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Self-Report May Underestimate Trauma Intrusions

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Abstract

Research examining maladaptive responses to trauma routinely relies on spontaneous self-report to index intrusive thoughts, which assumes people accurately recognize and report their intrusive thoughts. However, "mind-wandering" research reveals people are not always meta-aware of their thought content: they often fail to notice shifts in their attention. In two experiments, we exposed subjects to trauma films, then instructed them to report intrusive thoughts during an unrelated reading task. Intermittently, we asked whether they were thinking about the trauma. As expected, subjects often spontaneously reported intrusive thoughts. However, they were also "caught" engaging in unreported trauma-oriented thoughts. The presence and frequency of intermittent probes did not influence self-caught intrusions. Both self-caught and probe-caught intrusions were related to an existing tendency toward intrusive cognition, film-related distress, and thought suppression attempts. Our data suggest people may lack meta-awareness of trauma-related thoughts, which has implications for theory, research and treatment relating to trauma-related psychopathology.

Keywords: trauma, intrusions, mind-wandering, meta-awareness

Self-Report Underestimates Trauma Intrusions

1. Introduction

After exposure to a traumatic event, people often experience intrusive thoughts and memories of that event; such recurrent, distressing intrusive cognition is a ubiquitous feature of Post-Traumatic Stress Disorder (PTSD; American Psychiatric Association, 2000, 2013). Current practice for recording intrusive symptoms, in clinical settings and laboratory-based analogue trauma research, relies solely on people spontaneously self-reporting intrusive experiences. However, the “mind-wandering” literature (summarized below) indicates that people are not always accurate at tracking shifts in their attention (Smallwood & Schooler, 2006). Thus it is plausible that these procedures do not capture all instances of intrusive cognition; a possibility that has important implications for research on and treatment of intrusions. In two experiments, we investigated whether people sometimes fail to report when they are having an intrusive thought about a laboratory-based trauma analogue.

Involuntary memories of past experiences are one example of a broader category of spontaneous thought processes (Rasmussen & Berntsen, 2009). Although often cued by situational reminders, involuntary remembering occurs, by definition, without retrieval effort. Indeed, it is most likely to occur when attention is diffuse (e.g., Schlagman, Kvavilashvili, & Schultz, 2007). Berntsen (2009) argued that, generally speaking, involuntary memory is a functional mode of memory. For example, it can contribute to well-being by allowing people an automatic and non-effortful process by which to rehearse lessons from the past and prepare for the

future, perhaps acting as a “warning signal” about the potential for danger (Ehlers, Hackmann, Steil, Clohessy, Wenninger, & Winter, 2002; cf. Hintzman, 2011).

Although involuntary memories that serve these functions can be positive or negative, research has tended to focus on memories for negative experiences because they feature in a range of disorders, including PTSD and other anxiety disorders, depression, and eating disorders (Wegner & Pennebaker, 1993). Such memories are often experienced as upsetting. Our focus is on the occurrence of unwanted intrusive cognition following exposure to trauma-like stimuli.

Much of the empirical research on intrusive cognition has relied on spontaneous self-report data. For example, people watch a trauma film and monitor their thoughts for a specified period, marking the occurrence of any intrusions by verbalizing the thought, raising a finger, or, in multi-session studies, recording information in a diary (Berntsen, 2001; Holmes, Brewin, & Hennessey, 2004; Horowitz, Becker & Wilner, 1986; Nixon, Nehmy, & Seymour, 2007). Each procedure assumes that subjects have accurate meta-awareness of their own cognition. However, related research suggests that people do not always track the contents of their own consciousness.

Indeed, research demonstrates that people often engage in mind-wandering, “a shift of attention away from a primary task toward internal information, such as memories” (Smallwood & Schooler, 2006, p. 946). In doing so, they tend to lose track of the current focus of their attention, moving from task-related to task-unrelated thinking. Mind-wandering research highlights the potential importance of separating the frequency with which people *report* intrusions from the frequency with which they *experience* them. For example, Schooler, Reichle, and Halpern (2004) examined

how often people's attention drifted off-task while reading. "Mind-wandering" was measured in two ways (based on Schooler, 2002): (1) subjects self-reported whenever they noticed their mind had wandered (mind-wandering *with* awareness, as in prior studies of traumatic intrusions) and (2) subjects were intermittently asked whether their attention was off-task. These intermittent probes sometimes "caught" subjects engaging in task-unrelated thoughts the subject had not been spontaneously identified (mind-wandering *without* awareness). Of course, people were aware of the contents of their mind-wandering, but they were not meta-aware that they were mind-wandering (or they would have indicated as such). Furthermore, the more often participants lacked meta-awareness that their mind had wandered, the worse they performed on the concurrent task. The researchers argued that mind-wandering without awareness led to poorer reading comprehension, due to the decoupling of attention between the task and task-unrelated thinking (see also Smallwood, McSpadden, & Schooler, 2007).

Mind-wandering has conceptual overlap with involuntary cognition—including negative intrusions. Like involuntary memories, mind-wandering tends to occur when cognitive load is low, for example when people are carrying out an automatic or easy task and/or when they are not engaged in or motivated to perform a task (McVay & Kane, 2010). In addition, mind-wandering is particularly likely when people are experiencing negative mood (Smallwood, Fitzgerald, Miles, & Phillips, 2009).

Recently, Baird, Smallwood, Fishman, Mrazek & Schooler (2013) applied the concept of mind-wandering to unwanted negative thoughts. They wondered whether people would have difficulty accurately identifying the experience of

negative intrusions. During an unrelated reading task, subjects monitored intrusive thoughts about a prior romantic relationship, while simultaneously trying to suppress those thoughts. Again, the researchers measured intrusive thoughts using a combination of self-caught and probe-caught monitoring. Subjects were fairly often (14-22% across experiments) caught engaging in unwanted thoughts that they had not spontaneously reported.

Unlike traumas, prior romantic relationships are not uniformly negative and thoughts about them might be low in arousal (especially if the relationship ended long ago). We wondered whether we would see a similar pattern of results when the stimulus event was an analogue trauma: Would people sometimes fail to be meta-aware of, and hence fail to report, trauma-related intrusions? To test this question, we used a variation on the trauma film paradigm (Holmes & Bourne, 2008), first exposing subjects to a traumatic film and then monitoring their intrusive thoughts during a subsequent task. For this monitoring phase we used Schooler et al.'s (2004) reading task; asking subjects to read for comprehension but to self-report any off-task thoughts about the film (mind-wandering with awareness). We hypothesized that people would sometimes fail to recognize the occurrence of traumatic intrusions. To test this hypothesis, we intermittently asked subjects whether they were thinking about the film. We expected that these probes would occasionally "catch" subjects thinking about the film. In addition, to assess whether the presence of probes influenced the frequency with which people self-reported intrusions, we compared subjects exposed and not exposed to probes. Based on previous research, we expected one of two outcomes: (1) participants would self-catch a similar number of intrusions in the presence and absence of probes (Schooler et al., 2004)

or (2) participants would self-catch more intrusions in the absence of probes because sometimes probes would catch thoughts *before* participants noticed them and thereby preclude subjects from eventually noticing and reporting those thoughts (see Baird et al., 2013). Finally, although it was not central to our aims in this paper, based on previous research we expected that the more often participants were caught thinking about the film—and hence, the more their attention was divided between the articles and the film—the poorer their reading comprehension would be.

2.0. Experiment 1

2.1. Method

2.1.1. Design. We employed a simple between-subjects design. We asked half our subjects to press a key when they noticed an intrusive thought (*self-caught only* condition); the remaining subjects were additionally exposed to thought-sampling probes (*self-caught-plus-probes* condition). Our key dependent variables were the number of self-caught intrusive thoughts and the proportion of “yes” responses to probes (as a function of total probes received).

2.1.2. Subjects. Eighty-one Flinders University students participated for \$15 (Australian). We excluded data from 2 subjects who had seen the film previously, and 1 who did not follow instructions. Thus, our analyses focus on 78 subjects (68% female) aged 18-43 years old ($M=22.5$, $SD=5.1$)¹; a majority identified their ethnicity as “Australian” (48.7%) or other Caucasian (including White, English; 32.1%). Others reported as Asian (11.5%), Indian (2.6%), Middle Eastern (2.6%), African (1.3%), or

¹ Age data were missing for 2 subjects

mixed (1.3%). Our sample size replicated Baird et al. (2013). Socioeconomic data were not collected.

2.1.3. Materials and Procedure. This research was approved by the Social and Behavioural Research Ethics Committee at Flinders University and conducted in accordance with the provisions of the World Medical Association Declaration of Helsinki.

Subjects participated individually. We told subjects the study was about juror decision-making and graphic evidence and warned that they might find the material distressing. After consenting and completing a demographic questionnaire, subjects watched a 3m49s film depicting a multi-fatality car accident (see Strange & Takarangi, 2012) on iMac computer screens, using headphones. After the film, we introduced the reading task, composed of three non-fiction science articles (average = 1,063 words) presented one paragraph at a time, with three corresponding comprehension tests.

Subjects read the articles at their own pace, pressing the space bar to proceed between paragraphs. Each article was followed by a 10-item multiple-choice comprehension test (e.g., “What type of animal were proteins compared to?”). We randomized article presentation order for each subject, and recorded the total time (to the nearest minute) subjects spent on the task.

We instructed all subjects to press a particular key each time they noticed that they were experiencing an intrusive thought about the film. We told subjects in the self-caught-plus-probes condition that they would periodically be probed while reading with a screen that asked if they were thinking about the film at that particular moment, immediately before the probe screen appeared (“Just now were

you thinking about the film?”). Subjects responded yes or no by pressing the ‘Y’ or ‘N’ keys. Based on Baird et al. (2013), probes appeared independently of self-caught intrusions, with 8-150s between probes (average of one probe every 30s). Finally, we asked subjects if they had previously seen the film.

2.2. Results

We were primarily interested in whether people’s intrusive thoughts about the traumatic film occurred with or without meta-awareness. Thus we first examined intrusions captured by both the self-caught and probe-caught methods. We used a log-transformation to correct for positive skew in the distribution of self-caught responses. Subjects self-caught a similar number of intrusive thoughts, regardless of whether they were also exposed to intermittent probes: Self-caught-only: $M=.95$ 95% CI [.81, 1.09], Self-caught-plus-probe: $M=.86$ [.71, 1.01], $t(67.62)=-.90$, $p=.37$, $d=.21$, [-.24, .65]. (Untransformed data: Self-caught-only: $M=11.78$ [8.60, 14.96]; Self-caught-plus-probe: $M=10.89$ [7.55, 14.24]). Subjects who also experienced probes received 23.89 [21.98, 25.80] probes on average during the reading task.² They were caught having intrusive thoughts about the film 28.86% [22.16, 35.57] of the time. That is, on average they said “yes” to 29% of the probes. This is our central finding. We found no gender differences on self-caught intrusions ($t < 1$) and although probe-caught intrusions were directionally greater for women than men, the sample sizes were small and uneven and the CIs around that effect overlapped with zero ($t(35)=1.96$, $p=.06$, $d=.67$ [-.02, 1.36]).

² In several instances, due to response time, there was no delay between two of the probes. This situation was counted as one probe received.

We next examined the relationship between intrusive thoughts and subjects' performance on the reading comprehension task. We first calculated a partial correlation between self-caught intrusions and reading comprehension performance, controlling for overall time spent reading (related to both variables). There was no relationship, $r(75)=.06$, $p=.62$ [95% CI: $-.17, .27$]. We next calculated the correlation between frequency of probe-caught intrusions and performance. The more often subjects were caught thinking about the film, the less well they did on the comprehension test, $r(37)=-.51$, $p<.01$ [$-.22, -.72$] (see Schooler et al., 2004). One plausible explanation of this relationship is that undetected mind-wandering about the trauma film impaired attention to the reading task (Smallwood et al., 2007; Watkins, 2008).

One concern about the probe sampling method is that repeatedly probing subjects might increase intrusive thoughts over the reading period. To investigate the trajectory of intrusive thoughts, we grouped subjects' self-caught and probe responses by article (first, second, third). Again, we applied a log-transformation to correct for positive skew in the distributions, though we report untransformed descriptive statistics below. Regardless of condition, subjects self-caught the most intrusive thoughts immediately after watching the film, while they were reading the first article (Article 1: 5.87 [95% CI: 4.65, 7.09]); thereafter, intrusive thoughts dropped (Article 2: 3.05 [2.29, 3.81]; Article 3: 2.44 [1.64, 3.23]). A 3 (article order) x 2 (condition) mixed ANOVA on the transformed data revealed a main effect for article order, $F(2, 152)=33.46$, $MSE=.06$, $p<.01$, but no interaction, $F(2, 152)=2.04$, $MSE=.06$, $p=.13$. Within-subjects contrasts confirmed differences between all three articles [Article_{1 vs. 2}: $F(1,76)=35.54$, $MSE=.10$, $p<.01$, $d=.57$ [.36, .77]; Article_{1 vs. 3}:

$F(1,76)=50.59$, $MSE=.14$, $p<.01$, $d=.80$ [.55, 1.06]; Article₂ vs. 3: $F(1,76)=6.23$, $p=.02$, $d=.25$ [.05, .44]. We found an identical pattern for probe-caught intrusions. Subjects were most often caught having an intrusive thought while reading the first article (Article 1: 38.34% [29.50, 47.18]), compared to later (Article 2: 24.56% [16.11, 33.01]; Article 3: 21.92% [12.91, 30.93]). A within-subjects ANOVA revealed a main effect for article, $F(2, 72)=6.55$, $MSE=.04$, $p<.01$. Subjects were most likely to be caught on probes during the first article compared to both the second [$F(1, 36)=6.09$, $MSE=.12$, $p=.02$, $d=.53$ [.09, .97]] and third [$F(1, 36)=11.78$, $MSE=.09$, $p<.01$, $d=.61$ [.23, .99]] articles. Within-subjects contrasts showed that the latter two articles were not different, $F<1$. The fact that intrusive thought frequency declined over time and in both conditions suggests that repeatedly probing subjects did not increase the subsequent occurrence of intrusive thoughts.

3.0. Experiment 2

It is possible that the presence of multiple probes might—across the monitoring period—cause subjects to anticipate probes, artificially encouraging awareness and self-reporting of intrusions and thereby reducing “caught” rates. Indeed, other researchers have noted that monitoring methods draw attention to thinking and could artificially increase intrusions (e.g., Rassin, Merckelbach, & Muris, 2000). We tested this idea in Experiment 2 by adding two conditions with a single, unexpected probe presented early or later in the monitoring period. If multiple probes alter subjects’ response to probes, then single-probe-late (but not single-probe-early) subjects should less often report mind-wandering when probed than multiple-probe subjects probed at the same time. If multiple probes increase self-reported intrusions, than those rates should be higher in the multi-probe condition than in

either of the single-probe conditions (and perhaps higher in the single-probe-early condition than in the single-probe-late condition).

Additionally, in Experiment 2 we used a film depicting sexual assault to assess the generality of our results. A third novel aspect was that we added several individual difference measures that we hypothesized—on the basis of previous research and theory (e.g., Davies & Clark, 1998; Marcks & Woods, 2005; Nixon et al., 2007; Wenzlaff & Wegner, 2000)—might be related to the frequency of self-reported intrusive thoughts: general proneness to intrusive cognition, tendency to suppress intrusive thoughts, ratings of film unpleasantness and film-induced distress, attempts to suppress thoughts, and distress about intrusive thoughts. For example, in line with Baird et al. (2013), we wondered whether people who were motivated to suppress intrusive thoughts would be especially likely to experience unnoticed suppressed thoughts. We also wanted to examine relationships between these measures and probe-caught intrusive thoughts. The implications of the distinction between self-caught and probe-caught intrusive thoughts would be especially great if the two types of intrusions were differently related to these measures; such a result would suggest that responses to probes do not merely correct the absolute rate of intrusive thought frequency, but that there are psychological differences between intrusive thoughts that are versus are not detected by self-report measures.

3.1. Method

3.1.1. Design. We employed a between-subjects design. In the self-caught only condition, we asked subjects to press a key when they noticed an intrusive thought. In three other conditions we had combined self-report and probe methods. In the

multi-probe condition, we presented probes periodically throughout the reading task as in Experiment 1. In the *single-probe-early* condition, subjects saw a single probe, presented at the same time as the second probe in the multi-probe condition (54s after the start of the reading task). Finally, in the *single-probe-late* condition, subjects saw a single probe, presented at the same time as the seventh probe in the multi-probe condition (2min51s after the start of the reading task).

3.1.2. Subjects. We had 183 adults from Flinders University participate for \$10 (Australian). We excluded data from 16 subjects who had seen the film previously, 4 who did not follow instructions, 1 who—due to a computer malfunction—could not complete the task, and 8 who spent less than 3 minutes on the reading task (set in advance as the minimum time required; note this still indicates an above average reading rate of 372 wpm). Thus, our analyses focus on 154 subjects (71% female) aged 18-60 years ($M=22.44$, $SD=5.48$); a majority identified their ethnicity as Caucasian (including White, English; 44.8%) or “Australian” (20.1%). Others reported as Asian (18.8%), Indian (1.3%), Middle Eastern (2%), African (1.3%), Latino (2%), European (3.9%), Black American (0.7%), or mixed (2.6%). Four subjects did not report ethnicity. We increased our sample size so that we would have approximately the same number of participants per group as in Experiment 1. Socioeconomic data were not collected.

3.1.3. Materials and Procedure. The general procedure was identical to Experiment 1, with several exceptions. First, we asked subjects to watch an 8min scene from the movie, *The Accused* (1988), depicting a woman being gang raped in a bar. Second, we shortened the reading task to only the longest of the articles used in

Experiment 1. Third, subjects were not told to expect probes. Fourth, we added a series of measures—described below—at different points throughout the study.

Before viewing the film, we measured subjects' subjective ratings of their overall proneness to intrusive cognition and tendency to suppress such cognition, using single-item measures (Davies & Clark, 1998). The *Proneness to Intrusive Cognitions Scale* (PICS) item asked: "After you have seen something unpleasant on the television or at the cinema, do you find that it comes back into your mind without you wanting it to?" (0=not at all, 10=always). The *Thought Suppression Scale* (TSS) item asked: "When something unpleasant has happened in your life, to what extent is the following statement true of you?...I make an effort not to think about it" (0=not at all true of me, 10=true of me). We assessed the mood states of happiness, anxiety, depression, and anger before and immediately after the film, and after the reading task, using scales ranging from 0 (not at all) to 10 (extremely). Immediately after the film (and before the reading task), we asked subjects to rate on an 11-point Likert-type scale (0=not at all, 10=extremely) (a) how unpleasant they found the film, (b) how distressed they felt after it, (c) how closely they paid attention to it, and (d) how well they adhered to the instructions to record their intrusive thoughts. After the reading task, we asked them to rate on 11-point scales how hard they had tried not to think of the film (thought suppression), and how distressed they were by any intrusive memories of the film they experienced.

3.2. Results

3.2.1 Sample characteristics. We compared our four conditions on individual difference variables using ANOVAs (see Table 1). They were comparable on self-reported tendency toward thought suppression. However, they differed in

proneness to intrusive cognition. Specifically, post-hoc tests revealed that subjects in the single-probe-late condition reported a stronger tendency towards experiencing intrusive cognition than the self-caught and multi-probe conditions, $p < .01$. To address this fluke of random assignment, we included the PICS as a covariate in all analyses involving measures of intrusive cognition (a decision made prior to those analyses). The groups did not differ in how unpleasant they found the film, how distressed they felt after watching the film, their adherence to instructions, or attention to the film.

We also conducted a 3 (Group: multi-probe, single-probe-early, single-probe-late) x 3 (Time: before-film, after-film, after-reading) ANOVA for each of the four mood-states to assess mood change over the experiment (Table 2 presents descriptive statistics). Greenhouse-Geiser corrections were applied to the degrees of freedom. For all four measures, there was only a main effect for time: happiness [$F(1.72, 257.72) = 168.53, MSE = 3.29, p < .01$]; anxiety [$F(1.70, 254.47) = 52.98, MSE = 3.83, p < .01$]; depression [$F(1.62, 242.55) = 125.43, MSE = 4.08, p < .01$]; anger [$F(1.75, 258.43) = 329.13, MSE = 4.33, p < .01$]. For each mood state, mood became more negative following the film [$d_{\text{happiness}} = 1.73 [1.44, 2.01]$; $d_{\text{anxiety}} = .80 [.61, 1.00]$; $d_{\text{depression}} = 1.27 [1.04, 1.49]$; $d_{\text{anger}} = 2.58^3$] and improved following the reading task, though not to original levels [$d_{\text{happiness}} = .69 [.53, .85]$; $d_{\text{anxiety}} = .46 [.34, .59]$; $d_{\text{depression}} = .35 [.24, .46]$; $d_{\text{anger}} = .79 [.64, .94]$].

3.2.2. Self-caught intrusions. As in Experiment 1, we used a log-transformation to correct for positive skew in the distribution of self-caught intrusions (for

³ We used ESCI software (Cumming, 2012) to calculate confidence intervals. However, CI calculation is not available for paired designs where the value of d is greater than 2.

untransformed descriptive data, see Table 1). Subjects self-caught a similar number of intrusive thoughts, regardless of condition [Transformed data: Self-caught-only: $M=.66$ [95% CI: .52, .81]; Multi-probe: $M=.59$ [.44, .73]; Single-probe-early: $M=.72$ [.57, .86]; Single-probe-late: $M=.77$ [.63, .91]]. Thus, neither the presence nor frequency of probes affected how often subjects self-caught intrusions about the film. This result is consistent with Experiment 1, using a different film.

3.2.3. Probe-caught intrusions. Subjects in the multi-probe condition were caught having intrusive thoughts about the film on 39.48% [95% CI: 30.31, 48.66] of the probes. There was a slight and non-significant tendency toward a higher rate of probe-caught intrusions in Experiment 2 than in Experiment 1, $t(73)=1.89$, $p=.06$, $d=.43$ [-.02, .89]. This rate difference could be error variance or may be due to differences between the films and/or other differences between the two experiments.

We were particularly interested in whether subjects were equally likely to be caught thinking about the film by a probe presented alone or among multiple probes, and whether it mattered if the probe was presented near the beginning or later in the monitoring period, when—in the multi-probe condition—there would have been opportunity for any effect of multiple probes to build. Thus, we conducted two separate sets of analyses.

First, we compared the proportion of “yes” responses to the second probe in the multi-probe condition (34.21% [18.41, 50.01]), to the proportion of “yes” responses to the probe in the single-probe-early condition (55.26% [38.70, 71.82]). Although we found a statistically significant difference, recall that PICS scores varied between conditions. Therefore, to examine the effect of condition, controlling for PICS, we

followed up with a logistic regression analysis using condition and PICS as predictors. The more subjects self-reported they were prone to intrusive cognition in general, the more likely they were to say yes to probes, $\text{Exp}(B) = 1.29$, $p = .02$ [95% CI: 1.04, 1.59]. After taking PICS scores into account, the earlier difference between probe conditions was no longer significant, $\text{Exp}(B) = .56$, $p = .25$ [.21, 1.49]. In other words, subjects were equally likely to say yes whether the probe was presented alone or among other probes.

Second, we compared the proportion of “yes” responses to the seventh probe in the multi-probe condition (34.21%), to the proportion of “yes” responses in the single-probe-late condition (55.00% [38.89, 71.11]). Again, there was a statistical difference, but once again, the logistic regression analysis showed that the more subjects reported being prone to intrusive cognition in general, the more likely they were to say yes to probes, $\text{Exp}(B) = 1.29$, $p = .02$; 95% CI: 1.05, 1.59. As with the single-probe-early condition, after controlling for PICS scores, there was no effect of condition on the likelihood that subjects said yes to this probe, $\text{Exp}(B) = .77$, $p = .63$; 95% CI: .27, 2.20. Importantly, there was no difference between the two single-probe conditions: subjects were equally likely to say yes to a single probe whether it was presented early or later in the monitoring period, $\chi^2(1) = .001$, $p = .98$.

Taken together, our results suggest that the presence of multiple probes did not affect subjects’ propensity to say yes to an individual probe.

3.2.4. Correlational analyses. We also wondered whether self-caught and probe-caught intrusions might differ in some qualitative way. Thus we examined the relationship between these two measures and subject characteristics and reactions to the film. Table 2 presents the correlations, both collapsed across, and split by,

condition. There are several tentative conclusions that can be drawn from this table. First, as in Experiment 1, there was no relationship between self-caught intrusions and reading comprehension performance. However, again replicating Experiment 1, the more often subjects were caught thinking about the film, the worse they did on the comprehension test. Next, as noted previously, an existing tendency towards intrusive cognition was correlated with being more likely to experience intrusive thoughts about the film, both with and without meta-awareness. Third, experiencing the film as unpleasant and distressing and experiencing intrusions themselves as distressing, were all positively correlated with both types of intrusive cognition. Finally, although an existing tendency toward thought suppression does not appear to be related to intrusive cognition, attempting to suppress thoughts of the film while reading was correlated with intrusive cognition. Taken together, Table 2 suggests convergence between the two measures of intrusion in relation to these variables. However, this distinction warrants further investigation in future research.

4.0. General Discussion

Our results suggest that the self-report method researchers commonly use may not accurately reflect how often subjects experience conscious thoughts of trauma. There are several important implications. First, our results highlight the methodological limitations to using a traditional self-report measurement approach in both lab and field settings. Indeed, researchers in the field might consider using variations on the probe-caught method. For example, diary methods are commonly used to measure health behaviors (see Bolger, Davis & Rafaeli, 2003). O'Connor and Ferguson (2008)'s *event-contingent* (completing the diary when a specific event occurs) and *signal-contingent* (completing the diary in response to a signal) protocols

map directly onto the self-caught / probe-caught dichotomy. However, it may still prove difficult to “catch” real-life occurrences of such memories using the probe-caught method. So, what, if any, implications do our findings have for the study of everyday involuntary memories, which usually are not trauma-related? Studies in which participants have kept diaries reporting involuntary memories (e.g., Rasmussen & Berntsen, 2011) suggest that most people experience only a couple of dozen such memories per day. But it could be that people frequently experience fleeting involuntary autobiographical recollections without becoming meta-aware that they are doing so. If so, then the prior studies may underestimate the frequency of involuntary episodic memories (see Hintzman, 2011). Thus, it may be worthwhile to conduct a probe-caught study of everyday involuntary memories.

Our results also have the potential to inform theory, particularly relating to the monitoring and control of unwanted thoughts. For example, when attempting to suppress unwanted thoughts, people often experience an increase in intrusions (Wenzlaff & Wegner, 2000). One explanation for this surge is that the effort to suppress thoughts backfires and increases their frequency. However, our data suggest an alternative possibility: Maybe people are more likely to become meta-aware of intrusive thoughts when they are invested in suppressing them. That is, efforts to suppress trauma-related cognitions may not actually increase their frequency but only the likelihood that people become aware of and reflect upon them (or perhaps both mechanisms contribute to this paradoxical phenomenon).

As far as managing intrusive thoughts is concerned, in order to deal with the content of an intrusive thought—more than simply acknowledging the negative emotions—people first need to recognise they are experiencing that thought (Baird

et al., 2013). If a person is completely “meta-aware” of their conscious experience, then they can react appropriately; for example by restructuring negative thoughts, or adaptively dismissing them from consciousness. Research that examines people’s ability to monitor their intrusive thought experiences could help us understand why strategies like thought suppression tend to have unhelpful outcomes for people. For example, *unaware* thoughts might make people especially vulnerable to PTSD or other disorders in which involuntary negative thoughts and images are a feature. Further empirical and theoretical development in this area might ultimately assist people to better manage distressing intrusive experiences.

It is important to acknowledge several limitations. First, one could argue that our probe-caught intrusions were driven by demand characteristics. However, most subjects in the multiple probe conditions responded with a mix of yes and no answers, suggesting subjects differentiated between occasions when they were versus were not thinking about the film. Nonetheless, responding to probes still relies on a form of self-report. One important direction for future research is to develop and test more objective measures of mind-wandering. One possibility is to index off-task thinking by its effect on performance on a concurrent cognitive task (see Smallwood et al., 2007; Wessel, Overwijk, Verwoerd & de Vrieze, 2008). There are also some promising early indicators that brain imaging and other behavioral indices may reveal mind-wandering (e.g., Moss, Schunn, Schneider & McNamara, 2013; Schooler, Smallwood, Christoff, Handy, Reichle & Sayette, 2011).

Second, although our data suggest the presence of probes does not affect the rate of self-caught intrusions, perhaps the opposite is true: intrusions defined as “probe-caught” may sometimes reflect the non-reported (but meta-aware)

continuation of a previously self-caught thought. That is, subjects may have, on occasion, realized they were thinking about the film and hence reported an intrusion and then continued to ruminate about the intrusion (without re-reporting it) until probed; in some such cases subjects might have been meta-aware that they were thinking about the film when probed, having already reported the ongoing intrusion some seconds ago. Alternatively, in responding to the probe, subjects may have been thinking back to an earlier time when they were thinking about the film, rather than focusing on their thoughts immediately before the probe appeared. Thus, the rate of probe-caught intrusions may exaggerate the rate of genuinely unaware thinking (in our procedure and in other mind-wandering experiments). However, there are several reasons to think our probes do reveal some instances of genuinely unaware thoughts about the film. A higher frequency of probe-caught intrusions, but not self-caught intrusions, was associated with worse performance on the comprehension test, suggesting that probes capture a different underlying process. In addition, we specifically instructed our subjects to focus their attention back on the reading task after self-catching an intrusive thought. To the extent that people followed this instruction, our probe-caught measure should capture unaware intrusions. Finally, there were certainly many instances where “yes” probe responses occurred well after the previous earlier self-caught intrusions.

However, this issue also raises the possibility that unaware intrusive memories could have similar effects to rumination. Although ruminative thoughts may be conceptually distinct from self-caught intrusions (Ehring, Kleim & Ehlers, 2013), their relationship with probe-caught intrusions is currently unknown. Indeed, such a possibility could be important in light of the fact that rumination—and other

repetitive thought processes—is related to the development of PTSD (see Watkins, 2008, for a review). Future research examining the content of subjects' self-caught and probe-caught intrusions may disentangle this issue, and would also allow us to separate thought-based from image-based intrusions, a potentially important distinction (e.g., Hageraars, Brewin, van Minnen, Holmes & Hoogduin, 2010). In addition, a simple change in instructions could be used to identify whether participants have the same intrusion in mind when probes follow quickly after a self-caught intrusion.

A third limitation of the current research is that of course, thoughts and images related to a movie viewed in a lab study are far from a perfect model of real-world trauma-related intrusions. Our results very likely generalize to other trauma-film laboratory procedures, but whether or not they generalize to real-world traumatic intrusions is an empirical question that awaits study. Nonetheless, our data suggest that methodological changes are necessary so that this widely used paradigm can continue to be useful in refining clinical theories. Taken together with Baird et al.'s data, our results suggest that people can have thoughts about emotional autobiographical experiences without being meta-aware that they are having such thoughts. An important avenue for future research is to examine whether PTSD patients can have trauma-related intrusions without being meta-aware of doing so (which might in turn preclude the use of coping strategies to avoid such thoughts). There are two other directions we believe important for resolving questions raised by our studies. The first is systematic investigation of individual characteristics—using additional standardized measures and larger and more diverse samples—that may influence the frequency of intrusive thoughts with and without awareness, and

indeed the rate at which intrusive thoughts decline after a traumatic experience. Our data suggests that attempting to suppress thoughts of the film and having a tendency towards intrusive cognition are both associated with intrusive cognition with and without awareness. We suggest characteristics that predispose people to maladaptive cognitive strategies—such as thought suppression and rumination—may be important to a model of intrusive cognition that acknowledges meta-awareness, and hence should be the subject of future research.

Second, it may also be important to examine whether the distinction between meta-aware and unaware thoughts occurs for other emotionally significant material. For example, recent research shows that people do experience involuntary memories for both lab-based and personal positive events. Although mind-wandering is less likely when people are happy or engaged in enjoyable activities, and involuntary memories for positive events may be qualitatively different to those for negative events, examining how people re-experience positive events could improve our understanding of mood repair (Berntsen, 2001; Clark, Mackay & Holmes, 2013; Harvey & Bryant, 1998; Kane, Brown, McVay, Silvia, Myin-Germeys & Kwapil, 2007; Werner-Seidler & Moulds, 2011).

3.1. Conclusions

To summarise, we found that people often failed to recognize the occurrence of intrusive thoughts. Our results suggest that people may sometimes lack meta-awareness of their trauma-related thoughts. That fact may have important theoretical, methodological, and clinical implications.

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Table 1

Experiment 2: Sample characteristics and outcome measures, including means with 95% confidence intervals, and inferential statistics

Variable	Self-caught-only	Multi-probe	Single-probe-early	Single-probe-late	$F(3, 150)$	p	η_p^2
Proneness to Intrusive Cognition (PICS)	4.79 [4.00, 5.58]	4.05 [3.26, 4.85]	5.42 [4.63, 6.21]	6.60 [5.83, 7.37]	7.44	<.01	.13
Thought Suppression Scale (TSS)	5.39 [4.57, 6.22]	5.13 [4.31, 5.96]	5.18 [4.36, 6.01]	4.95 [4.15, 5.76]	0.20	.90	<.01
Film unpleasantness	8.63 [8.08, 9.19]	9.16 [8.61, 9.71]	8.89 [8.34, 9.45]	8.85 [8.31, 9.39]	0.60	.62	.01
Distress from film	7.05 [6.31, 7.80]	7.08 [6.34, 7.82]	7.24 [6.49, 7.98]	7.45 [6.73, 8.17]	0.24	.87	.01
Attention to film	7.71 [7.20, 8.22]	8.24 [7.73, 8.74]	8.47 [7.97, 8.98]	8.07 [7.58, 8.57]	1.56	.20	.03
Adherence to instructions	6.03 [5.13, 6.92]	6.68 [5.79, 7.58]	6.66 [5.76, 7.56]	7.15 [6.28, 8.02]	1.06	.37	.02
Self-caught intrusions	5.97 [3.11, 8.83]	6.53 [3.67, 9.39]	7.00 [4.14, 9.86]	8.45 [5.66, 11.24]	0.14†	.94	<.01
Suppression attempt	6.40 [5.52, 7.27]	6.40 [5.52, 7.27]	6.58 [5.70, 7.45]	6.93 [6.07, 7.78]	0.33	.80	.01
Distress at intrusions	5.03 [4.11, 5.94]	5.08 [4.17, 5.99]	4.89 [3.98, 5.81]	5.48 [4.59, 6.37]	0.30	.82	.01

Note: †This analysis included a measure of Proneness to Intrusive Cognition as a covariate, due to baseline differences.

Table 2

Experiment 2: The correlations between the measured subject characteristics and frequency of intrusive cognition

Intrusion type	Probes condition	N	Performance on comprehension test†	PICS	TSS	Unpleasantness	Distress at film	Distress at intrusions	Attempt to suppress thoughts
Self-caught	None	38	.10 [-.23, .41]	.43 [.13, .66]**	-.09 [-.40, .24]	.09 [-.24, .40]	.44 [.14, .67]**	.31 [-.01, .57]	.51 [.23, .71]**
	Multiple	38	-.03 [-.35, .29]	.15 [-.18, .45]	-.30 [-.57, .02]	.31 [-.01, .57]	.31 [-.01, .57]	.20 [-.13, .49]	.41 [.10, .65]*
	Single	78	-.03 [-.25, .19]	.37 [.16, .55]**	.03 [-.19, .25]	.30 [.05, .49]**	.31 [.09, .50]**	.54 [.36, .68]**	.44 [.24, .60]**
Probe-caught	Multiple	38	-.36 [-.61, -.05]*	.37 [.06, .62]*	-.15 [-.45, .18]	.29 [-.03, .56]	.53 [.25, .73]**	.50 [.22, .71]**	.54 [.27, .73]**
	Single	78	-.05 [-.27, .17]	.38 [.56, .17]**	-.04 [-.26, .18]	.26 [.04, .46]*	.34 [.13, .52]**	.50 [.31, .65]**	.36 [.14, .54]**

Note: *p<.05, **p<.01. †The correlations with self-caught intrusions controlled for overall time spent on the reading task.