Flinders UNIVERSITY

Abstract

Background and Objectives: People exposed to trauma often experience intrusive thoughts and memories about that event. Research examining people's responses to trauma assumes that people can accurately notice the occurrence of symptoms. However, we know from the broader cognitive literature on 'mind-wandering' that people are not always aware of their current focus of attention. That lack of awareness has implications for our theoretical and practical understanding of how trauma survivors recover from their experience. In the current study we investigated whether people's meta-cognitive beliefs about controlling trauma-related intrusions influenced the occurrence and meta-awareness of those intrusions.

Methods: We recruited participants who scored high (strong beliefs) or low (weak beliefs) on beliefs regarding the importance of controlling intrusive thoughts. Participants viewed a trauma film then—during a subsequent reading task—reported any film-related intrusions they noticed. We also intermittently asked half the participants to report what they were thinking at that particular moment, to "catch" intrusions without meta-awareness.

Results: People are not always aware of their trauma intrusions, and importantly, people with strong beliefs are more likely to notice trauma related intrusions both with and without meta-awareness than people with weak beliefs.

Limitations: We used an analogue trauma, and focused on a particular metacognitive belief, both of which somewhat limit generalizability. We also cannot definitively rule out demand effects.

Conclusions: Our data add to existing research showing people may lack meta-awareness of trauma-related thoughts, and suggest that survivors with particular

metacognitive characteristics may be more vulnerable to unaware ‘mind-wandering’ about trauma.

Keywords: Meta-cognitive beliefs, meta-awareness, trauma, intrusions, PTSD

1. Introduction

After exposure to trauma, people often experience intrusive thoughts and memories of the event; continued occurrence of such cognitions is a hallmark of posttraumatic stress disorder (PTSD). Importantly, people sometimes draw catastrophic conclusions ("something is wrong with me") about the meaning of those intrusions, and these appraisals increase the risk of PTSD (e.g., Bryant & Guthrie, 2005; Clohessy & Ehlers, 1999; Lindgren, Kaysen, Werntz, Gasser & Teachman, 2013; Owens, Chard & Cox, 2008). One explanation for this relationship between maladaptive appraisals and the persistence of PTSD is that people who possess negative beliefs about the meaning of their symptoms engage in strategies that tend to increase symptoms. However, people sometimes fail to catch themselves having an intrusive thought about a trauma analogue (Takarangi, Strange & Lindsay, 2014), suggesting that reported thoughts may not represent the entirety of people's unwanted cognition, only those thoughts that reach meta-awareness—defined as "the mental state that arises when attention is directed toward explicitly noting the current contents of consciousness" (Smallwood & Schooler, 2015, p. 495). Thus, perhaps people with negative beliefs, in addition to self-catching more intrusive thoughts, have more thoughts that fail to reach meta-awareness due to, for example, attempts at thought suppression. In the current study, we examine whether people with strong beliefs have more intrusive thoughts with and without meta-awareness than people with weak beliefs.

How people interpret their symptoms following exposure to trauma is critical to the development and maintenance of PTSD (e.g., Foa, Ehlers, Clark, Tolin & Orsillo, 1999; Reynolds & Brewin, 1998; Spinhoven, Pennix, Krempeniou, van Hermert & Elzinga, 2015; Wilksch & Nixon, 2010). People with PTSD often make idiosyncratic

negative appraisals of their reaction to a traumatic experience, such as, “My symptoms prove I’ll never get over this” (Clohessy & Ehlers, 1999; Steil & Ehlers, 2000). According to Ehlers and Clark’s (2000) cognitive model of PTSD, these negative interpretations produce a sense of current threat. To manage that threat, and minimize intrusive thoughts—particularly their negative connotations—people may come to believe they must establish control over those thoughts. Accordingly, people tend to engage in maladaptive control strategies such as avoidance and thought suppression. Similarly, according to Wells’ meta-cognitive theory of PTSD (2000), negative interpretations of symptoms can impede emotional processing and hence the recovery process, by activating thought suppression and avoidance (Wells & Sembi, 2004). Ironically, these strategies typically result in more intrusive experiences, a “rebound” effect (Beck, Gudmundsdottir, Paylo, Miller & Grant, 2006; Tolin, Abramowitz, Przeworski, & Foa, 2002; Wegner & Gold, 1995).

Taken together then, PTSD theories suggest that people with negative beliefs about intrusions will attempt to control unwanted cognition by suppressing or avoiding it, but these strategies will result in more persistent symptoms. Indeed, empirical evidence shows that unhelpful beliefs contribute to the maintenance of PTSD among clinical samples. For example, Holeva, Tarrier and Wells (2001) found thought control strategies were positively correlated with subsequent PTSD symptom development among road accident victims (see also Bryant & Guthrie, 2007; Ehlers & Steil, 1995; Shipherd & Beck, 2005).

Unfortunately, experimental or quasi-experimental research that explicitly examines the role of control beliefs is scarce. In one lab study, Broadbent and Nixon (2007) classified participants as having strong or weak beliefs based on their score on the Interpretation of Intrusions Inventory control subscale (III-31C, modified version).

Then, for 5-minutes, half the participants in each group actively suppressed any thoughts about a personally reported trauma; the others were instructed to "let their mind wander." Participants also indicated when they became aware of a trauma-related thought, and afterwards, rated their level of suppression effort. Contrary to expectations, participants with strong and weak beliefs about controlling thoughts reported a similar number of intrusions. However, suppression instructions led to increased suppression effort in both groups. Hence, these instructions may have levelled any pre-existing group difference in tendency to suppress, masking underlying group differences in intrusion frequency. Importantly though, suppression instructions did lead the expected rebound effect.

Wegner's (1994) Ironic Process Theory accounts for the rebound of intrusive thoughts with a dual-process system for controlling unwanted thoughts: the cognitively effortful *control* or *operating process* diverts attention away from self-caught unwanted thoughts in an attempt to suppress them, while the automatic *monitoring process* detects unwanted thoughts before they reach awareness. Under cognitive load, resources allocated to suppressing intrusions are deployed from the control process and hence the monitoring process may dominate. Detected thoughts then come to mind *more* easily, resulting in rebound, or hyperaccessibility (Wegner & Erber, 1992; Wenzlaff & Wegner, 2000). This model may help us understand why people who are more motivated to control their thoughts are also more likely to experience a rebound effect.

In particular, one untested explanation for the relationship between increased maladaptive beliefs and symptom occurrence relates to people's ability to accurately notice, or catch themselves, having intrusive thought experiences. Recent research—primarily in the *mind-wandering* domain—highlights the importance of separating the

frequency of self-reported intrusions from people's meta-awareness, or capacity to notice that they are experiencing an intrusion (Schooler, 2002; Smallwood & Schooler, 2006). Specifically, intermittent probes measuring where people's attention is directed often "catch" people engaging in unreported task-unrelated or target thoughts (e.g., Schooler, Reichle & Halpern, 2004), In one example, Takarangi, et al. (2014) measured participants' self-caught and probe-caught thoughts about an analogue trauma film during a subsequent unrelated reading task. Participants spontaneously reported intrusive thoughts about the film. However, across two experiments, participants also reported that they were thinking about the film for 29-55% of the probes. Thus, people might experience more unwanted thoughts than they report.

We also know attempts to suppress intrusions can result in reduced meta-awareness of unwanted thoughts. Baird, Smallwood, Fishman, Mrazek and Schooler (2013) found that participants under high cognitive load self-reported a similar number of unwanted thoughts as participants under low load, yet were more often caught experiencing unwanted thoughts they had not reported. Similarly, individual differences in tendency to suppress unwanted thoughts were strongly associated with being "caught." Given that people with strong beliefs about controlling their thoughts are more likely to engage in suppression and avoidance strategies, we wondered: Are people with strong beliefs therefore more likely to lack meta-awareness of their intrusive thoughts, compared to people with weak beliefs?

People with strong beliefs are likely to prioritize suppressing intrusions; and with greater resources required for suppression creating greater load, the control process is likely to fail more often, leading to greater rebound of intrusions. This process is consistent with data showing that maladaptive beliefs are associated with more self-

reported symptoms. However, it also suggests that people with strong beliefs should be more likely to experience intrusions that *fail* to reach awareness, compared to people with weaker beliefs (Wegner, 1994). As Baird et al. argue, load may also compromise the monitoring process, leading to failures in meta-awareness of the current contents of thought. Specifically then, our primary hypotheses were that, compared people with weak beliefs, people with strong beliefs would (1) self-catch more intrusive thoughts, and (2) experience more thoughts without meta-awareness (i.e., probe-caught thoughts).

To determine whether beliefs about the importance of controlling intrusive cognition influence people's ability to notice the experience of intrusive thoughts, we selected participants on the basis of their beliefs about intrusive cognition. Importantly, based on previous research (Nixon, Nehmy & Seymour, 2007; Mills et al., 2011), we expected that the majority of our student and community-based sample would have experienced a prior traumatic event. Indeed, even in the absence of explicit trauma exposure, people differ in the strategies—and beliefs relating to those strategies—that they use to deal with unwanted thoughts (e.g., Wells & Davies, 1994). We also expected that participants with strong beliefs would differ on a number of measures known to be associated with such beliefs, including PTSD symptoms, and, importantly, their tendency to experience and also suppress unwanted thoughts. We exposed participants to a traumatic film and measured film-related intrusions. It is possible that thought probes draw attention to film-related thoughts that might have eventually reached meta-awareness and been reported. Thus, the presence of probes could reduce self-caught thoughts. Alternatively, thought probes could cue people to experience *more* film-related thoughts. Either of these possibilities could interfere with the control and monitoring processes that we have

proposed underlie possible belief group differences. Thus, to assess the effect of introducing probes on participants' ability to spontaneously catch themselves having unwanted thoughts—and in particular whether the presence of thought probes would alter the number of self-caught thoughts differentially among strong vs. weak beliefs participants—we compared the self-caught only method with a combination of the self-caught and probe-caught intrusion sampling methods.

2. Method

The Social and Behavioural Research Ethics Committee at Flinders University and the City University of New York's University Integrated Institutional Review Board approved this research. Participants participated individually. We told them the study was about juror decision-making and graphic evidence and warned that they might find the material distressing.

2.1 Participants

One hundred and seventy-four eligible adults recruited from the Flinders University campus community participated for $10 (Australian). Participants were selected from a subject pool on the basis of their scores on the 9-item control subscale of the Interpretation of Intrusions Inventory (III-31; Obsessive Compulsive Cognitions Working Group [OCCWG], 2003), previously used as a selection measure for trauma research (Broadbent & Nixon, 2007). We excluded data from 20 participants who had seen the film, two who did not follow instructions, and one who was an outlier for time spent on the reading task (Z>3.29). Thus, we included 151 participants (70% female) aged 18-62 years (M=23.79, SD=8.12) in our analyses. The majority of participants identified as Caucasian (including White; 41.8%), or Australian (33.2%); the remainder were Asian (8.1%), European (6.2%), Indian (4%),

African (2.1%) or other (including Middle Eastern, 1.4%; New Zealand, 1.4%; Latino, 0.7%; Nepalese 0.7% and Sri Lankan 0.7%) descent. We aimed for approximately the same number of participants per group as Takarangi et al. (2014).

2.2 Design

Our study was a 2(unhelpful beliefs: weak and strong) x 2 (monitoring condition: self-caught only and self-caught-plus-probes) between-participants quasi-experimental design. We used participants' c-III-31 scores to categorize them as 'weak beliefs' if their score fell in the lower third (*M*=11.49, *SD*=7.13, range 0–22) and 'strong beliefs' if their score fell in the upper third (*M*=54.59, *SD*=8.60, range 44–82) of scores from 340 participants who completed a previous screening questionnaire in exchange for $5. We randomly assigned weak and strong beliefs participants to monitoring condition; there were no differences in c-III-31 scores across conditions. We asked *self-caught only* participants to press a key when they noticed an intrusive thought; *self-caught-plus-probes* also received thought-sampling probes.

2.3 Materials

Beliefs about intrusive cognition. We adapted the III-31C (Broadbent & Nixon, 2007; Obsessive Compulsive Cognitions Working Group [OCCWG], 2003), which measures people's beliefs about the importance of controlling negative intrusions. We told participants we were interested in their "experiences with negative thoughts or images that pop into your mind unexpectedly." We explained that sometimes these thoughts and images relate to a specific negative event, and that nearly everyone has such experiences, which vary in frequency and associated distress. We asked participants to first think about when they were bothered by these kinds of thoughts and then to rate how much they believed each of a series of statements. There were 7 filler statements and 9 target statements such as "I would be a better person if I gained

more control over this negative thought" rated on an 11-point scale (0=I do not believe this idea at all; 10=I am completely convinced that this idea is true). The III-31 has excellent psychometrics, with Cronbach's ά=0.94, comparable across males and females, and clinical and non-clinical populations (OCCWG, 2005). The control subscale has high internal reliability, Cronbach's ά=0.87 (Broadbent & Nixon, 2007).

Intrusive thought tendency. We used the *Frequency of Involuntary Thoughts Scale* (FITS; Hyman et al., 2015) to assess people's general propensity to experience involuntary thoughts. Participants rate how often various types of thoughts (e.g., visual images, memories, etc) come to mind involuntarily, on a likert-type scale (from 1=never to 6=constantly). Participants also completed Davies and Clark's (1998) single *Proneness to Intrusive Cognitions Scale* (PICS) item (''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).

Thought suppression tendency. The *White Bear Suppression Inventory (WBSI*: Wegner and Zanakos, 1994) is a 15-item measure of the tendency to suppress unwanted thoughts. Participants rate items (e.g., "There are things I prefer not to think about") on a 5-point scale (1=Strongly disagree; 5=Strongly agree). The WBSI has good internal consistency, Cronbach's ά=0.88 and satisfactory test–retest reliability *r*=0.78 (Hoping & de Jong Meyer, 2003). We also used Davies and Clark's (1998) *Thought Suppression Scale* (TSS) single item (''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).

Depression and Anxiety symptoms. The DASS-21 (Lovibond & Lovibond, 1995) is a 21-item measure of depression, anxiety and stress. Participants rate the degree to which each statement applies to them over the past week. Items include "I found it

hard to wind down" (0=Did not apply to me at all, to 3=Applied to me very much, or most of the time). The DASS-21 has acceptable concurrent validity with established measures as well as excellent internal consistency (Cronbachs: $\alpha_{Depression}$=.97; $\alpha_{Anxiety}$=.92; α_{Stress}=.95; Antony, Bieling, Cox, Enns & Swinson, 1998).

Post-traumatic stress symptoms. The Posttraumatic Diagnostic Scale (PDS; Foa, 1995) is a self-report measure of PTSD symptom presence and severity. Participants respond to a checklist of events sufficient to lead to PTSD (e.g., "Sexual assault by a stranger") and rate PTSD symptoms of re-experiencing, avoidance and arousal in the previous month (e.g., "Reliving the traumatic event, acting or feeling as if it was happening again") on a 4-point scale (0=not at all or only one time; 1=Once a week or less / once in a while; 2=2 to 4 times a week / half the time; 3= 5 or more times a week / almost always). The PDS has good internal consistency (Cronbach's α=.92).

Mood. Participants rated their current mood on four items (happiness, anxiety, anger and depression) using an 11-point scale (0=not; 10=extremely).

Trauma film. We used an 8-min scene from the movie, *The Accused* (1988), depicting a fictional gang rape (see Takarangi et al., 2014).

Film ratings. Participants rated (a) how unpleasant they found the film, (b) how distressed they felt after it, and (c) how closely they paid attention to it, using an 11-point scale (0=not at all, 10=extremely).

Reading and thought monitoring task. Participants read an article (1121 words) on a topic unrelated to the film (the structure of a cell), presented on the computer screen one paragraph at a time. We based this task on previous mind wandering research (i.e., Baird et al., 2013; Schooler et al., 2004), which aims to give participants a primary task on which task performance—and therefore the impact of mind wandering on task performance—can be measured. Other research (Giambra, 1989,

1995) also supports the idea that undemanding cognitive tasks induce task-unrelated thoughts. Here, we were specifically interested in off-task film-related thoughts. The article was followed by a 10-item multiple-choice comprehension test (e.g., "What type of animal were proteins compared to?"). We instructed all participants to press a particular key each time they noticed that they were experiencing an intrusive thought about the film throughout the reading task and then to refocus on the reading task. We also periodically probed the *self-caught-plus-probes* participants during the article with a screen that asked what they were thinking about immediately before the probe screen appeared ("Just now what were you thinking about?"). Here, participants pressed one of three keys: (1) "if you were thinking about the film" (2) "if you were thinking only about the article you were reading" (3) "if you were thinking about something else." [1] Based on Baird et al. (2013) and Takarangi et al. (2014), probes appeared independent of self-caught intrusions (approximately every 30 s, with a range of 8-150 s).

Intrusive thought experience ratings. To assess participants' intrusive thought experience during the reading task we asked them to rate on 11-point scales (0=not at all to 10=extremely) how hard they had tried not to think of the film (thought suppression) while reading the article, and how distressed they were by any intrusive memories of the film they experienced. We also asked them to complete the *Experience of Intrusions Scale* (EIS; Saulters-Pedneault, Vine, Mills, Park & Litz, 2009). The items measure intrusion frequency: "How often have you found yourself thinking to any degree about the film since seeing it?" (0=almost never, 1=infrequently, 2=occasionally, 3=frequently and 4=very frequently); and intrusion distress, unpredictability, unwantedness and interference (0=not at all, 1=a little, 2=moderately, 3=quite a bit and 4=extremely). The EIS has good internal consistency,

Cronbach's ά=0.83, good to excellent test retest reliability, r=0.90 and good convergent validity with the PTSD checklist-B cluster, p<.05 (Saulters-Pedneault et al., 2009).

Other ratings. We asked participants how well they adhered to the instructions to record their intrusive thoughts and—for self-caught-plus-probe participants—how accurate they were in answering the probe questions, using an 11 point scale (0=not at all to 10=extremely). Finally, we asked how easy or difficult (0=very easy, 1=moderately easy, 2=neither easy or difficult, 3=moderately difficult, 4=very difficult) and how interesting (0=not at all, 1=a little, 2=somewhat, 3=pretty, 4=highly) they found the article (based on Jackson & Balota, 2012).

2.4 Procedure

Prior to the main experiment, as part of a separate study, participants completed several screening measures, including the III-31C, WBSI and DASS. We invited a subset of participants to take part in the main study.

After obtaining written consent, subjects completed several questionnaires measuring baseline mood and general tendencies to experience, and suppress, intrusive cognitions. Participants then watched the trauma film on iMac computer screens, using headphones. After the film, we asked participants if they had previously seen the film and re-assessed their mood. Next, participants completed the reading and monitoring task. After the reading task, we again assessed mood, and participants' intrusive thought experiences during the reading task, their adherence to task instructions, and their impressions of the reading task. All participants were debriefed in verbal and written form.

3. Results and Discussion

3.1. Film impact. We first examined participants' film ratings and mood measures to assess the film's impact (see Table 1). Overall, participants rated the film as very unpleasant (M=8.92, SD=1.64); there were no statistically significant group differences. Participants also reported that the film was distressing; here, participants with strong beliefs rated the film as more distressing than participants with weak beliefs; there was no main effect for monitoring condition or interaction. We next conducted a 2(unhelpful beliefs: weak and strong) × 2(monitoring condition: self-caught only and self-caught-plus-probes) × 3(Time: before-film, after-film, after-reading) ANOVA for each of the four mood-states to assess mood change over the experiment. Greenhouse-Geiser corrections were applied to the degrees of freedom. For all four measures, there was a main effect for time: happiness [F(1.86, 271.30)=176.40, MSE=2.45, p<.01]; anxiety [F(1.79, 244.60)=60.87, MSE=3.51, p<.01]; depression [F(1.73, 253.00)=95.73, MSE=3.38, p<.01]; anger [F(1.88, 273.81)=285.08, MSE=4.36, p<.01]. Overall, participants reported feeling more depressed, angry and anxious immediately following the film, as well as feeling less happy [$d_{\text{happiness}}$=1.53 [1.28, 1.79]; d_{anxiety}=0.84 [.65, 1.02]; $d_{\text{depression}}$=1.06 [0.84, 1.26]; d_{anger}=2.32[2]]. After the reading task, participants' mood had significantly improved, but was still lower than at baseline [$d_{\text{happiness}}$=0.76 [.60, .91]; d_{anxiety}=.49 [.36, .62]; $d_{\text{depression}}$=.40 [.28, .52]; d_{anger}=.88 [.71, 1.05]]. For happiness and depression, there was an unexpected interaction between monitoring condition and time; in both cases the self-caught-only condition rated their mood as slightly higher than the self-caught-plus-probes condition prior to the film, and slightly higher after the film (happiness: F(1.86, 271.30)=3.64, MSE=2.45, p=.03, η_p^2=.02 [.00, .07]; depression: F(1.73, 253.01)=4.52, MSE=3.38, p=.02, η_p^2=.03 [.00, .08]). Pairwise comparison analyses revealed no significant group differences before the film (Fs<1), or after the film

(happiness: $F(1, 146)=1.64$, $p=.20$, $\eta_p^2=.01$; depression: $F(1, 146)=1.84$, $p=.18$, $\eta_p^2=.01$). We found no other relevant group differences.

3.2. Self-caught intrusions. Next, we turned to our primary interest in participants' intrusions. We used a log-transformation to correct for positive skew in the distribution. As predicted, participants with strong beliefs about the need to control their thoughts self-caught more intrusions ($M=.81$ [95% CI: .74, .89]; Untransformed: $M=7.28$ [5.74, 8.81]) than participants with weak beliefs ($M=.63$ [.55, .71]; Untransformed: $M=5.50$ [3.95, 7.04]) Interestingly, participants who were not exposed to probes self-caught more intrusive thoughts than participants exposed to probes (Self-caught-only: $M=.81$ [95% CI: .73, .88]; Self-caught-plus-probes: $M=.64$ [.56, .72]; Untransformed data: Self-caught-only: $M= 7.29$ [5.74, 8.83]; Self-caught-plus-probes: $M=5.49$ [3.96, 7.02]). This result suggests the presence of probes reduces the rate of participants' self-caught intrusions. Although it contrasts Takarangi et al.'s (2014) results, we proposed that probes could draw attention to film-related thoughts that might otherwise have been reported later, before they reached awareness. A 2 (Belief type: strong, weak) × 2 (Reporting condition: self-caught only, self-caught plus probe-caught) between participants ANOVA confirmed the main effects of condition, $F(1, 147)=8.36$, $MSE= .12$, $p<.01$, $\eta_p^2=.05$ [.01, .14]; and belief type, $F(1, 147)=10.18$, $MSE= .12$, $p<.01$, $\eta_p^2=.07$ [.01, .15].

We also found that strong beliefs participants reported higher mean scores on the EIS than weak beliefs participants. These data suggest that overall, participants with strong beliefs experienced more unwanted intrusions that occurred with greater unpredictability and caused more distress and interference with a task, than participants with weak beliefs.

3.3. Probe-caught intrusions. Based on Takarangi et al. (2014), we expected that

for participants exposed to probes, some proportion of their film-related intrusions would be experienced without awareness (in other words, they would report film-related thoughts in response to some probes). On average, participants were exposed to 11.46 (SD=3.02, range 7-26) probes; with no difference across strong and weak beliefs, $t<1$. Overall, participants reported they were thinking about the reading task (i.e. were "on task") on 64.42% (SD=25.76) of the probes, and about "other" things on 9.84% (*SD*=13.34) of probes. Participants therefore reported that they were thinking about the film on the remaining 25.74% (*SD*=24.45) of probes. Because these were thoughts in addition to those that participants self-reported, we classified them—in line with previous literature—as film-related intrusions that lacked meta-awareness. Interestingly, the extent to which participants reported they were following instructions to self-report intrusions predicted how many self-caught intrusions they had (r=.21, p=.01), but not the frequency of probe-caught thoughts about the film (r=-.09, p=.42). Of course, we were particularly interested in whether beliefs affected meta-awareness. Figure 1 presents the probe-response data for participants in the self-caught-plus-probes condition, classified by beliefs group. The percentage of film-related probe-caught intrusions was higher amongst people with strong beliefs (*M*=31.69, 95% CI [23.97, 39.40] compared to weak beliefs (*M*=19.80 [12.09, 27.51]), $t(74)=2.16$, p=.03, d=.50 [.04, .95]. As shown in Figure 1, film-related thoughts occurred at the expense of on-task thoughts, rather than "other" thoughts, for those with strong beliefs. In other words, participants with weak beliefs were more "on task" than participants with strong beliefs. Hence, it appeared that participants with strong beliefs were more likely to allocate cognitive resources away from the task at hand toward scanning and suppressing intrusive thoughts, leading to greater rebound, including of thoughts that fail to reach meta-awareness.

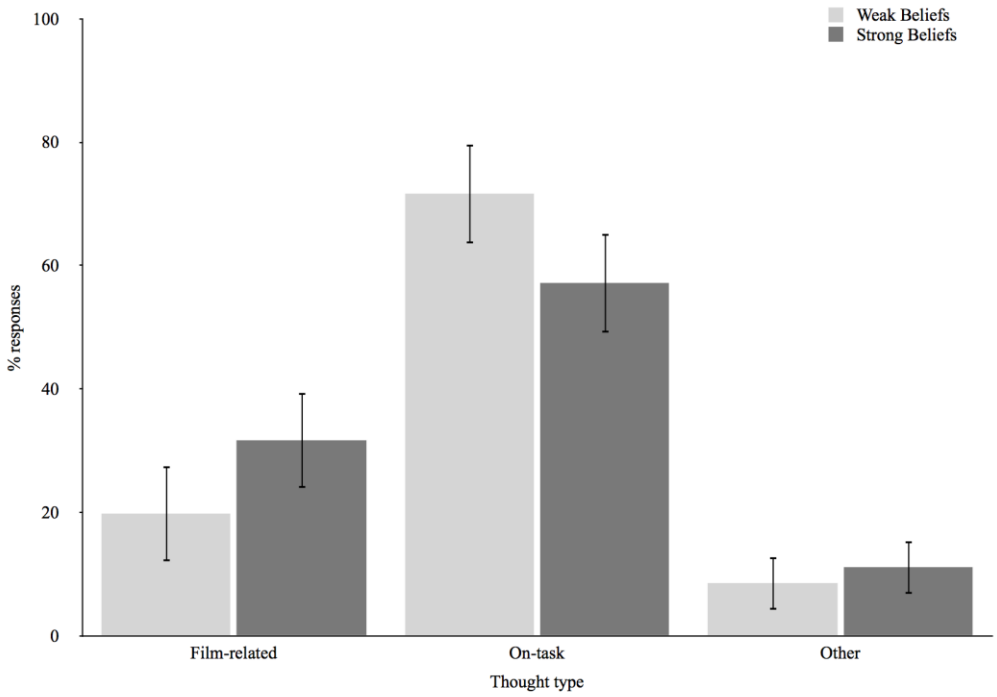

Figure 1. Frequency of probe-responses by beliefs group (error bars are 95% CIs)

We also expected that people with strong beliefs have pre-existing characteristics that make them more likely to experience trauma analogue intrusions both with and without meta-awareness. Thus we next examined group differences on our baseline measurements of proneness to intrusive cognition, thought suppression, combined measure of depression, anxiety and stress, and—for those participants who had reported exposure to a traumatic event (n=130; 85%), post-traumatic stress symptoms[3]. These analyses appear in Table 1. There were no significant effects of experimental condition on these outcome measures, with the exception of WBSI.[4] As expected, compared to participants with weak beliefs, participants with strong beliefs reported higher levels of unpleasant and general intrusive cognition on the PICS and

FITS. Similarly, they were more likely to make an effort not to think about unpleasant experiences and generally tended to avoid unwanted thoughts. Finally, they reported more mood and anxiety symptoms on the DASS-21, and more PTSD symptoms.[5] We expected participants with strong beliefs might also differ in how they reacted to experienced intrusions. Indeed, as shown in Table 1, people with strong beliefs reported more distress in relation to experienced intrusions, and they tried harder to suppress film related intrusions. These results are consistent with previous research showing dysfunctional beliefs are associated with symptoms of PTSD, depression and anxiety, and suppression of unwanted intrusions (Bahceci et al., 2014; Bennett, Beck & Clapp, 2009; Broadbent & Nixon, 2007; Tolin, Worhunsky & Maltby, 2006; Williams & Moulds, 2008).

Finally, participants not exposed to probes were more accurate on the reading comprehension test than participants who were exposed to probes. However, unlike previous research, among the self-caught-plus-probes participants, task accuracy was not significantly correlated with how often people reported being on-task to probes (r=.19, 95% CI [-.04, .40], p=.10).[6] Further, self-catching more intrusive thoughts significantly decreased task performance for participants in the self-caught-plus-probes (r=-.27 [-.47, -.05], p=.02) but not the self-caught-only (r=-.20 [-.41, .03], p=.09) condition, though there was no significant difference between these correlations, Z=-.45, p=.66 (Cohen & Cohen, 1983). These data suggest that the presence of probes, and the number of self-caught intrusions, were both detrimental to reading comprehension. However, when we split the data by beliefs group, the relationship between self-caught thoughts and task accuracy was only evident for those with strong (r=-.33 [-.52, -.11], p<.01), not weak, beliefs (r=-.04 [-.27, .19], p=.77), though again there was no significant difference between these correlations,

Z=-1.82, p=.07. Thus, people with strong beliefs possibly ruminate more and become more vigilant to the presence of intrusions than do people with weak beliefs; directing attention towards scanning for intrusions rather than reading would obviously affect comprehension.

Our data replicate and extend prior research (Baird et al. 2013; Takarangi et al., 2014) by demonstrating that there are individual differences in the experience of intrusive thoughts with and without meta-awareness. People with strong beliefs about the need to control intrusive thoughts self-caught more intrusions, and reported a higher proportion of intrusions without meta-awareness, compared to those with weak beliefs. In other words, people with strong beliefs experience more intrusive cognition both with and without meta-awareness.

Given that unhelpful interpretations of symptoms is implicated in PTSD development, it is not surprising that strong beliefs participants also exhibit higher levels of psychopathology and maladaptive coping strategies. Indeed, it could be that past experiences and symptoms contribute to the development of unhelpful beliefs. We opted therefore, not to account for these between-group differences in our main analyses, since doing so would essentially remove the differences based on our pre-selected beliefs groups. Of course, our findings in relation to self-caught and probe-caught intrusions *are* likely attributable to these underlying differences between groups. That is, our data suggest that people with strong beliefs are at risk of more intrusive cognition relating to trauma *because* they have a general proneness to involuntary thoughts, are bothered by and try harder to suppress unwanted thoughts—which we know can be associated with the rebound of those very thoughts—and because they have high rates of other symptoms that are associated with intrusive phenomena. Consequently, participants with strong beliefs appraise intrusions as

negative and unwanted, drawing negative conclusions about themselves and the world that lead to a dysphoric mood and unhelpful rumination (Bennett & Wells, 2010; Roussis & Wells, 2006). Why then did we opt to measure beliefs in particular? Because we think it is those beliefs about how to manage thoughts—and the maladaptive strategies for controlling thoughts that arise from these beliefs—that could be important to meta-awareness even if what underlies the beliefs is the extent and severity of PTSD symptoms (and/or depression, anxiety, etc). However, future research should test these causal mechanisms experimentally, or use a correlation/regression design to determine the most important contributing variables.

Our findings have theoretical, methodological and clinical implications. First, our data are consistent with theoretical models proposing that people who attempt to establish control over their intrusive thoughts also tend to engage in maladaptive strategies such as suppression to minimize distress, and therefore may enact these strategies when confronted with a new—here, analogue—trauma (Ehlers & Clark, 2000; Wells, 2000). The higher frequency of self-caught intrusions among our strong beliefs participants implies there may be a rebound effect of using such strategies, due to a failure in the thought 'control' mechanism when suppression consumes cognitive resources (Wegner, 1994). Further, these processes, combined with a more active monitoring process, may result in an increase in intrusions that fail to reach awareness, as well as those that people self-catch.

Importantly then, our findings suggest that some proportion of intrusive cognition is present without sufferers being meta-aware of it. This lack of meta-awareness could heighten anxiety—which would make new trauma cues more distressing—and cause distress when the intrusion does break through to meta-awareness. This process, combined with existing maladaptive coping strategies, is likely to maintain people's

intrusions and distress because they are being sensitized to the trauma as an ongoing threat, rather than being explicitly aware they can be exposed to the cues and not be harmed.

Clinically, intrusions experienced without meta-awareness may have a unique impact on psychological problems. A person with PTSD who re-experiences intrusive cognition without meta-awareness may be unable to apply adaptive coping strategies and thus cannot emotionally process the trauma. In relation to control beliefs, a person with strong beliefs may be at higher risk of persistent intrusions and ultimately, PTSD, following a trauma (e.g., Bryant & Guthrie, 2005). By understanding the characteristics associated with failures in meta-awareness, and mechanisms that bring intrusions into awareness, we may be able to modify treatments to address potentially treatable, yet sometimes inaccessible cognitions. Future research could examine whether meta-awareness improves following existing PTSD treatments.

From a methodological point of view, experience-sampling methods may produce more reliable information about the full range of thoughts about trauma. Examining and differentiating intrusion experiences with and without meta-awareness may determine underlying cognitive mechanisms of differentiated intrusion development.

This study has several key limitations. To reduce the possibility that participants might be biased to respond affirmatively to a yes/no question about their thoughts (as in Takarangi et al., 2014; see Weinstein & De Lima, 2015), we gave participants several options, including an "other" category to capture participants' task-unrelated thoughts about something other than the traumatic film. However, we cannot rule out responses based on perceived demand. Second, the probes likely caught some unwanted thoughts that, given sufficient time, would have reached awareness. Although we instructed participants to self-report all film-related thoughts that they

noticed, we cannot rule out instances where intrusions defined as "probe-caught" actually reflect the non-reported (but meta-aware) continuation of a previously self-caught thought. Thus, it is possible that our classification of probe-caught thoughts as intrusions that had not reached meta-awareness might over-estimate the proportion people are experiencing without meta-awareness. Nonetheless, recent data (Green, Strange, Lindsay & Takarangi, 2016; Skurray, Foster, Strange & Takarangi, 2016) suggest that this situation accounts for some, but not all, intrusions defined as lacking meta-awareness, and that participants *do* sometimes explicitly report lacking awareness prior to the probe, when asked directly.

Third, it is possible that some thoughts about the film were not experienced as 'intrusive' but rather involved mind wandering to thoughts of the film, deliberate attempts to process the film's content, or rumination about the film. We did not give our participants a suppression instruction, but they had a clear task set, so we considered non-related mental content to be intruding upon that task. Although typically when the term 'intrusion' is used in the clinical field, it is understood to be associated with distress, that is not always the case. Nevertheless, we examined data from the EIS subscales (responses ranged from 0-4), which showed that, on average, participants experienced their film-related thoughts as moderately distressing (M=2.00, SD=1.20) and unpredictable (M=2.10, SD=1.12) and 'quite a bit' unwanted (M=2.75, SD=1.21). Indeed, the modal response to unwantedness was 4=extremely. These data suggest that the thoughts our participants experienced in relation to the film could be classified as intrusive in both senses of the term.

Fourth, due to the constraints of examining an analogue trauma in the laboratory, we must be cautious in generalizing our findings. An important avenue for future research is to examine whether PTSD patients can have trauma-related intrusions

without being meta-aware of doing so. Finally, we focussed on participants with particular control beliefs. There are, of course, other unhelpful negative cognitions associated with PTSD (e.g., rumination) that may be important to a model of intrusive cognition that acknowledges meta-awareness.

4. Conclusions

Our findings show that meta-cognitive beliefs can influence a person's meta-awareness of their trauma-related intrusions. Specifically, people with strong beliefs about controlling thoughts are more likely to experience distressing intrusions both with and without meta-awareness compared to people with weaker beliefs. Research that examines factors that influence people's beliefs on their intrusion experience, using experience sampling, could be valuable for treatment of distressing negative intrusions that are symptomatic of psychological disorders.

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Footnotes

[1] Note that we counterbalanced responses (1) and (2)

[2] We used ESCI software (Cumming, 2012) to calculate 95% confidence intervals. However, CI calculation is not available for paired designs where the value of *d* is greater than 2.

[3] Note that 41% fell above a clinical cut-off in terms of moderate symptom severity (≥11, Foa, 1995).

[4] Here, despite random assignment, participants assigned to the self-caught-plus-probes condition were higher in their general tendency to avoid unwanted thoughts, compared to participants in the self-caught-only condition. We separately analyzed the influence of condition on self-reported intrusions, controlling for WBSI. Consistent with the original analysis, participants in the self-caught-only condition self-caught more thoughts than participants in the self-caught-plus-probes condition, $F(1, 147)=12.50$, $p<.01$, $\eta_p^2=.08$ [95% CI: .02, 17].

[5] Note that among people who reported experiencing a traumatic event, people with strong beliefs reported thinking about this event more recently (1=within the last year, 6=within the last 24 hours; $M=3.70$, $SD=1.74$) and more frequently within the previous 6 months (1=less than once a month, 6=several times per day; $M=2.54$, $SD=1.59$), than people with weak beliefs ($M=3.00$, $SD=1.71$, $t(126)=2.30$, $p=.02$; $M=2.03$, $SD=1.59$, $t(126)=2.01$, $p=.05$ respectively). The distress associated with experiencing these thoughts was not significantly different by beliefs group (1=none, 6=extreme; $M_{strong}=3.44$, $SD=1.06$; $M_{weak}=3.09$, $SD=1.16$, $t(127)=1.82$, $p=.07$)

[6] Note that in correlations with self-caught intrusions, we controlled for overall time spent on the reading task.

Table 1

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

	Self-caught-only		Self-caught-plus-probes				
	Weak beliefs *M* [95% CIs]	Strong beliefs *M* [95% CIs]	Weak beliefs *M* [95% CIs]	Strong beliefs *M* [95% CIs]	Beliefs group, *F*(1, 147) η_p^2 [95% CIs]	Condition, *F*(1, 147) η_p^2 [95% CIs]	Interaction, *F*(1, 147) η_p^2 [95% CIs]
Film unpleasantness	8.84 [8.31, 9.37]	9.03 [8.50, 9.55]	8.53 [8.00, 9.05]	9.30 [8.77, 9.83]	3.25 .02 [.00, .09]	<1	1.20 .01 [.00, .06]
Distress from film	6.78 [5.99, 7.58]	7.74 [6.95, 8.52]	6.40 [5.61, 7.18]	7.54 [6.75, 8.34]	6.90** .05 [.00, .13]	<1	<1
Proneness to Intrusive Cognition (PICS)	4.78 [3.89, 5.68]	5.58 [4.70, 6.46]	3.76 [2.88, 4.65]	5.66 [4.78, 6.54]	9.02** .06 [.01, .14]	1.11 .01 [.00, .06]	1.50 .01 [.00, .06]
FITS	31.60 [29.97, 33.22]	33.50 [31.90, 35.10]	32.00 [30.40, 33.60]	34.97 [33.37, 36.58]	9.01** .06 [.01, .14]	1.34 .01 [.00, .06]	<1
Thought Suppression (TSS)	3.81 [2.93, 4.69]	5.74 [4.87, 6.61]	4.26 [3.39, 5.13]	5.84 [4.97, 6.71]	15.73*** .10 [.03, .19]	<1	<1
WBSI	44.40 [41.01, 47.80]	55.00 [51.65, 58.35]	46.95 [43.60, 50.30]	59.84 [56.44, 63.23]	47.36*** .25 [.13, .35]	4.68** .03 [.00, .10]	<1
DASS-21	12.51 [8.37, 16.66]	24.68 [20.60, 28.77]	13.76 [9.67, 17.85]	27.54 [23.40, 31.68]	38.80*** .21 [.10, .32]	<1	<1
Post-traumatic stress symptoms (PDS)[a]	7.30 [4.06, 10.55]	16.35 [12.88, 19.81]	6.77 [3.62, 9.92]	15.46 [12.21, 18.70]	28.61*** .19 [.08, .30]	<1	<1
Attention to film	8.30	8.32	7.90	7.92	<1	2.19	<1

	[7.76, 8.84]	[7.79, 8.85]	[7.36, 8.43]	[7.38, 8.46]		.02 [.00, .07]	
Adherence to intrusion instructions	7.66	7.87	6.92	7.21	<1	3.49	<1
	[6.90, 8.42]	[7.14, 8.60]	[6.19, 7.65]	[6.48, 7.94]		.02 [.00, .09]	
Reading comprehension accuracy	0.57	0.60	0.53	0.46	<1	7.00**	1.84
	[0.51, 0.64]	[0.53, 0.67]	[0.46, 0.60]	[0.37, 0.53]		.05 [.00, .13]	.01 [.00, .07]
Reading difficulty	2.41	2.63	2.71	2.84	1.14	2.38	<1
	[2.08, 2.74]	[2.31, 2.96]	[2.39, 3.04]	[2.51, 3.17]	.01 [.00, .06]	.02 [.00, .08]	
Reading interest	1.76	1.92	1.71	1.68	<1	<1	<1
	[1.34, 2.17]	[1.51, 2.33]	[1.30, 2.12]	[1.27, 2.09]			
Distress at intrusions	4.76	5.95	4.16	5.37	6.20*	1.49	<1
	[3.79, 5.72]	[5.00, 6.90]	[3.21, 5.11]	[4.42, 6.32]	.04 [.00, .12]	.01 [.00, .06]	
Experience of Intrusions (EIS)	11.79	13.30	10.88	13.17	5.59*	<1	<1
	[9.97, 13.61]	[11.83, 14.76]	[9.35, 12.41]	[11.66, 14.68]	.04 [		
Suppression attempt	5.73	7.55	6.34	6.40	3.95*	<1	3.52
	[4.79, 6.68]	[6.62, 8.48]	[5.41, 7.27]	[5.47, 7.32]	.03 [.00, .10]		.02 [.00, .09]

Note: *p<.05, **p<.01, ***p<.001. [a] DF = (1, 126)