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Linguistic processing and Script-Driven Imagery for trauma exposure: A proof of concept pilot trial

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ABSTRACT

While several empirically supported treatments for posttraumatic stress disorder (PTSD) have been developed, these treatments are neither widely available nor universally efficacious. This pilot, proof of concept study evaluated a computerized imaginal exposure Script-Driven Imagery Training (SDI-T) for individuals with elevated trauma reactivity. The training was supplemented with two forms of linguistic processing, affect labeling (SDI-T + AL) and distraction (SDI-T + D), to determine whether linguistic inhibitory regulation augmented the effects of SDI-T.

Methods: Participants ($n = 64$) with trauma-related distress were randomized to SDI-T, SDI-T + AL, or SDI-T + D. Physiology and self-reported trauma distress were measured at pre- and post-training.

Results: The training was acceptable to participants and effective at reducing self-reported distress ($d = -0.41$), and physiological activation from pre- to post-training ($d = -0.49$, ps $< .01$), with some evidence that linguistic processing (SDI-T + AL and SDIT-T + D) conferred a benefit over SDI-T. The linguistic processing groups had significantly steeper reduction in physiology relative to the non-linguistic processing group ($p < .05$, $d = 0.59$). There was no benefit of SDI-T + AL over SDI-T + D.

Conclusions: This pilot study provides initial support for the acceptability and efficacy of computerized imaginal exposure training for PTSD. Clinical implications and future directions are discussed.

1. Linguistic processing and script-driven imagery for trauma exposure: a proof of concept pilot trial

Posttraumatic Stress Disorder (PTSD) is a chronic and impairing disorder that affects 7–12% of the general population, some of whom suffer for upwards of 50 years or longer (Gold et al., 2000; Gradus, 2017). Fear conditioning provides a useful model for understanding the development and maintenance of PTSD (Mahan & Ressler, 2012). In short, non-biologically significant stimuli (conditional stimuli; CS) are associated with a biologically significant traumatic experience (unconditional stimuli; US) that causes significant physical or emotional pain (unconditional response; UR). Through fear conditioning, an excitatory CS-US association forms wherein the CS predicts the likelihood of US occurrence. Subsequently, fear and avoidance (conditional responses; CR) develop. Extinction may be achieved through presentation of the CS in the absence of the US, an experimental analogue of exposure therapy, allowing for the formation of an inhibitory (CS - no US) association (Craske, Liao, Brown, & Vervliet, 2012).

Deficits in extinction learning are found in individuals with PTSD compared to traumatized and non-trauma-exposed healthy controls (Jovanovic et al., 2010). Twin studies have demonstrated that such deficits are specific to combat-exposed individuals with PTSD compared to non-exposed monozygotic twins (Milad et al., 2008), suggesting that they may be an after-effect of, rather than a familiar risk factor for, PTSD. Moreover, long-term PTSD maintenance is presumed to be due in part to continued avoidance of the CS, especially memories of the trauma (Karamustafalioglu et al., 2006), preventing the formation of inhibitory associations.

Several cognitive behavioral therapies (CBT) have been developed and empirically supported for PTSD (Cusack et al., 2016), including prolonged exposure therapy (PE; Foa, Hembree, & Rothbaum, 2007) and cognitive processing therapy (CPT; Resick & Schnicke, 1992). These treatments involve psychoeducation, exposure to the trauma memory, and cognitive processing or restructuring with varying

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degrees of emphasis. Direct comparisons of these treatments have revealed few outcome differences in either PTSD or depression symptoms, though both outperform waitlist control groups (Cusack et al., 2016).

CBT for PTSD has medium effect sizes (Hedges' $g = 0.62$, 95% $CI = 0.28–0.96$; Hofmann & Smits, 2008) on continuous self-report measures compared to placebo. However, despite the overall efficacy of CBT for PTSD, some patients receiving CBT improved minimally or not at all (Bradley, Greene, Russ, Dutra, & Westen, 2005; Loerinc et al., 2015). In one meta-analysis, 53% of CBT completers did not experience clinically significant improvement (Bradley et al., 2005). A systematic review reported treatment response rates that ranged from 28 to 88% (mean response rate = 59%) depending on the methods employed to evaluate response (Loerinc et al., 2015). In addition to limits on effectiveness, logistical barriers prevent the widespread dissemination and adoption of CBT for PTSD. For example, despite programs like the PTSD Mentoring Program, PTSD Consultation Program, and the rollout of CPT and PE in the U.S. Department of Veterans Affairs (VA; Karlin et al., 2010), many patients remain without adequate care even within the VA. A survey of PTSD-focused VA clinics revealed that providers continue to spend between 25–50% of their time providing supportive counseling rather than evidence-based PTSD treatment, particularly in under-staffed clinics (Finley et al., 2015). Furthermore, a large proportion of trauma survivors are not eligible for benefits through the VA, and community clinicians rarely offer exposure-based treatments for PTSD (van Minnen, Hendriks, & Olff, 2010). Technology assisted options are becoming increasingly available and promising (Knaevelsrud & Maercker, 2007), though these options typically still require the presence of a supportive therapist. Clearly, there is a need for accessible and effective treatments that can be disseminated in a wide variety of contexts, justifying the further development of technology-administered treatment protocols.

1.1. Script-Driven Imagery

Script-Driven Imagery is an assessment strategy for retrieving and assessing reactivity to trauma memories (Rauch et al., 1996). The procedure entails listening to a personalized audio-recorded description of a traumatic event for 30 s, followed by imagining the event in detail for 30 s, and a recovery period for 60 s prior to the next script presentation. Individuals with PTSD show a greater increase in heart rate and electromyography (EMG) startle reflex (Shin, Orr, & Carson, 2004), and increased limbic activation when listening to trauma relative to neutral scripts (Rauch et al., 1996). Further, significant reductions in physiological activation are detected after completing PTSD treatment (Hoge et al., 2012).

While Script Driven Imagery was developed as an assessment tool, it also acts as an abbreviated form of imaginal exposure to trauma memories. If repeated exposure to brief Script-Driven Imagery trials reduces reactivity to traumatic images, then it could be a more efficient and easily disseminated form of imaginal exposure compared to current gold-standard treatments which typically prescribe 9–12, 60–90 minute sessions. The goal of the current study was to collect pilot data on using Script-Driven Imagery as a method for reducing trauma reactivity.

1.2. Affect labeling

Affect labeling has gained support as an adjunctive component for exposure therapies to fear-provoking stimuli. While affect labeling initially pertained to labeling the emotional content of a stimulus (Lieberman, Inagaki, Tabibnia, & Crockett, 2011), two studies have evaluated the clinical utility of affect labeling of emotional experiences during exposure to feared spiders or public speaking situations (Kircanski, Lieberman, & Craske, 2012; Niles, Craske, Lieberman, & Hur, 2015). In the context of trauma exposure, affect labeling might involve verbalizing an emotional response by saying words such as "disgust," "shame," or "sad" during exposure trials. Research consistently demonstrates that verbalizing one's emotional experience results in an attenuation of negative affect (Pennebaker, 1997). One mechanism of action of affect labeling is increased activation of the right ventrolateral prefrontal cortex (rvlPFC) that in turn appears to exert inhibitory influences over the amygdala (Lieberman et al., 2007).

Affect labeling is comprised of several elements, the first being linguistic processing relative to non-linguistic cognitive tasks. In non-clinical samples, affect labels (a form of linguistic processing) paired with evocative images enhanced rvlPFC and attenuated amygdala activation compared to matching images according to similar facial expressions, gender, or shape (all non-linguistic processing), or exposure to evocative images only (Lieberman et al., 2007, Hariri, Bookheimer, & Mazziota, 2000). Labeling during exposure versus either matching images or exposure to images alone reduced neural activation in fear-related regions (i.e., the amygdala) and physiology in healthy controls (Hariri, Mattay, Tessitore, Fera, & Weinberger, 2003; Tabibnia, Lieberman, & Craske, 2008, study 1). Similar effects have emerged in clinical samples. In a study of public speaking anxiety, those who engaged in labeling during a speech performance had significant physiological reductions from exposure to later test during recovery from a speech task compared to those who engaged in a matching task (Niles et al., 2015). Similarly, in two different studies of spider phobia, linguistic processing plus exposure to either a live spider or images of a spider outperformed exposure alone (Kircanski et al., 2012; Tabibnia et al., 2008, study 2). Thus, across several studies in healthy and clinical samples, linguistic processing outperforms non-linguistic processing.

The second element involved in affect labeling is the emotional nature of linguistic processing. Across multiple studies in healthy control participants, affect labels outperformed non-affect labels in regulating neural activation while viewing emotional stimuli (Gorno-Tempini et al., 2001; Lieberman et al., 2007). Similar results have emerged in clinical samples. In the social anxiety study described above, affect labels outperformed a non-affect match task (Niles et al., 2015). Greater use of anxiety labels was associated with steeper physiological declines from exposure training to later test in anticipation of a speech task (Niles et al., 2015). In spider phobia, Kircanski et al. (2012) randomized participants to one of four groups: exposure to a live tarantula alone, exposure plus affect labeling, exposure plus reappraisal, and exposure plus distraction. Affect labeling outperformed the other conditions in terms of physiology and outperformed the non-emotional distraction condition in terms of behavioral approach when participants were re-tested with a novel spider in a novel context. As with Niles et al. (2015), participants who verbalized more words related to fear and anxiety experienced a significantly greater reduction in skin conductance arousal. Thus, beyond general linguistic processing, affect labeling appears to reduce subsequent emotional responding to evocative stimuli. However, these effects have not been investigated in trauma-exposed samples.

This pilot study examined the therapeutic effects of repeated Script-Driven Imagery alone and augmented with two linguistic processing variants, namely affect labeling and distraction (a control comparison), following procedures outlined by Kircanski et al. (2012). As Script-Driven Imagery has never been used as a standalone intervention, we recruited a sample of pilot participants with trauma exposure and at least mild PTSD distress to examine the feasibility and safety of the procedure. First, we hypothesized that participants across all experimental conditions would experience significant within-subject reductions in self-reported distress and physiological arousal from baseline to post-Script-Driven Imagery training. Second, we tested whether linguistic processing improved self-reported distress or physiological reactivity relative to no linguistic processing by comparing both linguistic processing groups (affect labeling and distraction) to Script-Driven Imagery alone. Consistent with prior research (Hariri et al., 2003), we hypothesized that linguistic processing would outperform Script-Driven Imagery alone in physiological arousal but not self-reported distress. Third, we tested whether the emotional content of linguistic processing