Forget about it!:

Thought suppression versus the Think/No-Think paradigm.

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Abstract

Throughout the literature, results of thought suppression and directed forgetting studies have raised a series of contradictions. Thought suppression (TS) research generally finds that attempting to suppress a thought leads to a paradoxical increase in its subsequent return to awareness (e.g., Wegner, 1994). Directed forgetting research, specifically the subset using the Think/No-Think (TNT) paradigm, conversely finds that people can effectively exercise sufficient mental control to intentionally forget material (Anderson & Green, 2001). Studies 1 ($N = 128$) and 2 ($N = 32$) modify the TS and TNT procedures to isolate the presence of a visual cue as a plausible source for these discrepant results. With the paradigms made more equivalent, results indicated some evidence of the typically observed rebound effect in TS, but no evidence of expected directed forgetting effects in TNT.
Forget about it!:

Thought suppression versus the Think/No-Think paradigm.

The term "thought suppression" may conjure images of Freudian chaises lounges and stories of forgotten traumas, but the deliberate attempt to remove a distressing, threatening, or simply distracting thought from consciousness is actually a regular occurrence. Recorded consequences of such suppression efforts, however, present contradictions within psychological literature. Thought suppression researchers argue that these efforts may be somewhat successful in the very short-term but quickly backfire, leading people to consistently suffer more persistent intrusions of the thought than had suppression not been endeavored (Abramowitz, Tolin, & Street, 2001; Brewin & Beaton, 2002; Wegner, 1994). One might expect this "rebound" to correlate with an increase in the thought's memorability. Directed forgetting researchers, however, have long argued that people are quite capable of intentionally forgetting material (Bäuml, 2008; Bjork, 1970; Davis & Okada, 1971). There is much work to suggest that focused suppression efforts can result in diminished recall of to-be-suppressed items (e.g., Anderson & Green, 2001; Bäuml, Pastötter, & Hanslmayr, 2010). The current study seeks to determine which variable(s) critically differ between the thought suppression and directed forgetting paradigms, lending themselves to either successful suppression and restricted recall, or to greater thought recurrence and enhanced recall.

**Thought Suppression**

The "white bear" study, one of the earlier endeavors to scientifically probe the paradoxical effects of thought suppression, has become both a psychology classic and the basis for decades of empirical thought suppression research (Wegner, Schneider, Carter, & White,
In this study, participants were assigned to either an initial suppression or initial expression group. The initial suppression group was instructed to first suppress all thoughts of a white bear (the target thought) and then, during the expression period, to think only of the bear; the initial expression group received these instructions in reverse order. Throughout the experiment, participants verbalized all thoughts in a stream-of-consciousness manner, ringing a bell each time they experienced a "white bear" intrusion. The initial suppression group exhibited a higher frequency of target thoughts during the expression period than did participants in the initial expression group.

Subsequent thought suppression (TS) studies have introduced modifications to this original design (see Abramowitz et al., 2001). In a typical TS study, participants are initially given no guidance regarding they should think about, but are all told to monitor their thoughts for the provided target thought; thoughts of the target are usually reported via covert (e.g., holding a key on a keyboard) or overt (e.g., ringing a bell) signals. Participants in the experimental group are then instructed to suppress thoughts of the target while continuing to monitor for intrusions; control group participants only monitor. After this phase, all participants are again asked simply to monitor their thoughts (i.e., the experimental group discontinues suppression efforts). The presence of a rebound effect is determined by comparing the intrusion frequencies experienced by participants in the experimental group to those of the control group during the final monitoring period. If, as was the case in the "white bear" study, there is an increase in the frequency with which a target thought intrudes into consciousness following the period of suppression efforts, a rebound is deemed to have occurred. This effect is believed to be

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1 Monitoring differs from the expression period in Wegner et al.'s (1987) study, which some suggest may exaggerate the rebound effect and result in ceiling effects (Abramowitz et al., 2001).
a robust and long-term consequence, regardless of participants' mental health or the content/emotional valence of the target thought (Magee, Harden, & Teachman, 2012; Rassin, Merckelbach, & Moris, 2000).

According to Wegner's (1994) theory of ironic processes, mental control is realized through an operating process, which laboriously brings relevant items to consciousness, and a monitoring process, which effortlessly and continuously searches consciousness for the target item. When suppressing, the operating process identifies items to serve as distracters from the to-be-suppressed thought, whereas the monitoring process automatically scans thought content for suppression failures. Thus, the monitoring process essentially opposes suppression by constantly searching for the very item the operating process desires to eliminate.

Although the rebound effect may appear definitive, supporting research relies heavily on self-reports to measure thought intrusions and does not attempt to address underlying inhibitory mechanisms required for successful suppression. Directed forgetting research, as opposed to that of thought suppression, focuses on investigating the cognitive components and recall ramifications of attempted suppression, purporting that intentional suppression (i.e., intentional forgetting) is conceivable and evidenced by reduced recall of to-be-suppressed material.

Think/No-Think

There are several avenues of study that fall under the umbrella of directed forgetting research (e.g., list-method directed forgetting), but the one that has garnered the most recent attention is the Think/No-Think paradigm (Bäuml, 2008). Anderson and Green (2001) devised the Think/No-Think (TNT) paradigm\(^2\) as an attempt to analyze executive control processes.

\(^2\) A modification of the Go/No-Go procedure, used to study executive motor control (e.g., Casey et al., 1997).
underlying the act of suppressing an item's mental representation and retrievability. This approach differs from thought suppression research, which focuses on general consequences of suppression efforts, and not inhibitory systems specifically.

In the original TNT experiment, participants first learned 40 unrelated cue-target word pairs (e.g., ordeal-roach) to 50% criteria, then memorized which targets were to-be-suppressed and which were to-be-remembered\(^3\). During the think/no-think phase, participants were instructed to concentrate on the cue words as they appeared on the computer screen, recalling the corresponding to-be-remembered targets and preventing the to-be-suppressed targets from entering consciousness. Cues were shown 0 (baseline), 1, 8, or 16 times to determine the effects of repetition on final recall, measured by same-probe and independent-probe tests \(^4\), of the pairs. Both tests indicated significant below-baseline recall (i.e., forgetting) for to-be-suppressed targets presented 16 times, supporting the existence of an inhibitory control mechanism.

A number of TNT studies have since detailed similar forgetting effects using a variety of stimuli: emotional, pictorial, facial, etc. (e.g., Anderson et al., 2004; Depue, Banich, & Curran, 2006; Hanslmayr et al., 2010). However, some researchers have not found such effects (e.g., Bulevich, Roediger, Balota, & Butler, 2006; Hertel & Gerstle, 2003; Mecklinger, Parra, & Waldhauser, 2009; Waldhauser, Johansson, Backström, & Mecklinger, 2011). Most notably,

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3 Many researchers have since altered identification of to-be-suppressed and to-be-remembered targets by using the colors of preceding fixation crosses. If the fixation cross is red, the following target is to-be-suppressed; green crosses signal to-be-remembered targets. The color-cue method may create an anticipatory phase during which the participant's brain pre-activates cognitive control networks/mechanisms, resulting in stronger forgetting effects (Hanslmayr, Leipold, & Bäuml, 2010).

4 Same-probe tests use the original cue words to prompt target recall (e.g., ordeal-____). Independent-probe tests use target categories and first letters (e.g., insect-r____ signals the target "roach") to rule out associated interference and unlearning effects as causes of diminished recall; if the item still cannot be recalled, its item representation has been actively inhibited. However, see Tomlinson, Huber, Rieth, and Davelaar (2009) for an alternate explanation as to the validity of independent-probe testing.
Bulevich et al. failed to find forgetting despite exactly replicating Anderson and Green's original work.

Though the results of TNT studies are somewhat inconsistent, they do present some evidence for an inhibitory control mechanism that enables direct suppression of item representations and, thus, actual forgetting of material. This seems at odds with the notion of a rebound effect and challenges Wegner's (1994) theory of ironic mental processes. To further understanding of the cognitive processes underlying thought suppression, it is important to determine under what conditions suppression attempts are successful or unsuccessful. TS and TNT procedures appear to rely on different methods to exercise inhibitory controls. Contrasting the two methodologies in the same study may help to identify the crucial component(s) responsible for the discrepant findings within the literature.

**Thought Suppression versus Think/No-Think**

Key differences between the TS and TNT procedures may explain these contrary findings. First, TS success is judged by a reduction in the frequency of target thought intrusions during the monitoring phase; the thought has not been forgotten. TNT, on the other hand, has no monitoring phase and is retrieval-based; forgetting has occurred if the final recall of to-be-suppressed items is lower than the final recall of baseline items.

The nature of the stimuli used in TS and TNT also differ. TS experiments predominantly use one thought, while participants in TNT studies learn approximately 40 stimulus pairs. Wegner (1987) suggests that ordinary TS studies are concerned only with what thought to avoid, offering no alternative thoughts. Lack of guidance about what thoughts to associate with, or distract from, the target thought may foster formation of multiple, vague associations which
prompt the to-be-suppressed thought. For example, Participant A, told to not think of a white bear, thinks instead of how cold the room is, how the nearby telephone cord is tangled, etc. As his attention drifts, subsequent thoughts of the room temperature or seeing the telephone cord remind him of the white bear. The pairing of a cue and target in TNT stimuli, however, creates an association between the two items, which may facilitate thought control efforts by providing participants with something specific to focus on, preventing the emergence of superfluous external associations.

The design of the experimental phase in TS and TNT may be the most pivotal factor. During TNT, the participant is presented with an ongoing series of cues from the memorized cue-target pairs. The visual manifestations of these cues on the screen provide continuous reminders of the task instructions and the targets to which the instructions apply, which, according to Anderson and Green (2001), must be inhibited by executive processes. In contrast, TS offers no regular reminder of the task at hand; to suppress the target, participants must perpetually remind themselves of the thought itself (completely counterproductive) and the suppression instructions. Moreover, visual cues may focus participants' attentions, encouraging more active suppression efforts rather than passive attention shifts that delegate little energy to actual suppression of the target.

Thought suppression and Think/No-Think studies have thus far existed separately in the psychology literature. The current design includes both paradigms within the same study for the first time and attempts to control for numerous differences between the tasks to explore their often contradictory results.
Study 1

Goals and Hypotheses

The first portion of the study investigates one potential source for the apparent opposition between TS and TNT performance results (i.e., suppression efforts leading to rebound versus successful forgetting) – namely, the visual cue, which is part of TNT but not TS designs. Study 1 isolates the visual cue variable by allowing it to differ across tasks (i.e., participants see a visual cue during the TNT task, in the hopes that it will enhance the success of suppression efforts, but not during the TS task), while modifying standard TS and TNT procedures to equate for other procedural differences across the tasks (e.g., the number of stimuli used). Additionally, potential connections between TS and TNT performance have not been examined; the within-subject aspect of the study should further the understanding of this relationship.

It is hypothesized that the Suppress condition of the TNT task (TNT-Suppress) will show below-baseline recall because of the effect of the visual cues, but forgetting is not anticipated in the Suppress condition of the TS task (TS-Suppress). Analogously, fewer reports of target thought intrusions are expected during the monitoring phase of TNT-Suppress than during TS-Suppress. A rebound effect in TS-Suppress is also predicted, in line with prior literature.

Methods

Overview

All participants completed both TS and TNT tasks over the course of two sessions (task order was counterbalanced), with Session 2 taking place no more than two days after Session 1. Participants received one of four different sets of instructions during the experimental phase for both TS and TNT: Baseline, Monitor, Suppress, or Think. The study was thus a two-session, 2
(Task: TS or TNT) x 4 (Instructions) design, with Task as a within-subjects variable and Instruction between-subjects.

Participants

Participants ($N = 128$, 68% female) consisted of undergraduate students enrolled in an introductory psychology course; they received partial credit for a course requirement in exchange for participation. Participant age ranged from 15 to 22 years ($M = 18.66$, $SD = .96$), with years of education ranging from 12 to 16 ($M = 12.41$, $SD = .76$). Race was reported as follows: 70.3% White, 12.5% Asian, 7.8% Black, 1.6% Hispanic, 6.3% Multiracial, and 1.6% Undeclared.

Task Design: Think/No-Think & Thought Suppression

It was necessary to equate for as many of the differences as possible between the prototypical TS and TNT procedures to determine what role, if any, visual cueing plays in suppression success. The overall structures of the tasks in Study 1 were identical; a basic template for them can be found in Figure 1. The tasks consisted of four distinct phases: learning, experimental, monitor, and recall; the full text for the instructions of the experimental and monitor phases (separated by condition, where relevant) can be found in Appendices A and B. Ordinarily, TNT tasks do not include a monitor phase, and TS tasks do not include a recall phase. Inserting monitor and recall phases into both tasks permits a more direct comparison between the TS and TNT paradigms of memorability and intrusiveness.

Stimuli.

Stimuli consisted of 15 conjunctive sentences per task; a list of all 30 sentences can be found in Appendix C. Sentences followed the template of "You" + Verb + Object "and" Verb +

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5 Parental consent was granted through the university's participant pool system for participants under the age of 18.
Object (e.g., You mop the floor and pocket some coins). Each sentence was assigned a value of two points: one point for the verb (pocket) and one point for the object (coins) of the second half of the sentence. A point system was important for the scoring of how many of the sentences were learned at the beginning of the task, and how many were remembered at the end. The sentences were designed to be neutral in valence. They were also designed to be autonomous, in that the sentences were independent of one another (e.g., "You mop the floor and pocket some coins." is unrelated to "You renew a permit and install a disc."), and nothing about the first half of the sentence necessitates the second half (e.g., "You mop the floor" is unrelated to "[you] pocket some coins.").

There were several reasons for this stimuli construction. The conjunctive nature of the sentences mimics the cue-target frame of more traditional TNT word pairs, which not only facilitates the experimental presentation of the stimuli, but also provides the associative factor that is part of TNT but not TS. Additionally, sentences as a whole are much closer to the "thought" aspect of TS stimuli than are word pairs. Thus, this approach maximized comparability to the original paradigms while allowing for a common design across the tasks.

The different numbers of stimuli between the two paradigms also needed to be equated to isolate visual cueing as the critical variable. Although not as numerous as the typical 40 word pairs of TNT, it was hoped that 15 sentences would be enough to elicit TNT effects without overwhelming the TS design. Because there are no visual reminders of the stimuli in TS, 40 sentences could easily have become too much for participants to keep straight in their minds; furthermore, having so many stimuli in the experiment would have made any results far less
applicable to real-world suppression efforts, a common critique of typical TNT findings (e.g., Rassin, 2005).

**Learning phase.**

All participants were told that they should do their best to memorize a series of sentences that would be presented on the computer screen. Participants learned the sentence stimuli corresponding to that session's assigned task (TS or TNT). They were shown each complete sentence, one at a time, on the computer screen for 3 seconds. Participants were tested after all 15 sentences had been shown. They saw the first halves of each sentence, one at a time, and verbally recalled the corresponding second half (e.g., "You mop the floor and _____" was displayed, and they were asked to verbally recall "pocket some coins"). If the second half was correctly recalled, the next sentence was cued; if the participant responded incorrectly or declared no memory of the second half, he/she was shown the second half as feedback. There was no time limit placed on verbal recall.

The experimenter scored each sentence, with a total of 30 points possible (i.e., all second halves recalled correctly). This study-test cycle was repeated if the participant earned fewer than 15 points, with the sentences presented in a new and random order. Points were not consolidated across cycles, so a participant must have earned at least 15 points (i.e., 50% correct) at the end of a single cycle in order to continue. A cap was not placed on the number of study-test cycles a participant could undergo. Once the minimum criterion was met, the next phase of the task began.
Experimental phase.

Instructions during this phase depended upon the assigned condition. The length of this phase was approximately nine minutes.

Think instructions.

Participants in the Think condition were instructed to focus only on the sentence stimuli during this phase. During the TNT session, Think participants saw the first half of each sentence one at a time and were told to think only of the corresponding second halves, and to really concentrate on them. The first halves, shown in a random order for 4 seconds each and separated by 200 milliseconds of a centered fixation cross, cycled through 8 times. Following each cycle, paraphrased Think instructions were shown for 3 seconds, reminding participants to intently think about each of the second halves of the sentences when the first halves appeared.

During the TS session, participants were also told to do their best to remember and really concentrate on the sentences; distinctions were not made between the first and second halves (unlike TNT, where the halves were distinct). In this case, they saw a blank white screen instead of sentence halves for 63 seconds, followed by 3 seconds of modified instructions to continue thinking about the stimuli, repeated 8 times.

Suppress instructions.

Participants in the Suppress condition saw the same sentence display that Think participants saw (i.e., during the TNT session, Suppress participants saw the sentence halves; during the TS session, they saw a blank screen). Only the instructions differed. TNT-Suppress participants were told to concentrate on the cues but to make every effort to keep the second halves of the sentences (i.e., the targets) from entering their minds. TS-Suppress participants
were told to keep the sentences from their minds; again, distinctions were not made between the first and second halves. Additionally, participants during the TS phase were to report any intrusions (i.e., thoughts of the sentences) by holding the spacebar for the duration of each intrusion.

Monitor instructions.

Participants assigned to the Monitor condition were told to "think freely...about whatever [they] would think about under normal circumstances," but to indicate thoughts of the sentences coming to mind by holding the spacebar for the duration of the thought. In this case, participants were not presented with the sentences during the TNT phase; instead, they saw a blank screen for 63 seconds, followed by 3 seconds of paraphrased instructions [to continue thinking freely but also to report any thoughts of the stimuli] in order to remind them of the task. This cycle was repeated 8 times to match the Think and Suppress conditions. Ergo, the visual display and instructions during the TNT and TS sessions were identical in this condition (but with a different set of 15 sentences for each task, introduced during the learning phase).

Baseline instructions.

Participants in the Baseline condition were not given any instructions with regard to the previously learned sentences; instead, they completed a subset of the Operation Span task (Unsworth, Heitz, Schrock, & Engle, 2005)\(^6\), which measures working memory capacity. It was hoped that the cognitive demands of the Operation Span task would prevent any conscious or unconscious rehearsal of the stimuli, but would match the time spent in the other conditions on the 8 sentence-viewing/blank screen cycles.

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\(^6\) The Operation Span task requires participants to judge the validity of arithmetic solutions (e.g., \(4 + 4 = 10\)) while maintaining a string of letters in working memory. After each equation, a new letter is presented on the computer screen. At the end of each 3-7 letter-set, participants report the string in its correct serial order.
Monitor phase.

The experimental phase was followed by a 2-minute monitor phase. All participants were told to think freely as they would under normal circumstances, but to report any thoughts of the sentences. The experimenter emphasized that this phase was separate from the previous phase and any instructions to suppress or think, as applicable, no longer pertained. Note, because this phase was the same for all participants, someone assigned to the Monitor condition consequently monitored for thoughts of the sentences, while thinking freely, for almost 11 minutes, each session.

Recall phase.

The recall phase was very similar to the test portion of the learning phase: participants saw the first half of each of the sentences, presented in a random order, and verbally recalled the corresponding second half. Each sentence was shown only one time, however, and no feedback was provided regarding the participant's accuracy. Participants were not limited in the amount of time they had to provide a response. Each sentence was scored in the same manner as during the learning phase (i.e., up to 2 points per sentence, 30 points total).

Additional materials

All participants completed the Digit Symbol-Coding and Information tasks from the Wechsler Adult Intelligence Scale (WAIS), third edition (Wechsler, 1997). The Digit Symbol-Coding task is designed to measure fluid intelligence, while the Information task is one measure of crystallized intelligence.

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7 Five other measures were included in the protocol, but are not reported here because they are not the focus of the current study. These measures were the Positive and Negative Affect Schedule-Positive and Negative subscales (PANAS; Watson, Clark, & Tellegen, 1988), a Stroop task (Salthouse, Atkinson, & Berish, 2003), the Obsessive Compulsive Inventory- Revised (OCI-R; Foa et al., 2002), the Thought Suppression Inventory (TSI; Rassin, 2003), and a Suppression strategy questionnaire (Anderson, Reinholz, Kuhl, & Mayr, 2011).
Procedure

Following informed consent in Session 1, participants filled out a demographic questionnaire, followed by the TS or TNT task (administered via E-Prime software) based on their task order assignment. After the final recall phase, participants completed the WAIS Digit Symbol-Coding and Information tasks. Participants were then reminded of their Session 2 appointment time but were not yet debriefed. In Session 2, participants completed either the TS or TNT task (whichever task was not completed in Session 1) before being debriefed.

Results

Sample characteristics

A number of analyses were run to determine whether the four instructional groups differed on any baseline characteristics. Chi-square tests showed no differences in either gender, $X^2 (3, N = 128) = 2.69, p = .44$, or race, $X^2 (12, N = 126) = 10.29, p = .59$. A one-way analysis of variance (ANOVA) revealed no main effects on either WAIS Information, $F(3, 124) = 1.26, p = .29, \eta^2 = .03$, or Digit Symbol-Coding scores, $F(3, 124) = .17, p = .92, \eta^2 = .00$, indicating that groups exercised comparable cognitive abilities. For descriptive statistics, see Tables 1 and 2.

Cycles Needed to Reach Criterion

All participants were required to learn at least 15-points worth (i.e., 50%) of the sentences before progressing to the experimental phase of the task, but the number of study-test cycles it took to reach this criterion varied. Table 3 lists the means and standard deviations of the number of cycles by Session, Task Order, and Instructions. A 2 (Session: 1 or 2) x 2 (Task Order: TNT-TS or TS-TNT) x 4 (Instructions: Baseline, Monitor, Think, Suppress) mixed ANOVA was

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8 E.g., TNT-TS: Session 1 = TNT, Session 2 = TS
conducted with the number of cycles required to reach the criterion as the dependent variable. Task Order and Instructions were between-subjects factors and Session was a within-subjects factor.

This analysis revealed a main effect of Session, $F(1, 120) = 12.99, p < .001, \eta^2_p = .10$: more cycles were necessary to learn the material during Session 1 ($M = 3.12, SD = 1.24$) than Session 2 ($M = 2.80, SD = 1.11$), $t(127) = 3.08, p = .003, d = .27$. There was also a significant interaction between Session and Task Order, $F(1, 120) = 44.45, p < .001, \eta^2_p = .27$. As depicted in Table 3, during Session 1, participants in the TNT task (i.e., Task Order = TNT-TS) needed fewer study-test cycles ($M = 2.83, SD = 1.11$) than did TS-task participants ($M = 3.41, SD = 1.31$), $t(122.69) = -2.70, p = .008, d = -.48$. Similarly, TNT-task participants during Session 2 needed fewer study-test cycles ($M = 2.52, SD = .85$) than TS-task participants ($M = 3.09, SD = 1.26$), $t(126) = -3.04, p = .003, d = -.53$. In other words, participants within each Task Order condition needed more learning cycles during the TS task than the TNT task. The differences, while statistically significant, are minute; each of the aforementioned means round to 3 cycles.

There was a significant, three-way interaction among Session, Task Order, and Instructions, $F(3, 120) = 2.91, p = .04, \eta^2_p = .07$. Baseline, Monitor, and Think participants in the TS-TNT Task Order group averaged more cycles during Session 1 than Session 2, $t's(15) > 3.64, p's < .003$. Monitor participants in the TNT-TS Task Order group, however, averaged fewer cycles during Session 1 ($M = 3.06, SD = 1.48$) than Session 2 ($M = 3.63, SD = 1.46$), $t(15) = -2.33, p = .03, d = -.39$.

There were no other significant effects in this analysis, $F's < 2.50$.

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$^9$ The degrees of freedom is not a whole number in this instance because there were unequal variances in the ANOVA (i.e., Levene's test: $F = 4.67, p = .03$).
Points Earned in the Learning Phase

The importance of the final recall score is dependent upon the number of points earned during the learning phase; if the number of sentences originally learned differs across groups, differences in the raw recall scores could be a result of the learning differences and not a consequence of the experimental manipulations. Table 4 lists the means and standard deviations of the number of points earned by Session, Task Order, and Instructions.

A 2 (Session: 1 or 2) x 2 (Task Order: TNT-TS or TS-TNT) x 4 (Instructions: Baseline, Monitor, Think, Suppress) mixed ANOVA was conducted with the number of points earned during the learning phase as the dependent variable; Task Order and Instructions were between-subjects factors and Session a within-subjects factor. This analysis revealed a main effect of Session, $F(1, 120) = 4.79, p = .03, \eta^2_p = .04$: fewer points were earned during the learning phase of Session 1 ($M = 19.37, SD = 3.20$) than Session 2 ($M = 20.37, SD = 3.98$), $t(127) = -2.20, p = .03, d = -.28$.

There were no other significant effects in this analysis, all $F$'s $< 1.77$.

Differences in Thought Recurrences

Two measures of intrusions/thought recurrences were collected: frequency, the number of stimuli-related thoughts per minute (as indicated by the number of spacebar presses), and duration, the amount of time spent thinking of the stimuli (as indicated by the length of time for which the spacebar was depressed). Raw duration data values for the experimental and monitor phases were converted into proportional values of the time spent thinking about the sentence stimuli divided by the total length of that particular phase. As such, means and standard deviations reflect this proportion rather than a unit of time. Converting the data in this fashion
allows for intrusion/thought recurrence values collected during the 9-minute experimental phase to be compared to those collected during the 2-minute monitor phase. Using raw data would make it difficult to draw any conclusions regarding changes in duration, independent of differences in phase length.

**Experimental phase.**

Only participants assigned to the Suppress and Monitor instructional groups were asked to monitor their thoughts for any intrusions/thoughts of the sentence stimuli while attempting to suppress the stimuli or thinking freely, respectively. During the TS-session\(^{10}\), Suppress participants spent less time \((M = .02, SD = .05)\) thinking about the sentence stimuli than did Monitor participants \((M = .05, SD = .07)\), \(t(56.32)\)\(^{11}\) = -1.90, \(p = .06, d = -.47\). Although the frequency of intrusions reported by Suppress participants \((M = .72, SD = .73)\) did not significantly differ from those of Monitor participants \((M = 1.00, SD = .93)\), \(t(58.93)\)\(^{12}\) = -1.34, \(p = .19, d = -.34\), the means were in the expected direction and there was a small to medium sized effect indicating less frequent intrusions for Suppress participants. Together, these findings are consistent with previous thought suppression research, which indicates a temporary reduction in intrusions while suppression efforts are being actively expended.

There were no evident Task Order effects on duration between Session 1 and Session 2 for either the Suppress groups, \(t(30) = .76, p = .45, d = .28\), or the Monitor groups, \(t(30) = .83, p = .42, d = 30\).

\(^{10}\) As a reminder, the TNT-session was not included in the analyses because Suppress participants were not asked during the experimental phase of the task to monitor their thoughts. It was thought that the visual cues on the screen would make monitoring while suppressing the quickly presented second halves excessively difficult.

\(^{11}\) Levene's test: \(F = 4.04, p = .049\)

\(^{12}\) Levene's test: \(F = 4.32, p = .04\)
Monitor phase.

All participants reported thought recurrences for the 2 minutes directly following the experimental phase of each task. Separate 2 (Session: 1 or 2) x 2 (Task Order: TNT-TS or TS-TNT) x 4 (Instructions: Baseline, Monitor, Think, Suppress) mixed ANOVAs were conducted on the frequency and duration of recurrences, which are shown in Tables 5 and 6, respectively. As a reminder, Task Order and Instructions were between-subjects factors while Session was a within-subjects factor.

With regard to frequency, there was a main effect of Session, $F(1, 117) = 8.63, p = .004$, $\eta^2_p = .07$, such that participants indicated a greater frequency of sentence recurrences during Session 1 ($M = 1.94, SD = 1.36$) than Session 2 ($M = 1.61, SD = 1.23$), $t(124) = 2.95, p = .004$, $d = .25$. This effect disappeared, however, when the number of cycles it took participants to reach the learning criterion was included as a covariate, $F(1, 115) = .18, p = .68$, $\eta^2_p = .00$.

There was also a main effect of Instructions, $F(3, 117) = 5.62, p = .001$, $\eta^2_p = .13$. Baseline participants reported a greater frequency of sentence recurrences than Suppress ($M = .67$) and Monitor ($M = .70$) participants, $p$'s = .01. Additionally, Think participants reported a greater frequency of recurrences than Suppress ($M = .85$) and Monitor ($M = .88$) participants, $p$'s < .004. Baseline and Think participants did not significantly differ ($M = .18$), $p = .50$, nor did Suppress and Monitor participants ($M = .03$), $p = .92$.

There were no other significant effects regarding frequency, all $F$'s < 2.69.

An analysis of the duration data showed a significant interaction between Session and Task Order, $F (1, 117) = 4.00, p = .048$, $\eta^2_p = .03$. This effect disappeared, however, when the

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13 Please note that $M$ is the mean difference score, collected via post-hoc LSD comparisons.
number of cycles it took participants to reach the learning criterion was included as a covariate\textsuperscript{14}, \( F(1, 117) = 2.13, p = .15, \eta^2_p = .02 \). There were no other significant effects regarding duration, all \( F \)’s < 2.34.

It was hypothesized that Suppress participants would experience more successful suppression during the TNT task than during the TS task, because of the visual cue that is provided during TNT, and would consequently report fewer sentence recurrences during the TNT than TS monitor phase. Contrary to these expectations, Suppress participants reported significantly more sentence recurrences per minute during the monitor phase of the TNT-session (\( M = 1.61, SD = .90 \))\textsuperscript{15} than the TS-session (\( M = 1.21, SD = .95 \)), \( t(30) = 2.12, p = .04, d = .44 \). Duration did not significantly differ between the TS-session (\( M = .03, SD = .06 \)) and TNT-session (\( M = .04, SD = .07 \)) monitor phases, \( t(30) = -.82, p = .42, d = -.19 \).

Rebound effect.

Whether a rebound effect occurred or not is determined by examining the differences in duration/frequency of reported thought recurrences of the targets (i.e., the sentence stimuli) from the experimental phase to the monitor phase by the Monitor and Suppress instructional groups. A 2 (Instructions: Monitor or Suppress) x 2 (Phase: Experimental or Monitor) mixed ANOVA of TS thought recurrence duration showed a significant interaction between Instructions and Phase, \( F(1, 61) = 4.82, p = .03, \eta^2_p = .07 \). Monitor participants display a significant decline, as indicated in Figure 2, in the amount of time spent thinking of the targets from the experimental phase (\( M \)

\textsuperscript{14} There are no other instances in which the number of cycles significantly covaries with an analysis.

\textsuperscript{15} The two relevant TNT averages given in Table 4 (Session 1 = 1.84, Session 2 = 1.44) average to 1.64, rather than 1.61. This is because one participant’s TS task frequency data from Session 2 was lost (computer error); the paired samples t-test that was conducted excluded that participant’s TNT task frequency data from the analyses. As such, the t-test reflects data from 31 Suppress-group participants while the means reported in Table 4 reflect data from all 32 participants.
= .05, SD = .07) to the monitor phase (M = .02, SD = .03), t(31) = 2.51, p = .02, d = .50.
Suppress participants, on the other hand, do not show a difference between the experimental (M = .02, SD = .05) and monitor phases (M = .03, SD = .06), t(30) = .72, p = .47, d = .17. There was
not a main effect of Phase, F(1, 61) = 1.20, p = .28, η²p = .02.

While not an exact rebound effect, the lack of significant decline in duration by Suppress participants suggests the mental representations of the stimuli were, to a degree, being actively
maintained. In light of the Suppression group's lower duration findings during the experimental
phase, this maintenance of intrusions over time seems plausibly to have occurred as a result of,
rather than in spite of, suppression efforts.

A 2 (Instructions) x 2 (Phase) mixed ANOVA of TS thought recurrence frequency did not
show a significant interaction between Phase and Instructions, F(1, 61) = .05, p = .82, η²p = .001,
suggesting the absence of a rebound effect with regard to thought recurrence frequency. There
was, however, a main effect of Phase, F(1, 61) = 32.59, p < .001, η²p = .35, such that both the
Monitor and Suppress groups showed a significant increase in frequency from the experimental
to monitor phases. As indicated in Figure 3, participants in the Monitor instructional group
reported less frequent thoughts of the sentences during the experimental phase (M = 1.00, SD = .93) than the monitor phase (M = 1.44, SD = 1.01), t(31) = -4.25, p < .001, d = -.45. Suppress
participants followed the same pattern, reporting less frequent intrusions during the experimental
phase (M = .73, SD = .74) than during the monitor phase (M = 1.21, SD = .95), t(30) = -3.87, p
= .001, d = -.56.
Final Recall of Sentence Stimuli

Proportional recall.

Given the main effect of Session on the number of sentences learned during the learning phase (i.e., prior to any experimental manipulations), raw recall scores were converted to proportions. The proportional recall score of each session reflects the total points recalled in the recall phase divided by the total points originally learned. For example, Participant A learned 17 points worth of sentences and recalled 22 points worth: her proportional recall score for that session/task is 1.29. The proportional measure allows for the detection of any enhancement effects, of recalling more sentences at the end of the task than had been learned by the end of the learning phase, without being affected by the original differences in sentence encoding. Table 7 displays TS and TNT means and standard deviations for the proportional recall of each instructional group.

A 2 (Session: 1 or 2) x 2 (Task Order: TNT-TS or TS-TNT) x 4 (Instructions: Baseline, Monitor, Think, Suppress) mixed ANOVA showed a main effect of Instructions on proportional recall, $F(3, 120) = 6.58, p < .001, \eta^2_p = .14$. Participants in the Think group recalled significantly more sentences than Baseline ($M = .12$), Monitor ($M = .11$), and Suppress ($M = .13$) participants, $p$'s < .002. Furthermore, proportional recall during the TNT task, but not the TS task, was significantly correlated ($r = .39, p < .05$) with thought recurrence duration during the monitoring phase (see Table 10). That Think participants show above-baseline recall suggests the designs of the current study's TS and TNT tasks were able to elicit well-documented effects

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16 The highest possible proportional recall score is 2.00. This score would require having earned the minimum number of points during the learning phase (15) and recalling the maximum number at the recall phase (30).

17 Means refer to mean differences as collected via LSD post-hoc analyses.
of repetition and retrieval on later recall success (e.g., Karpicke & Roediger, 2007; Wheeler, Ewers, & Buonanno, 2003).

There were no other significant effects, all $F$'s < 2.43.

**Conditional recall.**

The conditional recall score of each session depends upon the number of sentences initially learned during the learning phase: of those sentences, how many were correctly recalled at the end of the task? For example, Participant B learned 18 points worth of sentences and recalled 18 points worth at the end. His conditional recall score is 1.00 only if those 18 points refer to the exact same sentences as those 18 points learned; if only 9 points were the same, his score would be .50.\(^{18}\)

As opposed to the proportion recall score, the conditional recall score addresses only how the originally learned sentences were affected by the manipulations. Perhaps suppression efforts were only directed towards those sentences that the participant consciously knew, while sentences that had not been as strongly encoded during the learning phase were not subject to suppression attempts, and were, instead, allowed to be unknowingly retrieved/rehearsed.

Table 8 displays TS and TNT means and standard deviations for the conditional recall by each instructional group. The 2 (Session: 1 or 2) x 2 (Task Order: TNT-TS or TS-TNT) x 4 (Instructions: Baseline, Monitor, Think, Suppress) mixed ANOVA revealed no significant differences, all $F$'s < 2.26. These results suggest that instructions to suppress thoughts of the sentences did not lead to a significant reduction in conditional recall, regardless of whether those instructions were accompanied by a visual cue (TNT) or not (TS).

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\(^{18}\) The highest possible conditional recall score is 1.00; any sentences recalled at the end of the task that were not remembered during the learning phase are not reflected in this particular measure.
Correlations in Thought Recurrence

As reported in Tables 9-12, significant correlations were found between frequency and duration measures of the four instructional groups. Additionally, thought recurrence was related to recall during the TNT task for participants in the Think and Baseline instructional groups; the more frequently participants in these conditions thought about the sentences, the higher their proportional and/or conditional recall of them.

Discussion

As hypothesized, participants in the Suppress instructional group exhibited reduced thought recurrence (duration) during the experimental phase, and then a type of rebound effect (namely, the overall time spent thinking of the sentence stimuli did not decline for Suppress participants as it did for Monitor participants) in thought recurrence during the TS task. This is consistent with previous findings demonstrating that trying to suppress something leads to a delayed and paradoxical enhancement of that to-be-suppressed item.

A rebound effect was not exhibited with regard to the frequency of intrusions, as both the Suppress and Monitor groups showed an increase from the experimental to the monitor phase. Given that the Monitor group showed a significant decrease in overall duration, this increase in frequency evidenced by both groups could be a consequence of the monitor phase instructions, which referenced the sentence stimuli and may have reintroduced them to participants' consciousness (see Appendix B).

Unexpectedly, participants in the Suppress group indicated more frequent (but not longer) recurrences of thoughts of the sentence stimuli during the monitor phase of the TNT task than the TS task. It was thought that the visual cueing component of the TNT task would enable
participants to better focus their suppression efforts than during the TS task, which would in turn result in fewer subsequent thought recurrences during the monitor phase; this expectation was not realized.

Proportional recall analyses indicated significant above-baseline recall, but conditional recall analyses did not show the same pattern: Think and Baseline group conditional recall scores did not significantly differ. It is expected that the lack of difference in conditional recall is owing to ceiling effects as results of the proportional recall scores ensure that repeated retrieval of the sentences did evoke better final recall of them.

In line with previous evidence of unsuccessful suppression in the TNT task (e.g., Bulevich et al., 2006), instructions to suppress thoughts of the sentences in Study 1 did not lead to below-baseline recall (i.e., forgetting), as indicated by the lack of difference in recall rates between the Suppress and Baseline groups. Moreover, final recall scores of participants in the Suppress group were unrelated to their reported intrusions/thought recurrences.

While these results suggest that visual cueing within the TNT task did not facilitate suppression as predicted, it is equally possible that modifications made in the current study to the original TS and TNT tasks had unintended effects. For instance, normal TNT tasks do not include a monitoring phase and the inclusion of one may have countered the benefits of a visual cueing system.

Whetstone and Cross (1998) used a modified list-method directed forgetting procedure to investigate the effects of monitoring and reporting thought intrusions on successful suppression/forgetting. During this type of directed forgetting task, all participants learn a short list of words (List 1). "Forget" participants are then told to forget List 1 in favor of a new list (List 2) while
"remember" participants are told to remember List 1 in addition to List 2. All participants are asked to recall both lists of words at the end of the task, regardless of previous remember/forget instructions; participants who had been instructed to forget the List 1 words do, in fact, recall fewer words from List 1 than do participants instructed to remember them (MacLeod, 1998; Sahakyan & Delaney, 2003).

What was unique about this study is that some participants in the Forget condition and some in the Remember condition received instructions to monitor for any thoughts of words from List 1 while learning List 2; monitoring did not occur in a separate phase (like in the current study's Study 1), but was an additional component of the List 2 learning phase. These monitoring instructions did not affect final recall of participants instructed to remember the words, but it did prevent successful forgetting of the List 1 words. Participants in the Forget condition who were not told to monitor their thoughts showed a significant reduction in List 1 recall as compared to the Remember condition, while "forget" participants told to monitor did not significantly differ in recall from "remember" participants. In line with Wegner's (1994) theory of ironic processes, the researchers suggest that the act of monitoring launches a mental search for the to-be-suppressed target, effectively maintaining its activation and preventing its suppression.

Thus, Study 2 explores whether or not monitoring instructions for TNT in Study 1 perpetuated activation of the sentences' item representations, and, consequently, obstructed suppression.
Study 2

Hypotheses

Following the work of Whetstone and Cross (1998), removal of all monitoring instructions is predicted to result in below-baseline recall in the Suppress condition of the TNT task (TNT-Suppress). Additionally, TNT and TS recall rates in Study 2 should be lower than those of Study 1, as Study 2's lack of monitoring instructions is expected to prevent any extended and counterproductive activation of the sentences.

It is also hypothesized that suppression efforts by participants assigned to the TNT task will be more successful in reducing final recall than those by participants in the TS task; in other words, TNT-Suppress recall should be lower than that of TS-Suppress, owing to the presence of a visual cue during the experimental phase.

Methods

Participants

Participants (N = 32, 50% female) for Study 2 were taken from the same pool as participants for Study 1, though no participants who had already participated in the first study were eligible to participate in the second. Participant age ranged from 18 to 21 years (M = 18.81, SD = .93), with years of education ranging from 12 to 15 (M = 12.56, SD = .88). Race was indicated as follows: 53.1% White, 15.6% Asian, 15.6% Multiracial, 9.4% Black, 3.1% Hispanic, and 3.1% Undeclared.

Task Design: Think/No-Think & Thought Suppression

The second study was specifically intended to investigate the effect of instructions to monitor for intrusions on the success of suppression efforts, so the design was not as extensive as
Study 1. The entirety of Study 2 took place during one session and participants were assigned to either the TNT or TS task. All participants were instructed to suppress thoughts of the stimuli during the experimental phase. In other words, Study 2 was a one-session, between-subjects design, with Task the between-subjects variable.

**Stimuli.**

The sentence stimuli used in Study 2 were identical to those used in Study 1.

**Learning phase.**

The learning phase was identical to that of Study 1.

**Experimental phase.**

As in Study 1, the length of the experimental phase was approximately 9 minutes. The TNT and TS task during this phase were identical to the respective TNT- and TS-Suppress conditions of Study 1. In other words, during the TNT task, participants saw the first half of each sentence a total of 8 times on the computer screen and were instructed to make every effort to keep the second halves of the sentences from entering their minds. During the TS task, participants saw the blank screen and were told to make every effort to keep from thinking about the sentences. However, in this study, participants were not instructed to monitor for or report any intrusions (i.e., the intrusion reporting component of the suppression condition that had been present in Study 1 was removed).

**Filler phase.**

Study 2 did not have a monitor phase. Instead, participants worked on a complicated maze for 2 minutes in order to keep the timing comparable to Study 1.
Recall phase.

The recall phase of Study 2 was identical to that of Study 1.

Additional materials

All participants completed the Digit Symbol-Coding and Information tasks.\textsuperscript{19}

Procedure

Participants completed the informed consent, followed by a demographic questionnaire, and were then assigned to either the TS or TNT task. After the final recall phase, all participants were debriefed.

Results

Sample Characteristics

T-tests comparing TNT-Suppress and TS-Suppress groups showed no significant differences in WAIS Information scores, $t(30) = .29, p = .78, d = .11$, or Digit Symbol-Coding scores, $t(30) = .30, p = .76, d = .11$. Chi-square tests showed no group differences in either gender, $\chi^2 (1, N = 32) = .50, p = .48$, or race, $\chi^2 (4, N = 31) = 1.76, p = .78$. See Tables 1 and 2 for descriptive statistics.

Cycles Needed to Reach Criterion

The average number of cycles it took to reach the learning criterion in TNT ($M = 3.19$, $SD = .91$) did not significantly differ from the number of cycles in TS ($M = 3.25$, $SD = .93$), $t(30) = -.19, p = .85, d = .07$.

\textsuperscript{19} As in Study 1, the PANAS, OCI-R, TSI, Stroop task, and Suppression strategy questionnaire were also included in the design of Study 2, but are not reported here.
Points Earned in the Learning Phase

The number of sentences encoded during the learning phase (reflected by the number of points earned) of the TNT task ($M = 19.50$, $SD = 2.97$) did not significantly differ from those encoded in the TS task ($M = 19.44$, $SD = 3.01$), $t(30) = .06$, $p = .95$, $d = .02$.

Final Recall of Sentence Stimuli

Think/No-Think v. Thought Suppression.

Whether a visual cue was present or absent during the experimental phase was irrelevant to proportional recall.\textsuperscript{20} TNT-Suppress recall ($M = .96$, $SD = .16$) did not significantly differ from TS-Suppress recall ($M = 1.00$, $SD = .11$), $t(30) = -.78$, $p = .47$, $d = .29$.

Akin to proportional recall analyses, there were no significant differences in conditional recall between the TNT ($M = .84$, $SD = .13$) and TS tasks ($M = .80$, $SD = .10$), $t(30) = .74$, $p = .46$, $d = .34$.

Suppress groups: Study 1 v. Study 2.

During Study 1, all participants were asked to monitor for and report any thoughts of the stimuli for 2 minutes after the experimental phase; this monitoring phase is not part of the typical TNT protocol and may have had unintended effects within the modified paradigm. To determine whether the monitoring instructions in the first study affected recall (i.e., if monitoring was responsible for the lack of forgetting/suppression), the TS and TNT recall scores of Suppress participants in Study 1 were compared with the TS and TNT scores of Study 2 participants.

\textsuperscript{20} Although there were no significant differences between the TNT and TS groups concerning the number of points earned during the learning phase, proportional recall scores were used, rather than raw recall values, so that comparisons could be made with the recall data of Study 1.
Study 1's TNT proportional recall ($M = .96, SD = .23$) did not significantly differ from that of Study 2's ($M = .96, SD = .16$), $t(46) = .001, p = 1.00, d = .00$. Similarly, Study 1's TS recall ($M = 1.00, SD = .18$) was not significantly different from Study 2's ($M = .99, SD = .11$), $t(46) = .24, p = .81, d = .07$. These recall values are reported alongside those of Study 1 in Table 7.

Further, Study 1's TNT conditional recall ($M = .86, SD = .13$) did not significantly differ from that of Study 2's, ($M = .84, SD = .13$), $t(46) = .61, p = .55, d = .15$. Similarly, Study 1's TS conditional recall ($M = .84, SD = .14$) was not significantly different from Study 2's ($M = .80, SD = .10$), $t(46) = .81, p = .42, d = .33$. These recall values are reported alongside those of Study 1 in Table 8.

Thus, whether monitoring instructions were present or absent throughout the designated task appears unrelated to whether successful forgetting/suppression occurs.

**Baseline v. Suppress groups.**

Study 2 did not include a Baseline instructional group, so recall data from the TNT- and TS-Suppress groups of Study 2 was compared to the Baseline recall data from Study 1.

With respect to the TNT task, Suppress participants did not average significantly different conditional recall scores ($M = .84, SD = .13$) than Baseline participants ($M = .86, SD = .11$), $t(46) = -.69, p = .50, d = -.17$. Proportional recall scores followed a similar pattern, with Suppress participants' recall ($M = .96, SD = .16$) not significantly different from that of Baseline participants' ($M = .98, SD = .15$), $t(46) = -.44, p = .66, d = -.13$.

Regarding the TS task, Suppress participants' conditional recall scores ($M = .80, SD = .10$) were not significantly different from Baseline participants' ($M = .83, SD = .13$), $t(46) = -.68$,
$p = .50, d = -.26$. Similarly, proportional recall scores between Suppress ($M = .99, SD = .11$) and Baseline participants ($M = 1.00, SD = .13$) were not significantly different, $t(46) = -.40, p = .69, d = -.08$.

In short, there was no evidence of suppression/forgetting on behalf of the Suppress group in either the TNT or TS tasks, for either proportional or conditional recall scores.

**Discussion**

Recall rates of participants instructed to suppress thoughts of the sentences were unaffected by the removal of monitoring instructions during the experimental phase, and the replacement of the monitor phase itself with a 2-minute filler task. Within Study 2, recall of participants assigned to the TS task did not differ from that of participants assigned to TNT. Across the studies, participants in the TNT-Suppress and TNT-Baseline groups of Study 1 did not differ in recall from those in the TNT-Suppress group of Study 2; the same was true of participants who completed the TS task.

Though the results of Study 2 are not in line with those of Whetstone and Cross (1998), instructions to monitor one's thoughts may still have maladaptive effects on efforts to reduce subsequent thought recurrence. The list-method directed forgetting task used by Whetstone and Cross is quite different from the Think/No-Think paradigm: it relies on unconscious and unintentional retrieval inhibition processes (Bäuml, 2008; Wilson & Kipp, 1998), while Anderson and Green (2001) argue that below-baseline recall in the TNT task reflects "controllable inhibition processes" that are deliberately exercised by the participant (p. 368).

Furthermore, Whetstone and Cross introduced monitoring instructions while participants were learning List 2. Monitoring instructions in Study 1 did not occur at the same time as
participants were encoding novel material, nor do they occur during an encoding segment in
typical TS tasks. Had Whetstone and Cross included a separate monitoring phase, perhaps the
directed forgetting effect would not have been extinguished.

On the other hand, the absence of an effect of monitoring instructions on recall scores in Studies 1 and 2 may simply reflect the many modifications made to create the current study's TS and TNT procedures. It would be interesting to include monitoring instructions in a typical TNT task, as Whetstone and Cross did with the typical list-method task, to determine whether or not there are consequential changes in recall.

The lack of literature on this issue makes it impossible to draw strong conclusions regarding the relationship between monitoring instructions and directed forgetting recall outcomes. In order to compare directed forgetting and thought suppression research, however, it is important that any effects of monitoring, a crucial portion of typical thought suppression, be more thoroughly investigated.

**General Discussion**

Thought suppression and directed forgetting research (particularly studies implementing the Think/No-Think paradigm) have produced seemingly inconsistent findings. Results of thought suppression experiments suggest that active attempts to keep a specific thought from entering one's consciousness are futile, as the thought will shortly return with greater persistency than had such efforts not been expended (Abramowitz et al., 2001; Wegner et al., 1987). Directed forgetting work, on the other hand, argues that suppression efforts are not wasted and that the mind is equipped with effective inhibitory thought controls (Anderson & Green, 2001;
Bäuml, 2008). The current study investigated potential sources for these conflicting expectations.

Study 1 posited that the findings of forgetting in prior traditional TNT studies is owing to the presence of a visual cueing system (usually the first word of a word pair) concurrent with think or suppress instructions, and that the lack of successful suppression (and evidence of rebound) in prior traditional TS studies is owing to the absence of visual cues. The two-session design of the study enabled a direct within-subjects comparison of TS and TNT performance, a comparison that, to our knowledge, has yet to be examined in the literature. Results of Study 1 indicated no below-baseline recall in either the TS or TNT tasks, suggesting that the presence of visual cues did not facilitate suppression. In fact, only the Think instructional group differed from the other conditions, with participants remembering more sentences at the end of the task than had been originally learned.

During the TS task of Study 1, there was evidence of initial suppression and then a rebound effect, in that instructions to suppress resulted in a greater recurrence in thoughts of the to-be-suppressed stimuli, relative to instructions to monitor, during the period following suppression efforts (i.e., the monitor phase).

It has been proposed that instructions to monitor/report thought intrusions, however, may be responsible for subsequent rebound patterns (Whetstone & Cross, 1998). The inclusion of a monitor phase in the TNT task could also have prevented the expected below-baseline recall of the stimuli by maintaining the activation of their internal, mental representations. All instructions to monitor, both during and after the experimental phase, were consequently removed from the task design in Study 2, but there was still no evidence of a reduction in recall
for the Suppression groups at the end of either the TS or TNT tasks, and there were no significant differences in recall between Studies 1 and 2. (The removal of all monitoring instructions made it impossible to determine whether or not a rebound in thought recurrences had occurred in Study 2.)

In sum, the previously documented rebound effect of thought suppression was partially replicated in Study 1, but directed forgetting effects of the Think/No-Think paradigm were not found in either Study 1 or Study 2.

**Evidence of a rebound effect**

The current study used a greatly modified version of the ordinary TS design; for example, the number and nature of the stimuli were different, as was the manner in which they were presented to participants. Despite the multitude of alterations, Study 1 elicited a rebound of thought recurrences analogous to that found in typical TS studies (though it was evident as a lack of decline in intrusions over time for the suppression group, rather than a suppression/monitor group difference during the monitor phase). The robustness of this rebound phenomenon suggests that the actual instruction to suppress, rather than the more intricate details of the experimental setup, is the most important factor determining thought recurrence. Aspects of experimental design intended to increase internal validity are often responsible for diminishing the ecological validity of laboratory research; if the critical factor, however, is whether or not one attempts to suppress, TS research can be better generalized to real-world behaviors and consequences.

Furthermore, Study 1’s focus on the suppression attempt itself as the critical factor in predicting a rebound lends credence to Wegner's theory of ironic processes of mental control.
(Wegner, 1994). The maintained prevalence of the to-be-suppressed thought after trying to suppress it (versus decline for the monitor group) suggests a prolonged activation of the item's internal representation. Interestingly, however, the recurrence data was not closely aligned to the recall data. Though one would predict that continued activation would be evident in a subsequent recall test, this expectation was unsupported. Only participants who worked on a distracting Operation Span task (Baseline condition) or were instructed to think about the sentences (Think condition) during the TNT task showed any relationship between thought recurrence during the monitor phase and final recall. Suppression instructions did not affect the number of stimuli correctly recalled at the end of the task (i.e., during the recall phase) while Think instructions led to greater proportional recall than any other instructional group.

Perhaps the rebound effect of the TS task in Study 1 was not of a great enough magnitude to affect final recall, given the rebound was only evident for duration of thought recurrences, not frequency. The rebound, in this case, may only represent a change in the nature of the recurring thoughts; when they occurred, they were present in the participant's mind for more time. A longer monitoring phase might have allowed for a greater rebound, which may in turn have affected recall rates. Because a recall phase has not before been included in a TS design, this is a novel issue in need of further exploration. Future research could address this discrepancy by more routinely including a final recall phase at the end of TS tasks. Although this would require including more to-be-suppressed stimuli, as opposed to a single thought (e.g., a white bear), the greater number of stimuli in the current study did not seem to negatively impact the finding of a rebound effect.
Absence of below-baseline recall

The lack of forgetting by the Suppress group during the TNT task (Studies 1 and 2) indicates a failure to replicate Anderson and Green's (2001) original TNT effects. Notably, some other researchers have also been unable to replicate TNT findings (e.g., Bulevich et al., 2006; Waldhauser et al., 2011), and even when TNT effects are found, they tend to be rather small (Anderson & Green). It has been proposed that personal characteristics, such as working memory capacity (Brewin & Beaton, 2002), levels of trait anxiety (Waldhauser et al.), and exhibition of a repressive coping style, demonstrated by low anxiety but high defensiveness (Barnier, Levin, & Maher, 2004; Geraerts, Merckelbach, Jelicic, & Smeets, 2006; Hertel & McDaniel, 2010), can all affect one's ability to suppress a thought. These characteristics were not accounted for in either Study 1 or 2, nor is it customary to do so in the literature, pointing to the need to measure these moderators more routinely in future research to help explain the inconsistent outcomes of the TNT task across studies.

Another possible explanation for the absence of below-baseline recall follows from the many alterations that were made to the TNT procedure. Although Study 2 ensured that the monitoring phase did not interfere with potential forgetting in Study 1, fewer stimuli were used than is normal in TNT tasks and the sentence stimuli were designed to mimic actual thoughts, which the typical TNT stimuli (word pairs; e.g., ordeal-roach) do not do.

Previous research has indicated that the discreteness of the stimuli can affect the magnitude of the consequential rebound (Abramowitz et al., 2001; Rassin, 2005, p. 172). A discrete thought refers to a specific unit (e.g., a person, a thing), while a non-discrete thought is complex, incorporating multiple ideas that are, in turn, associated with other ideas. More
discrete thoughts (e.g., a white bear) elicit smaller rebound effects than do non-discrete thoughts (e.g., a story); non-discrete thoughts may trigger a wider variety of extraneous thoughts than discrete thoughts, which broadens the number of associations made with the to-be-suppressed thought and makes it more likely that it will return to one's mind.

Consider the sentence "you adjust your collar and pass a grocer." This is an example of a non-discrete thought, as it can easily and automatically trigger a wide variety of related thoughts: mental images of the actions within the sentence, memories of the last time a shirt with a collar was worn, what happened the last time that shirt was worn, items that need to be purchased at the grocer's, feelings of hunger, etc. A similar word pair (collar-grocer), however, is unlikely to elicit these associations. There is no semantic relationship between "collar" and "grocer," no provided action to imagine, etc. Triggered associations experienced by the participant would thus likely involve more intentional elaboration, a behavior someone instructed to suppress thoughts of the target "grocer" is unlikely to engage in. Hence, it is quite possible that discreteness affects recall measures, as well, and that Studies 1 and 2 evidenced no below-baseline recall because the stimuli were non-discrete, while the word pairs used in the original TNT task are more discrete.

Furthermore, instructions to think or to suppress ("not think") are always within-subject in TNT studies, rather than between. During ordinary TNT tasks, thinking about to-be-remembered word pairs provides interference for to-be-forgotten word pairs. Removing the think/remember aspect precludes the possibility of interference reducing recall for suppress items.\(^{21}\) It is possible that this modification prevented forgetting.

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\(^{21}\) Although it has been argued that recall reductions in TNT are owing to inhibition of the item representations, others have suggested that interference plays a greater role (see Tomlinson et al., 2009).
Notably, Anderson and Green (2001) reported consistently significant forgetting only after 16 cycles of think/no-think trials. The current study design relied on 8 cycles for logistical reasons: 16 cycles would have made the experimental phase last for almost 20 minutes, which is far too long to expect participants completing the TS task to continuously exercise mental control of their thoughts while staring at a blank screen. Also, Depue et al. (2006) showed forgetting after only 10 cycles, so it was hoped that 8 cycles would be sufficient. Given the non-discrete nature of the sentence stimuli, however, a much greater number of suppression cycles might be necessary to elicit below-baseline recall within the current study's task design.

The changes made to the tasks were intended to more closely equate the TS and TNT paradigms, and to determine whether visual cueing was the critical factor in suppression success. Another explanation for the lack of forgetting is simply that visual cueing is not crucial. Perhaps removing visual cueing in conjunction with using word pairs as the stimuli would lead to forgetting. The differences in the number and nature of the stimuli typically used in TS and TNT tasks might explain the differences in reported suppression/forgetting success, but TNT effects have been replicated with a variety of stimuli, including images and faces (Depue et al., 2006). Thus, it will be critical to more fully evaluate whether traditional TNT effects differ when the visual cue is manipulated.

**Cycle differences in Study 1**

The number of cycles it took participants to reach the learning criterion during Study 1 significantly differed among the different instructional groups. When reviewing these results, however, one should consider the value of a learning criterion over that of, for example, a flat, three-minute study phase. The most basic rationale for employing this criterion is that it is
simply a more customary procedure in the literature (e.g., Anderson & Green, 2001; Hertel & Calcaterra, 2005; Lambert, Good, & Kirk, 2010). More importantly, though, a learning criterion allows the researchers to exercise greater control over encoding patterns. A study phase of predetermined length does not guarantee a standard of encoding; some participants might only learn 15% of the sentences during the same space of time it took others to learn 100% of them. The criterion employed in the current study ensured that any differences during the recall phase were not confounded by differences in encoding, given all participants in the current study verifiably encoded at least 50% of the stimuli. Furthermore, including cycles as a covariate in the analyses of frequency and duration of thought recurrences and conditional/proportional recall did not render significant changes in the results.

Limitations and Conclusion

The aforementioned modifications made to the TS and TNT tasks in the current studies were done to better equate the tasks to permit more direct comparison, but naturally limit the conclusions that can be made about the prototypical tasks themselves. In addition to those points noted earlier, the sentences used may not have been good substitutes for materials used in the typical TNT and TS tasks. The associative strength between the two halves of each sentence was not formally evaluated. Perhaps the strength was too great and asking participants to forget the second half of a sentence was like asking them to remember "roses are red," but to forget the color of violets.

Nonetheless, the continued presence of a rebound effect in the TS task, in spite of many design changes, provides supports for the robustness of the phenomenon and the flexibility of the TS task. The TNT task may be less reliable or flexible than the TS task, in that it may be more
dependent upon a set procedure. If this is the case, it is important to be able to identify the boundary conditions for when directed forgetting is successful. Only once these conditions are recognized can real-world implications and applications be discerned.

Being able to exercise enough mental control to successfully inhibit selected material might greatly benefit management of the many mental disorders that involve unwanted intrusive thoughts, such as post-traumatic stress disorder and obsessive-compulsive disorder. A higher degree of control could empower patients with the ability to choose when to address an intrusive thought (e.g., during a designated time, rather than, for example, an important business meeting or social occasion).

The possibility of developing this control warrants continued study to understand which variable(s) within a laboratory task could further this prospect and how best to translate them to real-world situations. Claims of successful directed forgetting and controllable inhibitory networks should be viewed with some reserve, however, until the contradictions with thought suppression research have been further addressed.
References


Table 1

Sample Characteristics

<table>
<thead>
<tr>
<th>Gender/Race</th>
<th>Baseline</th>
<th>Monitor</th>
<th>Think</th>
<th>Suppress</th>
<th>Suppress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>19 59.4%</td>
<td>22 68.8%</td>
<td>21 65.5%</td>
<td>25 78.1%</td>
<td>16 50.0%</td>
</tr>
<tr>
<td>White</td>
<td>23 71.9%</td>
<td>24 75.0%</td>
<td>21 65.5%</td>
<td>22 68.8%</td>
<td>17 53.1%</td>
</tr>
<tr>
<td>Black</td>
<td>1 3.1%</td>
<td>4 12.5%</td>
<td>1 3.1%</td>
<td>4 12.5%</td>
<td>3 9.4%</td>
</tr>
<tr>
<td>Asian</td>
<td>5 15.6%</td>
<td>2 6.3%</td>
<td>6 18.8%</td>
<td>3 9.4%</td>
<td>5 15.6%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0 0%</td>
<td>0 0%</td>
<td>1 3.1%</td>
<td>1 3.1%</td>
<td>1 3.1%</td>
</tr>
<tr>
<td>Multiracial</td>
<td>3 9.4%</td>
<td>1 3.1%</td>
<td>3 9.4%</td>
<td>1 3.1%</td>
<td>5 15.6%</td>
</tr>
<tr>
<td>Undeclared</td>
<td>0 0%</td>
<td>1 3.1%</td>
<td>0 0%</td>
<td>1 3.1%</td>
<td>1 3.1%</td>
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<tr>
<td>Total N</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
</tbody>
</table>
Table 2

Means and Standard Deviations of WAIS Information and Digit Symbol-Coding Scores

<table>
<thead>
<tr>
<th>Measure</th>
<th>Study 1</th>
<th>Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Monitor</td>
</tr>
<tr>
<td>WAIS Info.</td>
<td>19.37 (3.48)</td>
<td>19.69 (4.05)</td>
</tr>
<tr>
<td>Digit Symbol</td>
<td>89.12 (12.83)</td>
<td>88.28 (15.14)</td>
</tr>
</tbody>
</table>

*Note.* Standard deviations are presented in parentheses.

WAIS Info. and Digit Symbol refer to the Information and Digit Symbol-Coding tasks, respectively, from the Wechsler Adult Intelligence Scale (WAIS), third edition (Wechsler, 1997).
### Means and Standard Deviations of the Number of Cycles - Learning phase (Study 1)

<table>
<thead>
<tr>
<th>Task Order</th>
<th>Instructions</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNT-TS</td>
<td>Baseline</td>
<td>3.19 (1.22)</td>
<td>3.50 (1.55)</td>
<td>3.34 (1.21)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>3.06 (1.48)</td>
<td>3.63 (1.46)</td>
<td>3.34 (1.39)</td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>2.69 (.60)</td>
<td>2.88 (.81)</td>
<td>2.78 (.52)</td>
</tr>
<tr>
<td></td>
<td>Suppress</td>
<td>2.38 (.81)</td>
<td>2.38 (.62)</td>
<td>2.38 (.62)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>2.83</strong> (1.11)</td>
<td><strong>3.09</strong> (1.26)</td>
<td></td>
</tr>
<tr>
<td>TS-TNT</td>
<td>Baseline</td>
<td>3.31 (1.08)</td>
<td>2.38 (.72)</td>
<td>2.84 (.87)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>3.69 (1.20)</td>
<td>2.44 (.73)</td>
<td>3.06 (.81)</td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>3.69 (1.70)</td>
<td>2.69 (1.20)</td>
<td>3.19 (1.36)</td>
</tr>
<tr>
<td></td>
<td>Suppress</td>
<td>2.94 (1.12)</td>
<td>2.56 (.73)</td>
<td>2.75 (.88)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>3.41</strong> (1.31)</td>
<td><strong>2.52</strong> (0.85)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>3.12</strong> (1.24)</td>
<td><strong>2.81</strong> (1.11)</td>
<td></td>
</tr>
</tbody>
</table>

**Note.** TNT-TS means that participants completed the Think/No-Think (TNT) task during Session 1 and the Thought Suppression (TS) task during Session 2. Conversely, TS-TNT means that the TS task took place during Session 1 and the TNT task during Session 2.
### Table 4

*Means and Standard Deviations of the Number of Points Earned - Learning phase (Study 1)*

<table>
<thead>
<tr>
<th>Task Order</th>
<th>Instructions</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNT-TS</td>
<td>Baseline</td>
<td>19.00 (3.39)</td>
<td>19.56 (2.76)</td>
<td>19.28 (1.59)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>18.63 (2.78)</td>
<td>20.81 (5.01)</td>
<td>19.72 (2.89)</td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>19.25 (3.73)</td>
<td>18.62 (2.47)</td>
<td>18.94 (2.35)</td>
</tr>
<tr>
<td></td>
<td>Suppress</td>
<td>19.44 (3.52)</td>
<td>21.25 (3.82)</td>
<td>20.34 (2.13)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>19.08 (3.39)</strong></td>
<td><strong>20.06 (3.72)</strong></td>
<td></td>
</tr>
<tr>
<td>TS-TNT</td>
<td>Baseline</td>
<td>20.06 (2.89)</td>
<td>19.75 (3.57)</td>
<td>19.91 (2.55)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>18.88 (3.63)</td>
<td>20.12 (4.53)</td>
<td>19.50 (3.21)</td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>20.75 (2.96)</td>
<td>21.19 (4.93)</td>
<td>20.97 (2.72)</td>
</tr>
<tr>
<td></td>
<td>Suppress</td>
<td>18.94 (2.72)</td>
<td>21.63 (3.93)</td>
<td>20.28 (2.48)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>19.66 (3.10)</strong></td>
<td><strong>20.67 (4.24)</strong></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td><strong>19.37 (3.20)</strong></td>
<td><strong>20.37 (3.98)</strong></td>
<td></td>
</tr>
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</table>
Table 5

*Means and Standard Deviations of Thought Recurrence Frequency During the Monitor Phase (Study 1)*

<table>
<thead>
<tr>
<th>Task Order</th>
<th>Instructions</th>
<th>Session 1</th>
<th>Session 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNT-TS</td>
<td>Baseline</td>
<td>1.72 (.89)</td>
<td>1.34 (.81)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>1.50 (1.39)</td>
<td>1.41 (1.21)</td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>2.28 (1.62)</td>
<td>1.94 (1.24)</td>
</tr>
<tr>
<td></td>
<td>Suppress</td>
<td>1.84 (.81)</td>
<td>1.03 (.64)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>1.84</strong> (1.23)</td>
<td><strong>1.44</strong> (1.04)</td>
</tr>
<tr>
<td>TS-TNT</td>
<td>Baseline</td>
<td>2.94 (1.76)</td>
<td>2.31 (1.46)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>1.47 (.78)</td>
<td>1.16 (.79)</td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>2.50 (1.45)</td>
<td>2.43 (1.82)</td>
</tr>
<tr>
<td></td>
<td>Suppress</td>
<td>1.38 (1.16)</td>
<td>1.44 (.96)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>2.06</strong> (1.47)</td>
<td><strong>1.83</strong> (1.39)</td>
</tr>
<tr>
<td>Averages</td>
<td></td>
<td><strong>1.95</strong> (1.35)</td>
<td><strong>1.63</strong> (1.24)</td>
</tr>
</tbody>
</table>

**THOUGHT SUPPRESSION V. THINK/NO-THINK**
Table 6

*Means and Standard Deviations of Thought Recurrence Duration During the Monitor Phase*

*(Study 1)*

<table>
<thead>
<tr>
<th>Task Order</th>
<th>Instructions</th>
<th>Session 1</th>
<th>Session 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNT-TS</td>
<td>Baseline</td>
<td>.07 (.09)</td>
<td>.04 (.04)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>.08 (.10)</td>
<td>.01 (.03)</td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>.07 (.07)</td>
<td>.06 (.07)</td>
</tr>
<tr>
<td></td>
<td>Suppress</td>
<td>.08 (.12)</td>
<td>.04 (.07)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>.08</strong> (.09)</td>
<td><strong>.04</strong> (.06)</td>
</tr>
<tr>
<td>TS-TNT</td>
<td>Baseline</td>
<td>.09 (.08)</td>
<td>.08 (.08)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>.03 (.03)</td>
<td>.09 (.22)</td>
</tr>
<tr>
<td></td>
<td>Think</td>
<td>.10 (.12)</td>
<td>.09 (.12)</td>
</tr>
<tr>
<td></td>
<td>Suppress</td>
<td>.03 (.04)</td>
<td>.02 (.04)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td><strong>.06</strong> (.08)</td>
<td><strong>.07</strong> (.13)</td>
</tr>
<tr>
<td>Averages</td>
<td></td>
<td><strong>.02</strong> (.02)</td>
<td><strong>.01</strong> (.02)</td>
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</tbody>
</table>
Table 7

*Means and Standard Deviations of Proportional Recall Scores*

<table>
<thead>
<tr>
<th>Task</th>
<th>Study 1</th>
<th></th>
<th>Study 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Monitor</td>
<td>Think</td>
<td>Suppress</td>
</tr>
<tr>
<td>TNT</td>
<td>.98 (.15)</td>
<td>1.03 (.18)</td>
<td>1.12 (.15)</td>
<td>.96 (.23)</td>
</tr>
<tr>
<td>TS</td>
<td>1.00 (.13)</td>
<td>.96 (.16)</td>
<td>1.09 (.22)</td>
<td>1.00 (.18)</td>
</tr>
</tbody>
</table>

*Note.* As there were no effects of Task Order, the data are collapsed and reported only by Instructions.
Table 8

*Means and Standard Deviations of Conditional Recall Scores*

<table>
<thead>
<tr>
<th>Task</th>
<th>Study 1</th>
<th></th>
<th></th>
<th></th>
<th>Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Monitor</td>
<td>Think</td>
<td>Suppress</td>
<td>Suppress</td>
</tr>
<tr>
<td>TNT</td>
<td>.86 (.11)</td>
<td>.86 (.12)</td>
<td>.87 (.11)</td>
<td>.86 (.13)</td>
<td>.84 (.13)</td>
</tr>
<tr>
<td>TS</td>
<td>.83 (.13)</td>
<td>.81 (.12)</td>
<td>.89 (.09)</td>
<td>.84 (.14)</td>
<td>.80 (.10)</td>
</tr>
</tbody>
</table>

*Note.* As there were no effects of Task Order, the data are collapsed and reported only by Instructions.
Table 9

*Pearson’s Correlations between Frequency and Duration, Suppress group*

<table>
<thead>
<tr>
<th>Task</th>
<th>Phase</th>
<th>Value</th>
<th>TS Exp.</th>
<th>Mon.</th>
<th>Recall</th>
<th>TNT Mon.</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Freq</td>
<td>Dur</td>
<td>Freq</td>
<td>Dur</td>
<td>Prop</td>
<td>Cond</td>
</tr>
<tr>
<td>TS</td>
<td>Exp.</td>
<td></td>
<td></td>
<td>.56**</td>
<td>.69***</td>
<td>.22</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>Dur</td>
<td></td>
<td>-.20</td>
<td>.17</td>
<td>.20</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>Mon.</td>
<td>Freq</td>
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<td>-.13</td>
<td>.29</td>
<td></td>
<td></td>
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<td></td>
<td>Dur</td>
<td></td>
<td>-.11</td>
<td>.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall</td>
<td>Prop</td>
<td></td>
<td>-.45*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cond</td>
<td></td>
<td>.14</td>
<td>.07</td>
<td>.35*</td>
<td>.30</td>
<td></td>
</tr>
<tr>
<td>TNT</td>
<td>Mon.</td>
<td>Freq</td>
<td></td>
<td>-.52**</td>
<td>.10</td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dur</td>
<td></td>
<td>-.18</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recall</td>
<td>Prop</td>
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<td>-.70***</td>
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<td></td>
<td>Cond</td>
<td></td>
<td>-.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*N*ote. *p < .05, **p < .01, ***p < .001. Significance is 2-tailed.

Exp. refers to the experimental phase; Mon. refers to the monitor phase.

Freq. refers to the number of thought recurrences per minute, as reported by the participants;

Dur. refers to the proportional duration of the thought recurrences relative to the length of the phase.

Prop. refers to the proportional recall scores; Cond. refers to the conditional recall scores.

Participants were not asked to monitor their thoughts during the experimental phase of the TNT task, as they were during the TS task, so only data from the monitor phase could be included.
Table 10

Pearson's Correlations between Frequency and Duration, Think group

<table>
<thead>
<tr>
<th>Task</th>
<th>TS</th>
<th>TNT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mon.</td>
<td>Recall</td>
</tr>
<tr>
<td>Phase</td>
<td>Value</td>
<td>Freq</td>
</tr>
<tr>
<td>TS</td>
<td>Freq</td>
<td>- .76***</td>
</tr>
<tr>
<td></td>
<td>Dur</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Recall Prop</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Cond</td>
<td>-</td>
</tr>
<tr>
<td>TNT</td>
<td>Freq</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Dur</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Recall Prop</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Cond</td>
<td>-</td>
</tr>
</tbody>
</table>

Note. * p < .05, ** p < .01, *** p < .001. Significance is 2-tailed.
Table 11

*Pearson's Correlations between Frequency and Duration, Monitor group*

<table>
<thead>
<tr>
<th>Task</th>
<th>TS</th>
<th>TNT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exp.</td>
<td>Mon.</td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>Value</td>
</tr>
<tr>
<td></td>
<td>Freq</td>
<td>Dur</td>
</tr>
<tr>
<td>TS</td>
<td>Exp.</td>
<td>Freq</td>
</tr>
<tr>
<td></td>
<td>Dur</td>
<td>-</td>
</tr>
<tr>
<td>Mon.</td>
<td>Freq</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Dur</td>
<td>-</td>
</tr>
<tr>
<td>Recall</td>
<td>Prop</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Cond</td>
<td>-</td>
</tr>
<tr>
<td>TNT</td>
<td>Exp.</td>
<td>Freq</td>
</tr>
<tr>
<td></td>
<td>Dur</td>
<td>-</td>
</tr>
<tr>
<td>Mon.</td>
<td>Freq</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Dur</td>
<td>-</td>
</tr>
<tr>
<td>Recall</td>
<td>Prop</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Cond</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* *p < .05, **p < .01, ***p < .001. Significance is 2-tailed.
Table 12

*Pearson's Correlations between Frequency and Duration, Baseline group*

<table>
<thead>
<tr>
<th>Task</th>
<th>Phase</th>
<th>Value</th>
<th>Mon.</th>
<th>TS</th>
<th>Recall</th>
<th>TNT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Freq</td>
<td>Dur</td>
<td>Prop</td>
<td>Cond</td>
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<tr>
<td>TS</td>
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<td>Freq</td>
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<td>.84***</td>
<td>-.32</td>
<td>-.16</td>
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<tr>
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<td>Dur</td>
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<td>-.28</td>
<td>-.02</td>
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<td>Prop</td>
<td></td>
<td>.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cond</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNT</td>
<td>Mon.</td>
<td>Freq</td>
<td>-</td>
<td>.61***</td>
<td>.37*</td>
<td>.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dur</td>
<td>-</td>
<td>-.36*</td>
<td>.41*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recall</td>
<td>Prop</td>
<td></td>
<td></td>
<td>.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cond</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. *p < .05, **p < .01, ***p < .001. Significance is 2-tailed.
Figure 1. The general template for the Think/No-Think (TNT) and Thought Suppression (TS) tasks of Study 1.
Figure 2. Changes in thought recurrence duration experienced by Suppress and Monitor participants from the experimental to monitor phases.
Figure 3. Changes in thought recurrence frequency experienced by Suppress and Monitor participants from the experimental to monitor phases.
Appendix A

Instructions- experimental phase

Think

Think/No-Think

You’re going to again see the first halves of the sentences you learned. The sentences will appear one at a time. I would like you to focus on the screen and the sentence. Try to remember the second half of each sentence (which will not be shown on the screen) and concentrate on it. Do this for every sentence that appears on the screen: think only about the corresponding second half. You will see each sentence multiple times. Do you have any questions?

Thought Suppression

I would like you to focus on the computer screen and think about the sentences you learned. Remember them to the best of your ability. You will not actually see the sentences on the screen, but it is very important that you do your best to really concentrate on them. The screen will be blank during this phase. Do you have any questions?

Suppress

Think/No-Think

You’re going to again see the first halves of the sentences you learned. The sentences will appear one at a time. I would like you to concentrate on the first half of the sentence but do NOT think about the second half (which will not be shown on the screen). Keep the second halves of the sentences from entering your mind. Do this for every sentence that appears on the screen: do NOT think about the corresponding second half. You will see each sentence multiple times. Do you have any questions?
Thought Suppression

I would like you to focus on the computer screen. You may think about whatever you like but do NOT think about the sentences you learned. Keep the sentences from entering your mind. You will not actually see the sentences, but it is very important that you do your best NOT to think about them. Do you have any questions?

If you happen to think of any of the sentences you learned earlier, though, please hold the spacebar for the duration of that thought. Thoughts of the sentences may include portions of one or more of the sentences (e.g., the first half) or any related images/thoughts.

Again, think freely, but please indicate any thoughts of the sentences by holding down the spacebar for the duration of the thought. Do you have any questions?

You should only press the spacebar if you are having thoughts of the sentences. Also, the screen will be blank during this portion; there will be no visual changes if you press the spacebar.

Again, try NOT to think of the sentences you learned. If you do happen to think of them, though, hold the spacebar down during the thought.

Monitor

I’d like you to think freely. By that I mean, think about whatever you would think about under normal circumstances, as if you weren’t here right now.

If you happen to think of any of the sentences you learned earlier, though, please hold the spacebar for the duration of that thought. Thoughts of the sentences may include portions of one or more of the sentences (e.g., the first half) or any related images/thoughts.

Again, think freely, but please indicate any thoughts of the sentences by holding down the spacebar for the duration of the thought. Do you have any questions?
You should only press the spacebar if you are having thoughts of the sentences. Also, the screen will be blank during this portion; there will be no visual changes if you press the spacebar.
Appendix B

Instructions- monitor phase

During the next portion of this experiment, I’d like you to think freely. By that I mean, think about whatever you would think about under normal circumstances, as if you weren’t here right now.

If you happen to think of any of the sentences you learned earlier, though, please hold the spacebar for the duration of that thought. Thoughts of the sentences may include portions of one or more of the sentences (e.g., the first half) or any related images/thoughts.

Again, think freely, but please indicate any thoughts of the sentences by holding down the spacebar for the duration of the thought. Do you have any questions?

You should only press the spacebar if you are having thoughts of the sentences. Also, the screen will be blank during this portion; there will be no visual changes if you press the spacebar.
Appendix C

Sentence stimuli

<table>
<thead>
<tr>
<th>Think/No-Think</th>
<th>Thought Suppression</th>
</tr>
</thead>
<tbody>
<tr>
<td>You mop the floor and pocket some coins.</td>
<td>You adjust your collar and pass a grocer.</td>
</tr>
<tr>
<td>You paste a flier and advise a friend.</td>
<td>You answer the phone and lock your trunk.</td>
</tr>
<tr>
<td>You label a drawer and arrange some flowers.</td>
<td>You button your shirt and paint a sign.</td>
</tr>
<tr>
<td>You peel some carrots and gather some herbs.</td>
<td>You discard the trash and solve a riddle.</td>
</tr>
<tr>
<td>You borrow a movie and mend a tear.</td>
<td>You drink some tea and join a forum.</td>
</tr>
<tr>
<td>You catch a ball and pluck a string.</td>
<td>You stack some papers and plug the drain.</td>
</tr>
<tr>
<td>You consume a meal and polish some brass.</td>
<td>You fix a hole and bathe your pet.</td>
</tr>
<tr>
<td>You locate your key and cross the road.</td>
<td>You move a clock and shampoo your hair.</td>
</tr>
<tr>
<td>You repair the sink and eject a tape.</td>
<td>You copy some digits and fasten your buckle.</td>
</tr>
<tr>
<td>You moisten a napkin and fold some laundry.</td>
<td>You lift your hamper and check your planner.</td>
</tr>
<tr>
<td>You knit a robe and scrub the windows.</td>
<td>You print some photos and cut some coupons.</td>
</tr>
<tr>
<td>You renew a permit and install a disc.</td>
<td>You lower the blinds and erase some files.</td>
</tr>
<tr>
<td>You furnish your bedroom and push a cart.</td>
<td>You post the mail and reach a hotel.</td>
</tr>
<tr>
<td>You address a letter and climb the stairs.</td>
<td>You rinse your dishes and haul some boxes.</td>
</tr>
<tr>
<td>You insure an antique and redeem an offer.</td>
<td>You hem some cloth and wipe the mirror.</td>
</tr>
</tbody>
</table>

*Note.* Verbs and objects range in length of 3 to 7 letters, 1 to 2 syllables, and are less than or equal to 200 on the Kucera-Francis written frequency scale (Wilson, 1988).