation point for 1.0 s. This continued until the end of the practice session. Afterward, a *TNT Diagnostic Questionnaire* was administered to ensure that participants were complying with the instructions and were not engaging in active deception such as thinking about other ideas during

No-Think suppression trials, or not reading the cues presented on the screen. Based on the answers to the diagnostic questionnaire items, participants were provided with additional feedback when necessary so they could complete the task as required. This was followed by a similar practice session (*TNT Practice 2*) followed by the *TNT Diagnostic Questionnaire* once again. By this time, all participants thoroughly knew the nature of the task and could execute it correctly.

Phase 2: TNT Phase

The practice tasks were followed by the TNT manipulation session where the critical (Think and No-Think) cue words were presented. Each of 16 Think and 16 No-Think cue words were presented 12 times (total 384 trials) in a random fashion. The TNT manipulation session was divided into four equal blocks each taking about 6.5 min to complete. After the first block, a participant would take a 30–40 s break so that they could relax their mind but were not allowed to turn their phones on or to get into any discussions outside the instructions of the task. After the second block, the *TNT Diagnostic Questionnaire* was administered once again to ensure that the instructions were still being followed correctly. The third block was followed by a 30–40 s mental rest, and Phase 2 ended after the fourth block.

Phase 3: Final Recall Phase

In this phase, the participant's memory was tested for all cue–response pairs memorized in Phase 1. The task was to freely recall responses to all cue words that were presented in white text on the gray background. Initially, they were trained for the SCT such that when presented with the original cue words (e.g., ORPHAN for ORPHAN–LAMB), they were asked to remember and say the response, LAMB, aloud. Then, they were trained for the ICT such that they were presented with independent cues coupled with the first letter of the response word (e.g., ANIMAL–L for ORPHAN–LAMB) and were asked to recall and say the response, LAMB, aloud. After training, both the SCT and ICT recall sessions took place one after another. For half of the participants, the SCT happened before, and for the other half, it happened after the ICT. Similar to Phase 1, the cue word was displayed on the screen for 4.0 s or until the response was given.

A follow-up *postexperimental questionnaire* was administered to assess if a participant deliberately attempted not to follow the instructions. In the postexperimental questionnaire, if a participant reported sleeping less than 4 hr, their data would also be disregarded. Finally, participants filled in the YBOCS and PCLC questionnaires and provided data on their age and sex via a Qualtrics survey. The whole experiment took between 90 and 105 min. Participants were debriefed before leaving. These are in accordance with Anderson and Green (2001) and Nardo and Anderson (2024).

Prior to this study, we conducted a pilot study without Hi or Lo YBOCS/PCLC groups (see Supplemental Material) that did not provide evidence of the SIF effect with No-Think manipulation. However, it led to a diverging effect of the Think effect (increased recall with SCT and decreased recall with ICT).

Design

The independent variable was the frequency of trials (0 for Baseline and 12 for manipulation) and whether the responses were suppressed (No-Think) or retrieved (Think). The dependent variable was the percentage of correct response words retrieved during the final recall test for both conditionalized and unconditionalized recall types (see below). It was a within-subjects design, and for each participant, the recall of response words in the Baseline was compared with the average recall of responses in the Think and the No-Think conditions.

Data Analysis

For each test type, SCT and ICT, the recall percentage was calculated in two ways: *unconditionalized* recall and *conditionalized* recall. In unconditionalized recall, the Phase 3 recall rate of Think, No-Think, and Baseline was calculated as a factor of 16 (16 being the total number of cue–response pairs in each manipulation condition). For instance, if a participant's recall for No-Think words was 12, their unconditionalized recall would be 12 out of 16 words or 75%. In conditionalized recall, the recall rate was calculated as a factor of response words that a participant was able to memorize during Phase 1. In the example of 12 No-Think words at recall, if the participant memorized 15 No-Think (obtained

from the criterion-feedback phase), their conditionalized recall rate would be 12 words out of 15 or 80%.

A repeated-measures ANOVA was conducted considering the following variables: Think and No-Think manipulations compared with Baseline and both SCT and ICT were added as within-subject factors. This ANOVA was a 2 (Baseline compared with Think or No-Think) × 2 (SCT, ICT) factorial design, and the suppression effect in both Hi and Lo groups was compared in the same model. A significant decrease in the recall of No-Think responses compared to Baseline would suggest the presence of a suppression effect due to the No-Think manipulation. By comparing Hi and Lo groups, we would also determine whether the effect was significantly different between the two groups. Alternatively, a significant increase in the recall of Think responses compared to Baseline would suggest the presence of a facilitation effect due to Think manipulation (see Nardo & Anderson, 2024, for a systematic guide). The results would only be acceptable if manipulation (being Think, No-Think, or Baseline) did not significantly interact with the test types (SCT and ICT). If manipulations significantly interacted with the test type, this would mean that the effect of the manipulations was different for SCT than ICT. When the test types do not significantly interact with the TNT manipulations, this would result in a more sensitive test affirming that there are not different levels of recall at the different levels of test types. Jamovi (v. 1.6) and RStudio (v. 3.6.3) were used to conduct statistical analyses.

The composite scores of YBOCS were calculated by summing up scores of all 10 items (min = 0 and max = 4 for each item), according to the YBOCS guidelines (Goodman et al., 1989). The same applied to PCLC, a 17-item scale (min = 1 and max = 5 for each item; Weathers et al., 1993).

Formation of Lo and Hi Groups

YBOCS and PCLC scores were changed to z scores to form Lo and Hi scorers. Based on previous TNT studies, $n = 24$ was the estimated minimum number of participants required for each group (Hi YBOCS, Lo YBOCS, Hi PCLC, and Lo PCLC).

Table 1 shows the recommended cutoff values for YBOCS (Cervin & Mataix-Cols, 2022) and PCLC. The cutoff for Lo YBOCS was set at 9 (<-0.8 *SD*) which included $n = 81$ participants. The YBOCS score of 20 (>0.9 *SD*) was set as the cutoff for Hi YBOCS and included $n = 72$ participants. This left $n = 214$ participants between the two extremes. The cutoff for Lo PCLC was set at 28 (<-0.9 *SD*) which included $n = 80$ participants, and 58 (>1 *SD*) was set for Hi PCLC which included $n = 69$ participants. Figure 1 shows a histogram of YBOCS and PCLC scores with different colors representing the extreme scorers.

The correlation between the YBOCS and PCLC scores was significant ($r = .53, p < .001$). Hence, $n = 21$ participants overlapped in Hi YBOCS and Hi PCLC, and similarly, $n = 18$ participants were simultaneously in Lo YBOCS and Lo PCLC groups. Finally, $n = 25$ from Hi YBOCS, $n = 28$ from Lo YBOCS, $n = 27$ from Hi PCLC, and $n = 29$ from Lo PCLC completed the TNT experiment.

Results

SIF Effect

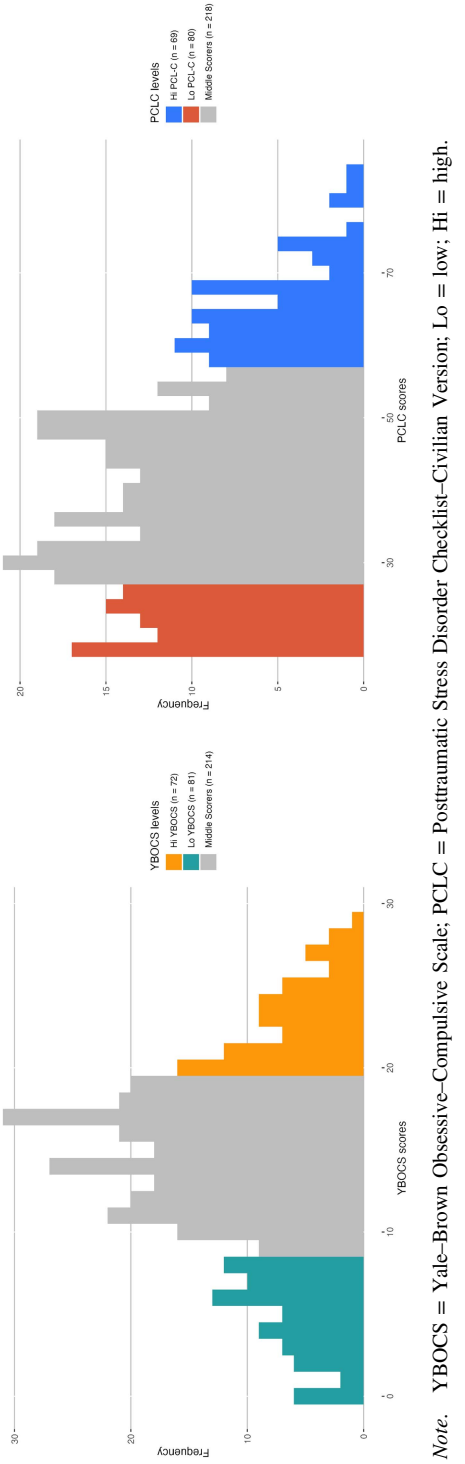
As presented in Table 2, a significant SIF effect was observed in the Lo YBOCS group for both

Table 1
YBOCS and PCLC Cutoff Values

YBOCS range	OCD severity	PCLC range	PTSD severity
0–13	Subclinical	17–29	No severity
14–21	Mild	28–29	Some symptoms
22–29	Moderate	30–44	Moderate to moderately high
30–40	Severe	45–85	High severity

Note. The YBOCS ranges classify OCD severity, while PCLC ranges classify PTSD severity. YBOCS = Yale–Brown Obsessive–Compulsive Scale; OCD = obsessive compulsive disorder; PTSD = posttraumatic stress disorder; PCLC = PTSD Checklist—Civilian Version.

Figure 1
Think/No-Think-Traits YBOCS and PCLC Groups



Note. YBOCS = Yale–Brown Obsessive–Compulsive Scale; PCLC = Posttraumatic Stress Disorder Checklist–Civilian Version; Lo = low; Hi = high.

Table 2

Analysis of Variance Statistics for the No-Think and Think Manipulation Conditions

Subsample condition	Condition of analysis	*MS*	*F*	*p*	η_p^2	*M* (Baseline)	*M* (No-Think)	*M* difference (Baseline–No-Think)
				No-think manipulation				
YBOCS								
Lo								
Unconditionalized	Manipulation	876.00	4.57	.037	0.08	86.10	80.60	5.50
Conditionalized		1545.00	4.39	.041	0.07	102.10	94.80	7.30
Hi								
Unconditionalized	Manipulation	625.00	2.39	.129	0.05	82.00	77.00	5.00
Conditionalized		63.80	0.18	.637	0.00	98.50	96.90	1.60
Lo + Hi								
Unconditionalized	Manipulation	1478.99	6.61	.012	0.06	84.00	78.80	5.20
Conditionalized		1062.70	3.02	.085	0.03	100.30	95.80	4.50
Lo × Hi								
Unconditionalized	Interaction	3.30	0.01	.904	0.00			
Conditionalized	Interaction	436.40	1.24	.268	0.01			
PCLC								
Lo								
Unconditionalized	Manipulation	982.00	3.52	.066	0.06	84.70	78.90	5.80
Conditionalized		2016.00	4.95	.030	0.08	102.00	93.60	8.40
Hi								
Unconditionalized	Manipulation	904.00	3.70	.060	0.07	81.80	76.00	5.80
Conditionalized		114.00	0.30	.588	0.01	101.30	99.20	2.10
Lo + Hi								
Unconditionalized	Manipulation	1883.38	7.18	.009	0.06	83.30	77.50	5.80
Conditionalized		1511.00	3.81	.054	0.03	101.60	96.40	5.20
Lo × Hi								
Unconditionalized	Interaction	0.01	0.00	.994	0.00			0.00
Conditionalized	Interaction	551.00	1.39	.241	0.01			0.00
Pooled								
Lo								
Unconditionalized	Manipulation	1075.00	4.58	.035	0.05	85.30	80.20	5.10
Conditionalized		2837.00	8.15	.005	0.09	102.40	94.20	8.20
Hi								
Unconditionalized	Manipulation	888.00	3.94	.051	0.05	82.30	77.40	4.90
Conditionalized		149.00	0.45	.506	0.01	100.80	98.70	2.10

(*table continues*)

Table 2 (*continued*)

Subsample condition	Condition of analysis	*MS*	*F*	*p*	η_p^2	*M* (Baseline)	*M* (No-Think)	*M* difference (Baseline–No-Think)
Lo + Hi								
Unconditionalized	Manipulation	1950.67	8.47	.004	0.05	83.80	78.80	5.00
Conditionalized		2058.00	6.03	.015	0.04	101.60	96.50	5.10
Lo × Hi								
Unconditionalized	Interaction	0.51	0.00	.963	0.00			
Conditionalized	Interaction	759.00	2.22	.138	0.01			
				Think manipulation				
YBOCS								
Lo								
Unconditionalized	Manipulation	345.00	2.76	.102	0.05	86.10	82.70	− 3.40
Conditionalized		0.52	0.00	.957	0.00	102.00	102.00	0.00
Hi								
Unconditionalized	Manipulation	189.00	1.33	.254	0.03	82.00	84.80	2.80
Conditionalized		90.80	0.40	.532	0.01	98.50	100.40	1.90
PCLC								
Lo								
Unconditionalized	Manipulation	75.80	0.57	.455	0.01	84.70	83.10	− 1.60
Conditionalized		32.40	0.15	.705	0.00	102.00	101.00	− 1.00
Hi								
Unconditionalized	Manipulation	5.97	0.04	.845	0.00	81.80	82.30	0.50
Conditionalized		55.10	0.19	.668	0.00	101.00	103.00	2.00

Note. Pooled represents the iteration where YBOCS and PCLC have been aggregated. *MS* = Mean Square; *F* = *F* statistic; *p* = *p* value; η_p^2 = Partial eta squared; YBOCS = Yale–Brown Obsessive–Compulsive Scale; PCLC = Posttraumatic Stress Disorder Checklist–Civilian Version; Lo + Hi = combining Lo and Hi in the similar group (YBOC or PCLC); Lo × Hi = interaction between Lo and Hi; Lo = low; Hi = high.

recall types, whereas this effect was absent in the Hi YBCOS group; see Figure 2 (error bars indicating confidence intervals) for mean differences (Baseline minus No-Think). However, with combining Hi and Lo groups together, the overall picture changes: The overall SIF effect still seems to be present during the unconditionalized recall, and it is marginally significant in the conditionalized recall too. This points out, expectedly, that perhaps the absence of the SIF effect in the Hi group was offset due to a larger sample size after combining with the Lo group. Crucially, the interaction between the YBOCS levels (Lo vs. Hi) and the No-Think manipulation was not significant in either recall type. This indicates that while the SIF effect is present in general, and in the Lo YBOCS group, there is no statistical evidence that YBOCS level moderates the effect of the No-Think manipulation on recall.

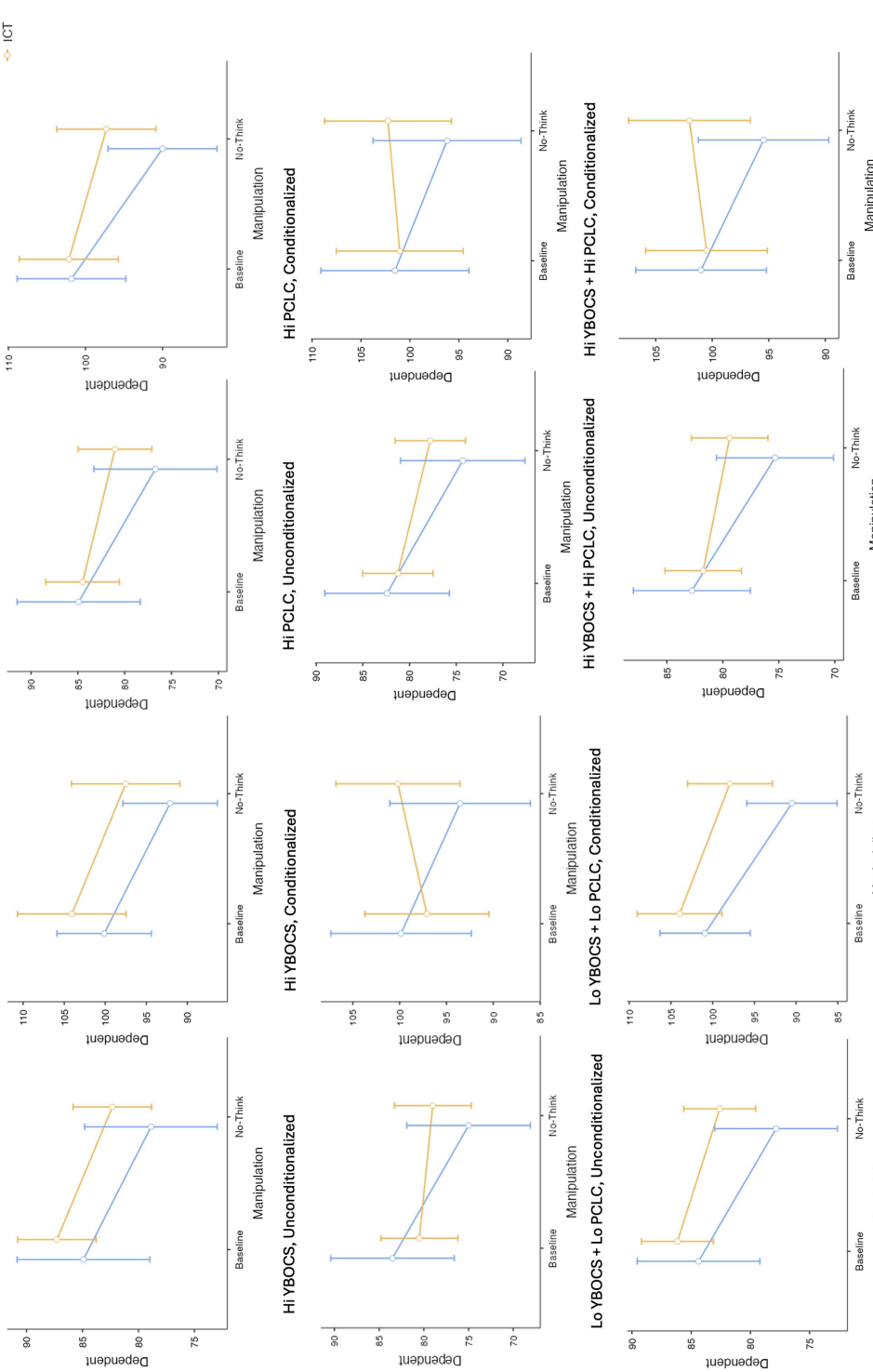
As shown in Table 2, the SIF effect was significant in conditionalized recall and marginally significant in unconditionalized recall for the Lo PCLC group; see Figure 2 (error bars indicating confidence intervals) for mean differences (Baseline minus No-Think). In contrast, the Hi PCLC group showed no significant SIF effect in conditionalized recall but a marginally significant effect in unconditionalized recall. Similar to the YBOCS analysis, when we combine both Hi and Lo PCLC groups together, the SIF effect is still present during the unconditionalized recall while being marginally significant in the conditionalized recall too. Here again, we see that the absence of SIF effect in Hi groups was offset. Yet, similar with the YBOCS group, the interaction between PCLC levels (Lo vs. Hi) and the No-Think manipulation was not significant for either recall type. This reinforces the finding that while the SIF effect is present in general, and in the Lo PCLC group, there is no statistical evidence that PCLC level moderates the effect of the No-Think manipulation on recall, mirroring the pattern observed in the YBOCS groups. It is worth noticing that the overall pattern of results for YBOC and PCLC is strikingly similar.

In general, three out of four SIF effects were statistically significant in the Lo groups, while one was marginally significant. In addition, the SIF effect was also evident when we combined Lo and Hi groups. Therefore, we confirm Hypothesis 2, concluding that the No-Think manipulation successfully induced SIF. In contrast, the Hi YBOCS and Hi PCLC groups consistently showed no significant differences between Baseline and No-Think recall scores. Moreover, the interaction between No-Think and YBOCS/PCLC levels (Lo vs. Hi) was not significant, indicating that the ability to suppress memories did not differ significantly between high and low scorers on either measure. Thus, we did not find evidence supporting Hypothesis 1, which predicted that individuals with higher YBOCS or PCLC scores would experience greater difficulty suppressing memories. Finally, the lack of significant interactions between manipulation and test type (SCT, ICT) suggests that the SIF effect was consistent across different recall conditions, reinforcing the robustness of the observed SIF effects in the Lo groups.

Given the comorbidity between OCD and PTSD (Medina Rodríguez & Solís Villegas, 2022) and the significant correlation between Hi scorers in this study, we pooled both groups (ensuring that the overlapping participants were used only once) and conducted the same analysis again. The previous findings were replicated: A significant SIF effect in the pooled Lo group for both unconditionalized and conditionalized recalls (see Table 2) was detected, whereas there was a significant SIF effect with unconditionalized recall in the pooled Hi group and nonsignificant during conditionalized recall. Combining Hi and Lo groups together, the SIF effect sustains with both recall types, whereas it does not significantly interact with the YBOCS/PCLC levels (Lo vs. Hi). These findings are extremely crucial as they signify that (a) the SIF effect is globally present in our data and it becomes more pronounced when Lo and Hi groups are combined together; (b) this effect generalizes during unconditionalized and conditionalized recalls; and (c) the manipulation effect does not interact with the YBOCS/PCLC levels (Lo vs. Hi)—meaning that these levels do not significantly moderate the SIF effect. This reinforces our previous assertions that although we do see an overall SIF effect in both YBOCS and PCLC groups due to No-Think manipulation, this effect does not substantially differ between Hi and Lo scorers.

Figure 2

A Comprehensive Figure of Different Marginal Means for Different No-Think Manipulation Conditions



Note. YBOCS = Yale–Brown Obsessive–Compulsive Scale; PCLC = Posttraumatic Stress Disorder Checklist–Civilian Version; Lo = low; Hi = high; SCT = same-cue test; ICT = independent-cue test.

The Think Effect

Think effect was not significant, and we observed a diverging pattern of the effect in relation to the test type (SCT and ICT) in both Lo and Hi groups further highlighted by estimated marginal means graphs (Figure 3, error bars indicating confidence intervals), and see the relevant statistics in Table 2. Hence, there was generally an increase in recall due to Think manipulation with SCT, but a decrease with ICT, thus supporting Hypothesis 3.

Discussion

The aim of this study was to evaluate whether individuals at the subclinical level of OCD and PTSD could use No-Think manipulation to actively suppress unwanted memories. This was examined by assessing memory suppression in those who scored high (Hi) or low (Lo) on OCD and PTSD measures, YBOCS and PCLC, respectively. Notably, this is the first behavioral TNT study to consider Hi and Lo scorers on these conditions. We initially screened $n = 367$ university students using these scales to identify and recruit Hi and Lo scorers. In the next stage, participants from each group were selected for the TNT test, with the Hi groups representing the subclinical populations of these conditions.

According to the executive deficit hypothesis, participants with varied executive control abilities might demonstrate relatively varied degrees of suppression capability with No-Think suppression such that those with higher levels of executive deficit would demonstrate less suppression ability and vice versa (Küpper et al., 2014; Levy & Anderson, 2008). Evidently, both OCD and PTSD involve impaired executive control abilities (Anderson et al., 2004; Bannon et al., 2008; Depue et al., 2007; Gagnepain et al., 2014; Menzies et al., 2008; Remijnse et al., 2006).

As hypothesized, the SIF effect from the No-Think manipulation was confirmed in the Lo YBOCS and Lo PCLC groups and was also observed when Lo and Hi groups were combined. These findings are crucial, as they demonstrate that the SIF effect is consistently present in our data and becomes more pronounced when both groups are analyzed together, generalizing across both unconditionalized and conditionalized recall. Consistent with previous research, the SIF effect was successfully replicated, aligning with the findings of Anderson and Green (2001) and Levy and Anderson (2008).

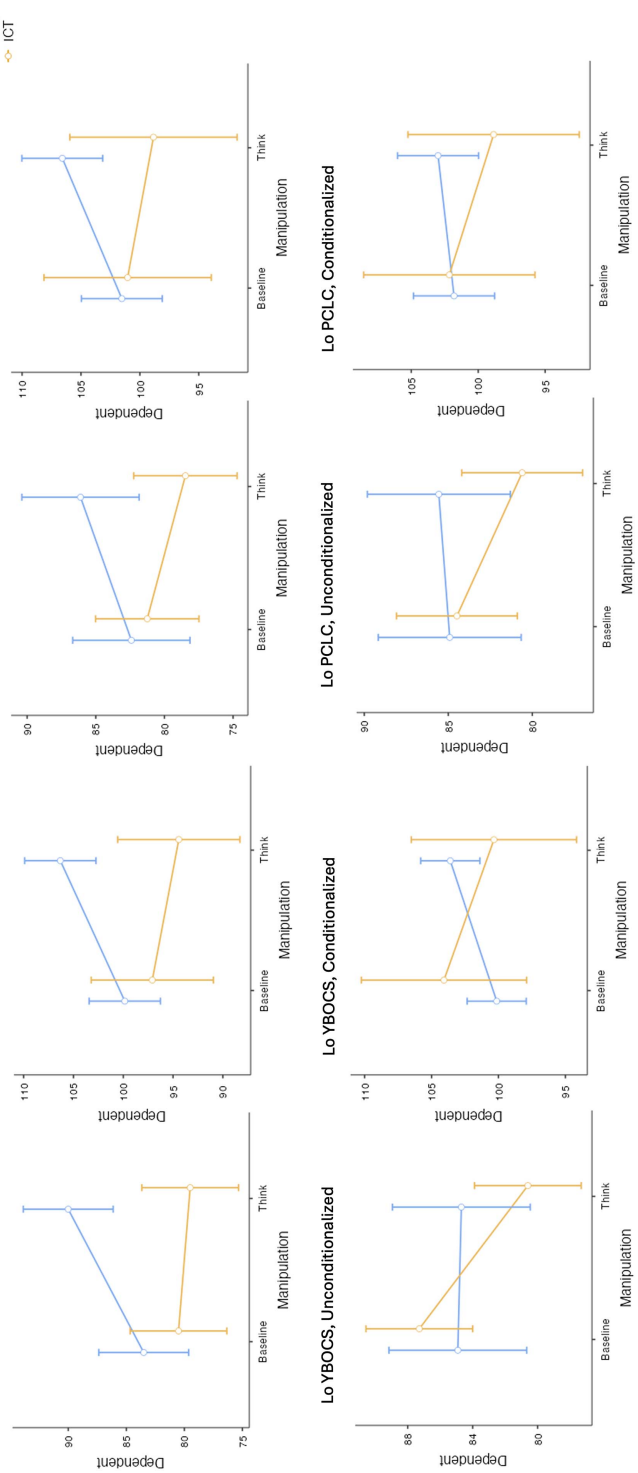
However, there was no significant SIF effect in the subclinical Hi YBOCS and Hi PCLC groups. Moreover, while combining Lo and Hi groups resulted in an overall SIF effect, as previously stated, the manipulation effect did not interact with YBOCS or PCLC score levels (Lo vs. Hi). This suggests that the measure level does not significantly moderate the SIF effect. These findings reinforce our previous assertions that, although an overall SIF is present due to No-Think manipulation, the effect may not substantially differ between Hi and Lo YBOCS or PCLC scorers. These analyses contradict previous TNT research suggesting that individuals with higher levels of executive deficit would exhibit impaired suppression ability (e.g., Anderson et al., 2004; Anderson & Hanslmayr, 2014; Benoit & Anderson, 2012; Catarino et al., 2015; Depue et al., 2007; Gagnepain et al., 2014; Levy & Anderson, 2008). Consequently, the Lo YBOCS and PCLC groups demonstrated a SIF effect. However, we do not have convincing evidence to suggest a lack of suppression capability at the subclinical OCD and PTSD groups. As a result, our findings are not consistent with the executive deficit hypothesis.

The absence of the SIF effect in the subclinical groups raises important questions. One possible explanation is that, despite their elevated symptom scores, these individuals had not been formally diagnosed with OCD or PTSD. While subclinical individuals have the potential to receive a diagnosis (Maes et al., 1998; Mylle & Maes, 2004), they are not the same as clinically diagnosed participants. It is possible that the executive control deficits associated with these disorders are more pronounced in fully diagnosed individuals, and thus, if our sample had included clinically diagnosed participants, the results may have been different.

Another potential factor is our use of emotionally neutral cue–response pairs, in contrast to previous studies (e.g., Catarino et al., 2015; Depue et al., 2007; Streb et al., 2016), which employed emotionally charged cue–response pairs. Emotional salience might have been a factor in enhancing memory suppression effects, and it is possible that the absence of emotional content in our stimuli reduced the impact of the No-Think manipulation. This difference in selecting cue–response pairs may have influenced the results,

Figure 3

Think Condition Marginal Means for Lo and Hi Trait Groups, Both Recall Types



Note. YBOCS = Yale–Brown Obsessive–Compulsive Scale; PCLC = Posttraumatic Stress Disorder Checklist–Civilian Version; Lo = low; Hi = high; SCT = same-cue test; ICT = independent-cue test.

potentially explaining why we did not observe the SIF effect in subclinical groups.

Notwithstanding, the overall presence of SIF effect in combined Lo and Hi groups, as well as in the Lo groups alone, stands as one of our most substantial observations. This is particularly notable given that many previous studies failed to produce behavioral evidence of No-Think suppression (Bergström et al., 2007; Bulevich et al., 2006; Hertel & Calcaterra, 2005; Hertel & Mahan, 2008; Mecklinger et al., 2009; Wessel et al., 2020; Wiechert et al., 2023) despite some providing evidence suggestive of this effect on a neurophysiological level (e.g., Bergström et al., 2007; Mecklinger et al., 2009). Importantly, three of these studies (Bergström et al., 2007; Bulevich et al., 2006; Mecklinger et al., 2009) used 16 repetitions of Think and No-Think trials during the manipulation phase, yet failed to demonstrate behavioral active suppression effect. Similarly, three studies that used 12 repetitions (Hertel & Calcaterra, 2005; Hertel & Mahan, 2008; Wiechert et al., 2023) also did not find significant SIF effect, despite having a larger sample size than the present study. It is worth noting, however, that Wiechert and colleagues implemented the TNT task online, which may have influenced their findings.

A study that used fewer repetitions (e.g., five and 10; Depue et al., 2006) suggested that the SIF effect was stronger with 10 repetitions than with five, though it employed a slightly different analysis protocol and stimulus set. Meanwhile, Benoit and Anderson (2012) used 12 repetitions and reported a significant SIF effect; however, that study was not independent of Anderson's research lab.

Therefore, the present study represents the first to report behavioral evidence of a No-Think SIF effect using 12 repetitions, conducted independent of Anderson. Furthermore, our study adhered to an experimental protocol identical to Anderson's studies, employing cue–response word pairs. This reinforces the robustness of our findings and underscores the significance of our methodological approach.

The reported presence of SIF effect aligns with the theoretical foundation of the TNT paradigm. Rather than passive mechanisms of forgetting, such as decay or interference (Allen & Baddeley, 2009; Anderson, 2003; Anderson & Hanslmayr, 2014), our findings demonstrate the successful employment of an active and deliberate process of forgetting, the No-Think suppression (Anderson & Hulbert, 2021). This mechanism effectively inhibits the habitual retrieval of a response to a given stimulus, referred to as retrieval suppression (Anderson & Hanslmayr, 2014). Importantly, this form of suppression has been proposed as a potential strategy for emotion regulation (Engen & Anderson, 2018; Gagnepain et al., 2017), suggesting broader cognitive and affective implications. Given that we did not find robust evidence of an impaired SIF effect in subclinical OCD and PTSD participants, future research could investigate the potential of No-Think manipulation as a coping mechanism for intrusive and distressing thoughts. More broadly, No-Think exercises may be applicable to other conditions requiring cognitive control over emotionally distressing memories (Depue et al., 2007), as well as for managing everyday upsetting experiences (Mamat & Anderson, 2023). However, such applications must be substantiated through further research.

Notably, the No-Think manipulation did not differ due to SCT and ICT test types. This indicates that regardless of whether participants employed SCT or ICT, the outcome of No-Think suppression remained consistent, reinforcing the robustness of the suppression effect across different instructional contexts.

Requiring a larger sample size or pooling data to produce a suppression effect is not necessarily a major disadvantage. Some previous studies, such as MacLeod and Macrae (2001), also used a larger participant pool to demonstrate the SIF effect. A recent study recruited more than 400 participants and used 16 repetitions, reporting a SIF effect with the TNT paradigm (Liu et al., 2021). Importantly, being able to produce a No-Think effect with fewer repetitions means that participants would not find the manipulation phase—which requires the most effort—as lengthy and arduous. With 12 repetitions (48 s suppression time per word), each of the four blocks in the TNT manipulation (Phase 2) takes about 6.5 min. This increases to about 10 min with 16 repetitions (64 s suppression time per word), requiring more sustained suppression efforts.

The Think manipulation did not result in a facilitation effect and produced opposite recall patterns depending on test type: increased recall with SCT and decreased recall with ICT (see Nardo & Anderson, 2024, for further elaboration). This is not uncommon and aligns with Lambert et al. (2010), one of the few

studies reporting a similar effect. One explanation is retrieval-induced forgetting (Anderson et al., 1994), where recalling a target word (e.g., ROACH) suppresses competing related concepts (e.g., INSECT), reducing recall (Anderson et al., 2000). Another explanation is encoding specificity (Tulving, 1979); SCT benefits from strengthened cue–response associations through rehearsal, while ICT requires participants to generate an alternative response, leading to weaker recall (Lambert et al., 2010). Functional fixedness (Duncker, 1945; Welling, 2011) may also play a role—SCT maintains consistency between learning and retrieval, whereas ICT disrupts this pattern, making recall more difficult. Since No-Think responses are actively suppressed, functional fixedness would not apply to them. Further studies could explore these mechanisms through subjective reports during the ICT recall phase, as done in prior TNT research (Levy & Anderson, 2012).

An important factor in causing forgetting due to active suppression is participant compliance with experimental instructions. Liu et al. (2021) confirmed that the No-Think SIF effect was negatively correlated with compliance levels and recommended closely monitoring participants during the manipulation phase. Similarly, the detailed experimental instructions by the Medical Research Council Cognition and Brain Sciences Unit (Nardo & Anderson, 2024) likely contributed to the successful execution of this project. Specifically, the use of a diagnostic questionnaire during manipulation and a postexperimental questionnaire to prevent deception, along with ensuring participants had sufficient sleep before testing, appears to be a crucial procedural strategy for maintaining compliance and preventing fatigue—factors that may have undermined previous independent replications. Given that we followed Anderson's protocol without their team's direct involvement in our data collection, this study reinforces that the No-Think SIF effect can be reliably replicated by independent researchers who adhere closely to the same methodology.

Limitations

These studies primarily involved younger, mostly female, university students who may have superior executive control abilities and, consequently, better suppression capability (Levy & Anderson, 2008). Therefore, the SIF effect observed with 12 repetitions should not be generalized to older adults, who often exhibit impaired executive control (Anderson et al., 2011), unless specifically instructed (Murray et al., 2015). Future studies should recruit older participants to clarify this further.

Our method of identifying subclinical groups and the recruitment approach for Hi versus Lo scorers impact the generalizability of our findings. Participants were selected based on self-reported scores rather than clinical diagnoses, introducing variability and some overlap between groups. While this raises concerns about whether Hi scorers exhibited true executive function deficits, subclinical individuals may still be prone to suppression difficulties (Maes et al., 1998; Mylle & Maes, 2004; Yang et al., 2020). Additionally, although clinical samples offer clearer diagnostic distinctions, they may introduce confounds related to treatment (Abramowitz et al., 2014). Despite these limitations, we successfully replicated the SIF effect independent of Anderson, supporting the robustness of the No-Think effect. Future research should refine sorting criteria, recruit individuals with higher YBOCS and PCLC scores, and incorporate clinical interviews to strengthen findings.

A key limitation of our study is the use of neutral word pairs in the TNT task, which may not fully capture the types of intrusive thoughts typically suppressed in OCD and PTSD. Real-life suppression efforts often involve personally relevant, emotionally charged content rather than neutral associations (Engen & Anderson, 2018; Lambert et al., 2010). While using neutral stimuli allows for controlled examination of suppression deficits without the confounding effects of emotional reactivity, it may limit the ecological validity of our findings. However, evidence suggests that suppression deficits in PTSD and OCD extend beyond emotional material, affecting inhibitory control more broadly (Catarino et al., 2015; Mary et al., 2020). Future research should incorporate personally relevant stimuli to better assess how suppression deficits manifest in real-world contexts.

The subclinical PCLC group was not screened for trauma exposure, and we acknowledge this as

a limitation in our study. However, our primary aim was to recruit participants with high PCLC and YBOCS scores at a subclinical level, regardless of trauma history. Our focus on OCD and PTSD stems from the potential comorbidity between the two (de Silva & Marks, 2001; Medina Rodríguez & Solís Villegas, 2022) and their shared feature of heightened recurrent intrusive thoughts (de Silva & Marks, 2001), rather than specifically diagnosing a disorder or confirming trauma exposure.

Color blindness constituted one of our exclusion criteria. In a recent article, Nardo and Anderson (2024) mentioned using blue–yellow color-coding instead of green–red as a theoretical possibility, although this is yet to be empirically tested.

Future Directions

TNT research should further continue to examine the SIF abilities in those diagnosed with psychopathological disorders such as OCD and PTSD and ADHD using neutral as well as emotionally valenced stimuli. SIF could usefully be employed to try to forget unwanted memories in some of these participants.

Conclusions

This study examined the ability to actively suppress unwanted memories in subclinical OCD and PTSD participants. University students were screened using YBOCS and PCLC, with high (Hi) and low (Lo) scorers recruited based on z scores and cutoff values (Goodman et al., 1989; Weathers et al., 1993). While Lo scorers showed a significant SIF effect, Hi (subclinical) scorers did not differ between Baseline and No-Think recall. However, closer inspection revealed that the SIF effect was not moderated by symptom severity, providing no strong evidence of impaired suppression in subclinical groups. Combining Hi and Lo groups revealed a stronger overall SIF effect. The Think manipulation had opposing effects, with SCT facilitating recall and ICT reducing it—potentially due to functional fixedness or retrieval mechanisms (Anderson et al., 1994; Tulving, 1979). Replicating suppression effects remains challenging due to their small-to-medium effect size (Stramaccia et al., 2021), requiring strict methodological control.

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