A TRANSLATIONAL STUDY OF THE MECHANISMS OF EXPOSURE THERAPY FOR OBSESSIONS: GRADUAL VS. VARIABLE EXPOSURE INTENSITY

Ryan J. Jacoby

A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for a degree of Doctor of Philosophy in the Department of Psychology and Neuroscience (Clinical Psychology).

Chapel Hill
2016

Approved by:

Jonathan Abramowitz

Donald Baucom

David Penn

Stacey Daughters

Daniel Bauer

ABSTRACT

Ryan J. Jacoby: A Translational Study of the Mechanisms of Exposure Therapy for Obsessions: Gradual vs. Variable Exposure Intensity
(Under the direction of: Jonathan S. Abramowitz)

Despite the efficacy of exposure and response prevention (ERP) for OCD, patients who primarily experience obsessions are at heightened risk of attenuated outcomes and relapse. The current study sought to translate laboratory research on inhibitory learning to the use of ERP for primary obsessions, with the ultimate aim of maximizing outcome and reducing the need for follow-up services for this group of at-risk patients. Although preliminary research suggests that learning to tolerate varying levels of fear during exposure therapy enhances long-term outcomes for some anxiety-related problems, no previous studies have examined this in the treatment of obsessions. In the current study, 30 participants with a moderately distressing obsessional thought were randomly assigned either: (a) the gradual exposure condition (EXP-G), emphasizing fear reduction, or (b) the variable exposure condition (EXP-V), emphasizing variability in exposure intensity (EXP-V). Both groups completed four twice-weekly exposure sessions in which subjective and physiological indices of fear were collected. Clinical interview, self-report, and behavioral outcome measures were evaluated by an independent assessor at pre-treatment (PRE), post-treatment (POST), and 1-month follow-up (1MFU). Both the EXP-G and EXP-V interventions were associated with significant decreases in interview, self-report, and behavioral measures of fear from PRE to POST, with no significant differences in PRE/POST changes between the two groups. Furthermore, there was no significant return of fear for either

group from POST to 1MFU. Variability in subjective and physiological fear did not predict treatment outcomes, which is in contrast to previous studies suggesting benefits of variability in fear level during exposure for other anxiety-related problems. These results indicate that random/variable exposure warrants future study to better understand the mechanisms, moderators, and implications of this novel approach.

Key words: Exposure therapy, Obsessive Compulsive Disorder, Fear Hierarchy, Variability, Heart Rate, Skin Conductance

ACKNOWLEDGEMENTS

` First are foremost, I would like to thank Dr. Jonathan Abramowitz for his endless guidance, enthusiasm, and support throughout the course of this project. I cannot thank him enough for the freedom he gave me to pursue my research interests, and the guidance he provided me along my developmental trajectory in becoming an independent investigator. I would also like to thank my committee members Drs. Donald Baucom, David Penn, Stacey Daughters, and Daniel Bauer for their study design and data analysis suggestions, thoughtful questions, and supportive feedback. Additionally, thank you to the undergraduate research assistants (Dana Mansfield, Siobhan Hsu, Mackenzie Brown, Nina Notman, and Sarah Jessup) who served as independent evaluators and thus without whom this project would not have been possible. Additionally, thank you to Addie Jeffs and Jeremiah Hartsock for their careful attention to detail in data entry. I am also very grateful to my labmates Lillian Reuman and Shannon Blakey for their time and enthusiasm while I brainstormed research ideas, for their support and suggestions while I practiced my proposal and defense, and for cheering me on along the way. Finally, thank you to my family, including Patrick Crownover, for their continued love and support as I completed this educational milestone.

The research described in this paper was supported in part by grants from the Association for Behavioral and Cognitive Therapies (ABCT Graduate Student Research Grant) and the American Psychological Association (APA Dissertation Award).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

1MFU	1-month Follow-up
AR	First-order Autoregressive Parameter
ASDC	Anxiety and Stress Disorders Clinic
BAT	Behavioral Approach Test
BDI-II	Beck Depression Inventory
BIC	Bayesian Information Criterion
BSH	Between-session Habituation
CBT	Cognitive Behavioral Therapy
CEQ	Credibility/Expectancy Questionnaire
CS	Conditioned Stimulus
CSQ	Client Satisfaction Questionnaire
DOCS-UT	Dimensional Obsessive-Compulsive Scale–Unacceptable Thoughts
EPT	Emotional Processing Theory
ERP	Exposure and Response Prevention
EXP	Exposure
EXP-G	Gradual Exposure Condition
EXP-V	Variable Exposure Condition
HR	Heart Rate
IE	Independent Evaluator
IFA	Initial Fear Activation
III-31	Interpretation of Intrusions Inventory
ILT	Inhibitory Learning Theory

ISD	Intra-individual Standard Deviation
IU	Intolerance of Uncertainty
MINI	Mini-International Neuropsychiatric Interview
MLM	Multi-level Modeling
OCD	Obsessive Compulsive Disorder
POST	Post-Treatment
PRE	Pre-Treatment
ROF	Return of Fear
SCID	Structured Clinical Interview for the Diagnostic and Statistical Manual for Mental Disorders
SCL	Skin Conductance Level
SUDS	Subjective Units of Distress Scale
UNC-CH	University of North Carolina at Chapel Hill
US	Unconditioned Stimulus
UT	Unacceptable Thoughts
WSH	Within-session Habituation
Y-BOCS	Yale-Brown Obsessive Compulsive Scale

A TRANSLATIONAL STUDY OF THE MECHANISMS OF EXPOSURE THERAPY FOR OBSESSIONS: GRADUAL VS. VARIABLE EXPOSURE INTENSITY

To date, exposure and response prevention (ERP; Abramowitz, 2006; Foa, Yadin, & Lichner, 2012) is the most efficacious psychological treatment for obsessive compulsive disorder (OCD; Abramowitz, 1996; Eddy, Dutra, Bradley, & Westen, 2004; Foa et al., 2005; Olatunji, Davis, Powers, & Smits, 2012) outperforming control treatments (e.g., relaxation) on primary OCD symptom measures with a large effect size (Olatunji et al., 2012). Meta-analytic reviews conclude that approximately 69% of patients experience a clinically significant improvement in OCD symptoms upon completion of a therapeutic course of ERP (Eddy et al., 2004). Despite the success of this treatment, however, a substantial percentage of patients (14-31%) are classified as non-responders (Foa et al., 2005; Norberg, Calamari, Cohen, & Riemann, 2008). Furthermore, of those who respond, up to 50-60% experience at least partial relapse (i.e., significant worsening of symptoms at a later follow-up assessment; Craske & Mystkowski, 2006; Eisen et al., 2013; Simpson, Franklin, Cheng, Foa, & Liebowitz, 2005).

Patients who primarily experience obsessions (sometimes referred to as "pure obsessionals") are especially likely to have attenuated outcomes (Alonso et al., 2001; Christensen, Hadzi-Pavlovic, Andrews, & Mattick, 1987; Mataix-Cols, Marks, Greist, Kobak, & Baer, 2002; Rufer, Fricke, Moritz, Kloss, & Hand, 2006; Williams et al., 2014). Individuals with this presentation of OCD often meet criteria for the OC subtype involving unacceptable obsessional thoughts, images, urges, or doubts regarding sex, immorality, religiosity, or harm, along with subtle mental rituals, neutralizing, reassurance-seeking, and avoidance behavior

(Abramowitz, Taylor, & McKay, 2009). Given that absolute certainty can never truly be attained about some of these matters (e.g., "Am I a good person?" or "Is God upset with me?"), plus the relative ease and frequency with which mental rituals can be enacted (e.g., without the therapists' awareness), these individuals tend to experience heightened daily distress and attenuated responses to treatment (Williams et al., 2011; Williams, Mugno, Franklin, & Faber, 2013). Thus, enhancing ERP outcomes for this impervious manifestation of OCD represents a strong unmet need.

The majority of clinical research on ERP, including investigations addressing the treatment of primary obsessions, has emphasized maximizing treatment outcome in the short-term (i.e., therapy efficacy); however, investigations aimed at maximizing the *long-term* effectiveness of ERP and reducing patient need for follow-up services (i.e., relapse prevention) are necessary. In addition, it is important to not only determine whether ERP is efficacious, but also to better understand the *mechanisms of change* by which patients with obsessions improve, as understanding these mechanisms can lead to maximizing the long-term effectiveness of this treatment approach.

Recently, the mechanisms of exposure have been questioned, as researchers (e.g., Craske et al., 2008) are contending that the long-standing and widely accepted idea that exposure works by breaking conditioned fear responses via habituation (i.e., Emotional Processing Theory, EPT) is at odds with laboratory research on *fear extinction*—the learning process that occurs during exposure therapy (Eelen, Hermans, & Baeyens, 2001; Eelen & Vervliet, 2006; Hermans, Craske, Mineka, & Lovibond, 2006). Specifically, this research shows that rather than "breaking" fear-based connections (as was traditionally proposed), exposure therapy leads to the learning of *new* non-threat (i.e., inhibitory) associations that compete with older threat associations. An important

aim of exposure therapy, therefore, is to promote the encoding and long-term recall of the newly learned non-threat connections so that they inhibit fear-based learning; a process termed "inhibitory learning". The current study, therefore, sought to translate laboratory findings on inhibitory learning to exposure therapy for obsessions in order to ultimately improve ERP for this especially at-risk group. I will first review the theorized mechanisms of change in ERP by discussing the traditional EPT and its limitations, and contrasting this model with laboratory research supporting inhibitory learning theory (ILT) approaches to exposure. Next, I will summarize research aiming to optimize inhibitory learning and long-term treatment outcome for anxiety disorders by maximizing exposure variability (i.e., varying the intensity of exposures). Finally, I will describe how the current study aims to extend this work to individuals with primary obsessions.

Theoretical Mechanisms of Change in ERP

Emotional Processing Theory (EPT). Emotional processing theory (EPT; Foa, Huppert, & Cahill, 2006; Foa & Kozak, 1986; Foa & McNally, 1996), has traditionally been the dominant theoretical model for explaining improvement during ERP. This theory suggests that in order to be effective, exposure must activate a "fear structure" and then "information provided during therapy must…be incompatible with the pathological elements in the [fear] structure" (Foa & McNally, 1996, p. 332). This incompatible information is theorized to become integrated via "corrective learning," such that non-fear based elements replace (Foa & Kozak, 1986), or compete with (Foa et al., 2006; Foa & McNally, 1996), fear based associations.

According to EPT, *habituation of fear* (Groves & Thompson, 1970; Lader & Mathews, 1968; Watts, 1979) is a critical index of change in ERP and has been considered evidence that learning is taking place. Habituation is a short-term non-associative sensory effect resulting in

one's "decreased response to repeated stimulation" (Groves & Thompson, 1970, p. 419) such that one's "original reaction towards the stimulus diminishes in intensity or even disappears" (Eelen et al., 2001, p. 251). Thus, patients who experience habituation of anxiety are expected to respond less fearfully to anxiety-related stimuli over time. There are a variety of ways in which habituation can be quantified. Specifically, Lang's three-systems approach suggests that fear reactions are made up of three response symptoms: *verbal* (i.e., self-report quantification of anxiety level using the Subjective Units of Distress scale, SUDS; Wolpe, 1973), *behavioral* (e.g., observable avoidance), and *physiological* (e.g., heart rate [HR] and skin conductance [SC]).

Accordingly, therapists operating from an EPT framework use reductions in patient distress within and between exposure sessions as indicators of successful treatment outcome. Specifically, Foa and colleagues proposed that there are three indicators of emotional processing that predict successful outcomes in exposure therapy: (1) *initial fear activation* (IFA; peak fear level during an exposure minus baseline fear level before exposure began), (2) *within-session habituation* (WSH; peak fear level during an exposure minus ending fear level), and (3) *between-session habituation* (BSH; peak fear level during an exposure minus peak fear level during the subsequent exposure). Foa further suggests that between-session habituation is dependent on within-session habitation, and thus is the basis for longer-term learning.

This focus on habituation has several implications for the traditional delivery of exposure therapy for obsessions. First, when providing the rationale for ERP, therapists explain that "anxiety does not last forever but instead it decreases over time" (i.e., WSH; Foa et al., 2012, p. 94) and that "after repeated exposure practice, such situations will no longer make you feel as uncomfortable as they once did" (i.e., BSH; Foa et al., 2012, p. 150). Second, therapists determine the length of the session based on the time to habituation; specifically, exposures can

be terminated once habituation occurs (Foa et al., 2012). Third, therapists take a hierarchical approach to planning exposures in order to facilitate BSH, such that treatment begins with exposures of moderate intensity (e.g., provoking SUDS in the 40-50 range) and systematically progresses up the fear hierarchy until more intense (i.e., anxiety-provoking) exposures are accomplished. Thus, the importance of WSH and BSH as indicators of treatment success is embedded in: (a) the treatment rationale, (b) the implementation of exposure, and (c) longer-term treatment planning. Indeed, therapists are warned that "patients who fail to habituate during exposure would be expected to profit little from therapy" (Foa & Kozak, 1986, p. 30).

Questioning habituation as an indication of learning. Although habituation *usually* occurs during exposure sessions (Grayson, Foa, & Steketee, 1982; Grey, Sartory, & Rachman, 1979; Parkinson & Rachman, 1980; Sartory, Rachman, & Grey, 1977; Watson, Gaind, & Marks, 1972), the literature examining habituation as a predictor of exposure therapy outcome is overwhelmingly mixed (For a comprehensive review, see Craske et al., 2008). For example, although some studies demonstrate that WSH is predictive of better treatment outcome (Foa et al., 1983; van Minnen & Hagenaars, 2002), many additional studies have found no relationship (Baker et al., 2010; Jaycox, Foa, & Morral, 1998; Kozak, Foa, & Steketee, 1988; Meuret, Seidel, Rosenfield, Hofmann, & Rosenfield, 2012). Additionally, one study that examined the inter-relationship between WSH and BSH found no significant association (Baker et al., 2010), challenging EPT's tenant that WSH is a necessary prerequisite of BSH and thus longer-term change. Other studies demonstrate that successful response to exposure can occur in the *absence* of habituation (e.g., Rachman, Craske, Tallman, & Solyom, 1986; Rowe & Craske, 1998; Tsao & Craske, 2000). In summary, these investigations suggest that habituation is not necessarily evidence of "corrective learning" and is not a reliable predictor of outcome for the treatment of

anxiety. Thus, therapists may be over-relying on habituation as an indicator of patient improvement since decline in anxiety during exposure *may* occur, but this decline is not *necessary* for optimal long-term outcome.

Consequences of over-reliance on habituation. In addition to these findings that habituation may be an unreliable predictor of treatment success, over-reliance on fear reduction may also have various unintended negative consequences for the lessons patients take from exposure therapy (Abramowitz & Arch, 2014). First, emphasizing the importance of habituation of anxiety during exposure may foster a continued "fear of fear," implying that lower levels of anxiety are "safer" or "easier to tolerate" than higher levels. This might also amplify anticipatory anxiety about items reserved for later in treatment (i.e., at the top of the fear hierarchy). Second, if immediate fear-reduction is the primary treatment goal, patients may end up using exposures as a means of *controlling* their anxiety rather than learning that anxiety itself is not threatening and can be managed (Craske, Liao, Brown, & Vervliet, 2012). Finally, as a result of over-reliance on habituation, patients might interpret surges of high anxiety following treatment as a sign of failure, meaning that one instance of return of fear may lead to a full relapse (Abramowitz & Arch, 2014; Craske et al., 2008). This is particularly problematic in the case of treating obsessions since these types of intrusive thoughts are ubiquitous experiences (e.g., unwanted thoughts about harm; Abramowitz, 2006) and often intrude abruptly without identifiable evoking stimuli (Lee & Kwon, 2003); thus, unexpected surges of anxiety are especially likely. Although short-term success often appears to be achieved relying on habituation, therefore, these various lessons patients learn when therapists emphasize fear reduction may problematically attenuate longer-term retention of treatment gains.

The New Theory of Disuse: Fear expression vs. fear learning. In addition to these theories that habituation may be a deceptive (and perhaps problematic) index of change, Bjork and Bjork's (1992, 2006) *New Theory of Disuse,* provides *empirical* evidence that an emphasis on in-session performance (i.e., habituation) is misleading for understanding long-term exposure treatment outcome. This work applies lessons from basic research on learning and memory to exposure therapy for anxiety disorders. In explaining how humans store and recall information from memory, Bjork and Bjork distinguish between *retrieval strength* and *storage strength*. First, when learned associations are not continually accessed (i.e., with "disuse"), their absolute and relative *retrieval strength* (i.e., the amount of information an individual can access from memory at a given moment in time or "performance") will lessen over time until these associations are no longer accessible. This process is adaptive, so that items that are not being actively used are not interfering with other items in memory (e.g., the name of your kindergarten teacher when you are a senior in college).

On the other hand, once *storage strength* is accumulated (i.e., how "entrenched" or "inter-associated" items are in memory and thus how well a piece of information has been "learned") it can never be lost, and these associations are readily re-learnable should they become important again (i.e., if the original environmental, interpersonal, emotional, or situational cues associated with the information are reinstated). Thus, learned associations remain in memory even with disuse (i.e., the memories themselves don't fade; but *access* to them does). Again, this process is adaptive because following a change in context the original learning may become applicable again (e.g., if you returned to visit your elementary school). With anxiety disorders, however, this persistence of learned associations and fearful responding can be

problematic, as the original fear-based associations that remain in memory (even with disuse) leave individuals vulnerable to relearning and relapse following exposure therapy.

Based on these distinctions between retrieval capacity (i.e., performance in the session) and storage strength (i.e., long-term learning generalized to real-world contexts), therefore, treatment should be designed to optimize storage strength of new non-fearful responding (vs. focusing on retrieval strength). However, Bjork and Bjork (2006) argue that exposure therapists incorrectly assume that performance during exposure trials (i.e., habituation) is predictive of long-term learning. Accordingly, they may favor treatment techniques that facilitate performance in the session (e.g., systematic and gradual exposure to foster habituation) versus methods that maximize the long term encoding and generalization of storage strength (as described in the sections that follow).

Fear extinction and inhibitory learning theory. In contrast to habituation of fear, which is a non-associative process representative of performance during a session, *fear extinction* is a form of associative learning in which patients repeatedly confront fear-eliciting stimuli (i.e., conditioned stimulus, CS) in the *absence* of an aversive unconditioned stimulus (US), with the desired result being the reduction of expectancies about the likelihood and severity of feared consequences (i.e., one no longer expects the US to follow the CS; Eelen et al., 2001; Myers & Davis, 2007; Rescorla, 2001; Vansteenwegen, Dirikx, Hermans, Vervliet, & Eelen, 2006). The ultimate therapeutic goal is for patients to alter their behavior as a result of these new expectancies. For example, consider the case of Cindy who experiences unwanted intrusive thoughts and impulses that she may one day stab her spouse with a knife when she is cooking. To allay her uncertainty, she engages in mental rituals (e.g., assuring herself "I'm a good wife") and avoids anxiety-provoking triggers (e.g., knives). During fear acquisition, Cindy

learned the contingency between knives (i.e., the CS) and experiences of anxiety and uncertainty (i.e., the US). During exposure therapy (i.e., extinction), she would practice confronting knives and thoughts about stabbing her partner (i.e., the CS) without the US (i.e., she learns that anxiety and uncertainty are more tolerable that she thought and that being near knives is not as dangerous as she expected).

A mechanism that has been proposed to explain the process of extinction is *inhibitory learning theory* (ILT; Lang, Craske, & Bjork, 1999; Myers & Davis, 2007; Rescorla, 2001). According to ILT, the original excitatory threat (CS-US) association learned during fear acquisition is not erased or replaced by the new non-threat (CS-noUS) inhibitory associations learned during extinction (i.e., exposure therapy). Rather, the CS becomes an *ambiguous* stimulus with two opposite meanings, which both remain in memory and compete for retrieval (e.g., Bouton, 1993; Bouton & King, 1983; Rescorla, 1996, 2001). That these original fear-based associations remain is demonstrated by the fact that fear can return following successful exposure therapy, which will be discussed in the following section.

Return of fear. *Return of fear* (ROF; Rachman, 1979, 1989) refers to "reappearance of fear that has undergone partial or complete extinction" (Rachman, 1989, p. 147). When ROF occurs, the patient has recovered the original stimulus-response association, and his or her fear returns to a higher level than was demonstrated at the end of extinction (for reviews see: Craske & Mystkowski, 2006; Hermans et al., 2006; Vervliet, 2008).[1] There are three ways in which previously extinguished fear responses might reappear.

[1]Importantly, this concept refers to a heightened response to a single presentation of a stimulus (Rachman, 1989), but an instance of ROF can also contribute to a complete clinical *relapse* in which distress and functional impairment result.

First, *spontaneous recovery,* refers to the fact that fear of the CS can return with the passage of time in the absence of further training (Baum, 1988; Pavlov, 1927; Quirk, 2002). The process of memory regression suggests that when we learn something new (e.g., unwanted thoughts of stabbing a loved one are not necessarily dangerous), this newer learning is most accessible immediately following the learning process (Bjork & Bjork, 1992). If this newer learning is not continually practiced (i.e., with disuse) it becomes less and less accessible, while the original fear learning (i.e., unwanted stabbing thoughts are dangerous) becomes progressively more accessible (since it was acquired over a longer period of time and has likely generalized to multiple contexts). Thus, patients may perform well at the end of treatment, but not maintain their gains at a later follow-up assessment.

Second, *context renewal* refers to a return of fear as a result of a context change after extinction (Bouton, 2002; Bouton & Swartzentruber, 1991; Mystkowski & Mineka, 2007; Vansteenwegen et al., 2006). Specifically, when a CS (e.g., knife) is paired with a US (i.e., anxiety, uncertainty, fear) in one context during fear acquisition (e.g., the kitchen at home), and then is presented alone during extinction in a different context (e.g., the therapy room with the therapist), renewal occurs when the CS is encountered either back in the original context or in a novel context (e.g., a restaurant; Bouton, 1993; Bouton & Bolles, 1979; Bouton & King, 1983; Vansteenwegen et al., 2005). Thus, following extinction the CS has become ambiguous (i.e., it predicts both the occurrence and absence of the US), and the meaning retrieved is determined by the degree to which the extinction context matches the follow-up context (Bouton & Brooks, 1993).

Finally, *reinstatement* refers to the occasion in which unexpected (i.e., without the CS being present) presentations of the aversive US reignite fear of the previously extinguished CS

(Bouton & Swartzentruber, 1991; Dirikx, Hermans, Vansteenwegen, Baeyens, & Eelen, 2004, 2007, Hermans et al., 2005, 2005; Rescorla & Heth, 1975; Vansteenwegen et al., 2006). For example, an unexpected surge of anxiety (US) could reinstate fear-based associations and expectancies of anxiety such that individuals become once again fearful of confronting OCD-related cues (CS; e.g., knives).

Overall therefore, the fact that original fear-based associations can be uncovered by these three processes suggests that fear is not "unlearned." Thus, a challenge when implementing exposure therapy is to maximize the likelihood that the new non-threat associations will inhibit the retrieval of the threat associations (Lang et al., 1999). As a result, a new methodology of exposure is necessary that optimizes inhibitory learning (rather than emphasizes immediate fear reduction) in order to maximize long-term outcome and inoculate patients against later return of fear. One important way to maximize inhibitory learning is to vary the intensity of exposures, which will be discussed in the following section.

Optimizing Inhibitory Learning by Maximizing Exposure Variability

Theorized benefits of variability. Importantly, introducing variability into exposures serves to foster "desirable difficulties" (Bjork, 1994). Variation is a "difficulty" because it introduces challenges for the patient during exposure (as learning cues and levels of anxious arousal shift and change) and slows the rate at which fear declines in the short-term. At the same time, this is "desirable" because it results in more durable long-term learning (i.e., retention, transfer, and generalization) by introducing elements of surprise and uncertainty that patients encounter in real-world settings (Bjork, 1994). Specifically, there are three concrete benefits to introducing variability in exposure practice (Bjork & Bjork, 2006).

First, greater variability may allow more opportunities for corrective learning to occur. The Rescorla-Wagner model (Rescorla & Wagner, 1972; Wagner & Rescorla, 1972) states that we learn something new when there is a discrepancy between what we predict is going to happen (i.e., our expectancy) and what actually occurs; in other words, when we are "surprised" (Rescorla, 1988, p. 153). Based on this theory, when individuals are just beginning exposure therapy, the discrepancy between fearful predictions and reality are high (Rescorla & Wagner, 1972). For example, if Cindy were conducting an exposure to holding a knife while standing near her husband and her predictions (i.e., that she won't be able to handle the anxiety, will "fall apart," and will stab him) do not occur, this surprising experience will violate her expectations and a powerful non-threat association will be generated. Over time with repeated exposure, however, the level of surprise diminishes as individuals' expectations are modified. Accordingly, introducing elements of variability (i.e., varying exposure intensity and associated fluctuations in anxious arousal) maximizes surprise and provides patients with repeated opportunities to learn something new about the CS (by disconfirming their expectations as dramatically as possible).

Second, the more diverse the conditions under which learning takes place, the more *retrieval cues* are generated (i.e., signals that will trigger memories of the extinction learning). State-dependent learning (Bouton & Swartzentruber, 1991) suggests that extinction is specific to the physiological context, such that individuals who learn and are tested while in congruent physiological states (e.g., high anxious arousal) will have better memory of the learning phase than individuals who experience a mismatch of internal states (e.g., learning when unaroused and testing when highly aroused). These findings have been demonstrated with both anxiolytic (i.e., anxiety reducing, e.g., diazepam; Marks, Viswanathan, Lipsedge, & Gardner, 1972) and anxiogenic (i.e., anxiety inducing, e.g., caffeine; Mystkowski, Mineka, Vernon, & Zinbarg,

2003) substance-induced states. Accordingly, the experience of fluctuating fear during exposure therapy allows for a broader variety of emotions and stimuli (e.g., fear, uncertainty, obsessive thoughts) to become associated with extinction (Bouton, 2000; Bouton, Woods, & Pineño, 2004) so that non-threat associations will be more easily retrievable (Culver, Stoyanova, & Craske, 2011).

Finally, these variabilities ultimately promote a generalization of durable corrective learning, as patients discover that non-threat associations hold across a variety of emotional contexts (Craske et al., 2008, 2012). Indeed, the patient has to engage in higher order learning (i.e., analyzing, evaluating, and synthesizing vs. just memorizing or remembering) in order to combine information across contexts and develop a common strategy for handling fear cues that maximizes performance despite the variation (e.g., Bjork & Bjork, 1992, 2006; Bouton & Swartzentruber, 1991; Estes, 1955; Magill & Hall, 1990; Schmidt & Bjork, 1992). Since encounters with obsessional stimuli tend to present themselves unexpectedly and randomly in the real world, the variation more fittingly prepares patients for experiences following therapy.

Therefore, in contrast to the lessons patients may take from an exposure framework that emphasizes fear reduction and habituation (as described above), from a "desirable difficulty" approach (i.e., maximizing variability and optimizing inhibitory learning), patients ideally learn that obsessions, anxiety, and uncertainty are *opportunities* to practice managing and tolerating these internal experiences, as opposed to signs of relapse or failure. This approach may serve to inoculate patients against ROF. Indeed, whether an unexpected increase in anxiety following treatment (i.e., a *lapse*) leads to a more permanent return of symptoms (i.e., a *relapse*) may depend on the degree to which the patient has learned to *tolerate* anxiety (i.e., obsessional thoughts, and uncertainty) during exposure (Abramowitz & Arch, 2014).

As previously mentioned, individuals with obsessions may *especially* benefit from exposures maximizing surprise and variability in order to practice fear tolerance, since these types of intrusive thoughts often intrude abruptly without identifiable evoking stimuli (Lee & Kwon, 2003). Furthermore, individuals with the unacceptable thoughts dimension of OCD (i.e., obsessing and mental neutralizing) tend to demonstrate high levels of *intolerance of uncertainty* (IU; Abramowitz & Deacon, 2006; Holaway, Heimberg, & Coles, 2006; Jacoby, Fabricant, Leonard, Riemann, & Abramowitz, 2013; Tolin, Brady, & Hannan, 2008). IU refers to "beliefs about the necessity of being certain … and about adequate functioning in situations which are inherently ambiguous" (Obsessive Compulsive Cognitions Working Group, 1997, p. 678). Individuals who are high in IU have a lower perceptual threshold of ambiguity, find uncertainty to be distressing, believe that uncertainty is negative, think it should be avoided, and have difficulty functioning in uncertain or ambiguous situations (Buhr & Dugas, 2002; Krohne, 1993). Given the ubiquity of ambiguity and uncertainty in everyday life, individuals high in IU tend to experience heightened daily distress. Thus, it may be that individuals with obsessions would particularly benefit from interventions that maximize variability and uncertainty during exposure.

Variability of fear responding predicts treatment outcome. In support of these theories about the benefits of variability for long-term learning, research examining mechanisms of change during treatment indicates that variability of fear responding during exposure predicts superior long-term outcomes. Specifically, in samples fearful of public speaking (Culver, Stoyanova, & Craske, 2012) and contamination (Kircanski et al., 2012), variability in subjective fear (i.e., the standard deviation of SUDS ratings across exposures) predicted lower self-reported fear at follow-up testing. These finding suggest that individuals who learned to tolerate varying levels of anxious arousal during treatment experienced reduced fearful responding long-term.

Experimentally manipulating exposure intensity to optimize variability. Based on these findings, a few studies have sought to determine whether conducting exposures in a random and variable order can *experimentally* induce physiological variability and optimize long-term gains. As previously mentioned, exposures are typically conducted in a gradual (i.e., hierarchical) manner in clinical settings. Specifically, potential exposure tasks are rank-ordered according to predicted SUDS levels, and then treatment progresses by systematically working up the fear hierarchy. However, as previously discussed, there are pitfalls to this approach due to problematic over-reliance on habituation and perpetuation of "fear of fear" in patients. Therefore, instead of structuring exposures in a systematic and gradual way (i.e., to foster habituation), patients may maximally benefit from exposure designs in which random and variable practice is emphasized in order to purposely provoke physiological variability.

Indeed, preliminary research suggests that varying the intensity of exposures (and associated anxious arousal) enhances long-term outcomes relative to taking a gradual hierarchical approach for some anxiety-related problems. First, in a sample of individuals with fears of spiders, Rowe and Craske (1998) compared "constant-stimulus" exposure (in which all exposure trials were conducted with the same spider) versus "varied-stimulus" exposure using four different spiders of varying "shape, color, hairiness, quickness, and size" (p. 723). As hypothesized, individuals who received varied-stimulus exposures experienced less habituation of anxiety during the exposure trials (i.e., demonstrated worse performance) relative to the constant-stimulus exposure group, due to the fact that the exposure stimuli were constantly changing. But when both groups were presented with a familiar spider at 3-week follow-up (i.e., a spider both groups had previously seen at pre and post-assessments), the variable-stimulus group displayed *less* return of fear (i.e., improved performance) than the constant-stimulus

exposure group; thus, the varied-stimulus group benefited in the long-term from the "continual readjustment to varying stimulus information" (p. 732). Surprisingly, however, the groups did not differ in response to a novel spider at follow-up, which was contrary to hypotheses that individuals receiving varied-stimulus exposure would demonstrate generalization of non-threat learning to new stimuli and display less ROF in response to this novel spider compared to the constant-stimulus group.

The second study comparing random/variable to gradual exposure was conducted in a sample of individuals with fears of heights. The "gradual" exposure group systematically progressed up the floors of a tall building (i.e., exposure on the 2nd, 3rd, 4th floors, etc.) consistently approaching the balcony in the same manner. The "random and variable" group, however, practiced exposures to heights in a random order (e.g., 7th floor, 2nd floor, 5th floor, 10th floor, etc.) and approached the balcony in a different style at each trial (e.g., leaning on the railing vs. looking down; Lang & Craske, 2000, Experiment 1). Although the random/variable group experienced higher peak levels of fear (self-report and heart rate) during exposure itself, the varying practice resulted in lower self-report general anxiety at 1-month follow-up. However, this finding did not extend to specific fears of heights or physiological measures.

Two additional studies that have attempted to experimentally vary fear levels have failed to do so. First, in a sample of individuals fearful of public speaking, Culver and colleagues (2012) compared traditional public speaking exposure to exposure with additional hypothesized excitatory stimuli (presented either concurrently or sequentially), which were intended to enhance arousal and fear responding during exposure (i.e., a tightened workman's belt designed to cause the sensation of chest restriction and a video camera connected to a monitor on which participants could view their performance). Contrary to hypotheses, however, the excitatory

stimuli did not result in increased fear responding or differential outcomes relative to the traditional exposure group. Second, in a sample of individuals with contamination fears, Kircanski and colleagues (2012) compared long-term outcomes for groups assigned to three weekly sessions of either "consistent and gradual" exposure to contaminants (to maximize habituation) or "random and variable exposure" to maximize variability. Again however, contrary to hypotheses both groups experienced significant decreases in subjective fear, with no differing long-term findings at two-week follow-up. Thus, while these preliminary findings are intriguing, study replication is certainly needed to (a) help clarify these mixed results, (b) investigate their applications beyond circumscribed fears of spiders, heights, public speaking, and germs, and (c) determine more effective ways of experimentally manipulating variability of fear responding using random/variable exposure.

The Current Study

While this preliminary research suggests that learning to tolerate varying levels of fear during exposure therapy enhances long-term outcomes for some anxiety-related problems, no previous studies have empirically examined this question in the treatment of individuals with primary obsessions (who may especially benefit from a random/variable approach). Accordingly, with the aim of translating the laboratory research described above to help improve ERP for an especially at-risk group, the current project compared the processes and outcomes (interview, self-report, behavioral, and psychophysiological) of two brief exposure-based interventions for unwanted obsessional thoughts. The *gradual exposure condition* (EXP-G) used the conventional ERP approach (i.e., emphasizing habituation and fear reduction) such that exposure intensity was gradually increased in a hierarchical manner. In contrast, the *variable exposure condition* (EXP-

V) aimed to enhance inhibitory learning by maximizing variability in exposure intensity and corresponding physiological arousal.

The two interventions (described in the Method section below) were intentionally brief and specific in order to maximize the study's internal validity without sacrificing clinical utility. In particular, the interventions and outcome measures targeted only one of the participant's obsessional thoughts. A feature of this study is that it included objective biological measures of therapeutic mechanisms and processes (i.e., continual measures of skin conductance and heart rate during exposure trials) along with the standard self-report assessments of anxiety, for more complete understanding of fear learning. Furthermore, in order to maximize the clinical utility of these findings, experimenters aided participants in ideographic exposure stimuli selection (to maximize the experimental manipulation of variability), and provided them with a rationale for EXP (i.e., explaining how variability can introduce "surprises" that are similar to real-world settings and help individuals practice "fear tolerance"), both of which have been lacking in previous research. Importantly, presenting a rationale allows therapists to cultivate a "bring it on" attitude, in which surges of anxiety can be labeled as "wanted challenges" and "opportunities" to practice learning new inhibitory associations, as opposed being labeled as signs of failure. Clinicians have anecdotally remarked that providing a sound rationale to explain the benefits of exposure variability allows patients to understand and engage in these difficult procedures (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). However, these rationales had yet to be empirically examined in terms of credibility and acceptability.

My hypotheses were as follows: First, given the demonstrated efficacy of exposure therapy for obsessions/OCD (e.g., Olatunji et al., 2012), I expected that both EXP conditions would produce significant immediate (POST) and longer-term (1MFU) reductions in obsessional

symptoms (**Hypothesis 1**). Furthermore, due to the predicted benefits of introducing variability into exposure (e.g., Bjork & Bjork, 2006; Lang & Craske, 2000; Rowe & Craske, 1998), I predicted that individuals receiving EXP-V would demonstrate superior outcome at long-term (i.e., 1-month) follow-up relative to individuals receiving EXP-G (**Hypothesis 2**). Finally, since previous studies have found fear variability (Culver et al., 2012; Kircanski et al., 2012), but not habituation (Craske et al., 2008), to be a consistent predictor of exposure therapy outcome, I hypothesized that in both conditions, average subjective (SUDS) and physiological (HR, SC) fear variability during exposure, but not habituation , would predict outcome for the target obsessional thought (**Hypothesis 3**).

METHOD

Participants

Participants included 30 adults with a distressing unacceptable obsessional thought (i.e., about sex, immorality, religion, or harm) as determined by a structured clinical interview (described below). I elected to test my hypotheses in a non-clinical OC analog sample based on a body of research indicating that: (a) 80-99% of people in the general population experience unwanted intrusive thoughts similar in content to clinical obsessions (Belloch, Morillo, Lucero, Cabedo, & Carrió, 2004; Clark & de Silva, 1985; Rachman & de Silva, 1978; Radomsky et al., 2014; Salkovskis & Harrison, 1984), and (b) "non-clinical obsessions" and clinical obsessions are associated with the same developmental and maintenance factors (Abramowitz et al., 2014). Accordingly, the study of non-clinical intrusive thoughts has the potential to inform the mechanisms involved in the treatment of clinically severe obsessions.

Participants were recruited through the University of North Carolina at Chapel Hill (UNC-CH) Psychology Participant Pool, and received 4 hours of research credit as part of Introduction to Psychology (PSYC 101) in exchange for their participation (53.3%; $n = 16$). Participants were also recruited through the University community via informational emails, Internet advertisements (e.g., Join the Conquest), and flyers (46.7%; $n = 14$). The sample as a whole was primarily female (73.3%, $n = 22$), non-Latino (96.7%, $n = 29$), and Caucasian (70.0%, $n = 21$); 6.7% African American, 10.0% Asian, and 13.3% Biracial / Multiracial. The group's mean age was 22.97 years ($SD = 6.17$; range = 18 – 39) and the mean number of years of education reported was 15.20 ($SD = 3.63$; range = 12 - 24), suggesting that the average

participant had completed at least some college. Participants were full-time students (undergraduate or graduate; 53.3%, *n* = 16), working full-time (30.0%, *n* = 9), or both in school and working part-time (16.7%, *n* = 5). The majority of participants had never been married (76.7%, *n* = 23; 10.0% married, 3.3% divorced or separated, 10.0% other/domestic partnership). Seventy percent (*n* = 21) of the sample reported ever previously receiving psychological/psychiatric treatment, and 46.7% (*n* = 14) reported currently receiving treatment. More specifically, 26.7% (*n* = 8) of the sample reported currently taking a stable dose of psychiatric medication, 10.0% (*n* = 3) were receiving ongoing supportive psychotherapy, and 10.0% (*n* = 3) were taking both medication and receiving therapy.

Study inclusion/exclusion criteria were as follows: **Inclusion criteria**: (a) at least 18 years old; (b) willing to attend and audiotape all study sessions; (c) fluent in English; (d) presence of one or more obsessional thoughts about sex, immorality, religion, or harm (and not primarily related to another construct such as trauma, eating disorders, or generalized worry) that cause marked distress (as defined below); (e) if on a psychiatric medication (e.g., anti-depressant medication), willing to remain at a fixed dose while participating in the study (and stabilized on medication for 30 days before beginning). **Exclusion criteria**: (a) previous cognitive-behavioral therapy (CBT) for anxiety (to eliminate the possible confound of having received different messages about the rationale and methods of exposure); (b) current suicidal ideation; (c) current substance use disorder; (d) current mania or psychosis; and due to interference with psychophysiological measures: (e) currently taking an acute anxiolytic (e.g., Ativan) or stimulant (e.g., Ritalin) medication; (f) any heart, respiratory, or neurological condition; or (g) current pregnancy.

Measures

An independent evaluator (IE) blind to experimental condition administered the following outcome and process measures (see Table 1 for administration schedule).

Mini-International Neuropsychiatric Interview (MINI: Sheehan et al., 1998). The MINI is a structured diagnostic interview to determine clinical diagnoses with adequate psychometric properties and a strong correlation with the Structured Clinical Interview for the Diagnostic and Statistical Manual for Mental Disorders (SCID; Sheehan et al., 1997). The following modules were administered to determine exclusion criteria: (a) manic and hypomanic episodes, (b) suicidality, (c) alcohol/substance use disorder, and (d) psychotic disorders.

Yale-Brown Obsessive Compulsive Scale (Y-BOCS; Goodman, Price, Rasmussen, & Mazure, 1989a, 1989b). The Y-BOCS is a widely used interview measure of OCD symptoms that includes a 10-item severity scale of good reliability, validity, and sensitivity to change following treatment. The Y-BOCS checklist was administered by phone to determine the participants' most distressing intrusive thought (i.e., the thought to be targeted in the study's intervention), and any related compulsive or neutralizing behaviors. Severity ratings were assessed in person by an IE blind to experimental condition, and focused on only this thought and related compulsions. These ratings assess the severity of obsessions and compulsions on the following five parameters: (a) time, (b) interference, (c) distress, (d) resistance, and (e) control; total scores range from 0 to 40 and scores above 16 indicate clinical levels of OCD symptoms. The Y-BOCS was the primary interview outcome measure. Internal consistency of the Y-BOCS in the present sample was good ($\alpha = .84$).

Dimensional Obsessive-Compulsive Scale–Unacceptable Thoughts (DOCS-UT; Abramowitz et al., 2010). The DOCS-UT is self-report measure of the unacceptable thoughts

(UT) OC symptom dimension (i.e., the type of obsessions targeted in the current study). The measure begins with examples of representative UT obsessions (e.g., "Unpleasant thoughts about sex, immorality, or violence that come to mind against your will") and compulsions (e.g., "Mentally performing an action or saying prayers to get rid of an unwanted or unpleasant thought"). The measure then has five items (rated 0 to 4) assessing the following parameters of current UT symptom severity: (a) time occupied by obsessions and compulsions, (b) avoidance behavior, (c) associated distress, (d) functional interference, and (e) difficulty disregarding obsessions and resisting compulsive urges; DOCS-UT total scores range from 0 to 20. The DOCS has good to excellent reliability in clinical and undergraduate samples, and converges well with other OCD measures. The DOCS-UT was the primary self-report outcome measure. Internal consistency of the DOCS-UT in the present sample was good ($\alpha = .83$).

In addition, for the purposes of the present study, the first three items of the Interpretation of Intrusions Inventory (III-31; Obsessive Compulsive Cognitions Working Group, 2003, 2005) were included to gather baseline descriptive information about the UT. Specifically, participants were asked: (a) how long ago they last experienced the intrusive thought, (b) how often they experienced the intrusive thought in the last six months, and (c) the average level of distress they have when experiencing an intrusion on a scale from 0 (*None*) to 5 (*Extreme*).

Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II is a 21-item self-report scale that assesses the affective (e.g., guilt), cognitive (e.g., decision making difficulties), motivational (e.g., social withdrawal), vegetative (e.g., loss of appetite), and psychomotor (e.g., fatigue) components of depression. Total scores range from 0 to 63. Scores of 10 or less are considered normal; scores of 20 or greater suggest the presence of clinical depression. The BDI-II has excellent reliability and validity as a measure of general distress, and

is widely used in clinical research (Beck et al., 1996; Sprinkle et al., 2002; Steer, Ball, Ranieri, & Beck, 1999). Internal consistency of the BDI-II in the present sample was good (α = .89).

Behavioral Approach Test (BAT; Steketee, Chambless, Tran, & Worden, 1996). IEs blind to experimental condition administered an *in vivo* measure of participants' responses to their target obsession (i.e., discomfort, willingness to experience). Specifically, participants were asked to complete a series of increasingly difficult tasks related to their unacceptable thought: (a) Say the thought aloud, (b) Write the thought down on a piece of paper, (c) Write the thought on their hand in ink, (d) Say "I will never know for certain whether one day [the thought] might come true," (e) Say "I hope and pray [the thought] comes true." Participants were instructed to complete as many tasks as they could, and to inform the experimenter if there were any tasks they did not wish to complete because they were too difficult, thus providing a behavioral measure of task completion (0-5). Participants were also asked to report after each step if they performed a neutralizing ritual from a list of options (e.g., distracted themselves from the thought or reassured themselves it was just a thought). The number of steps participants were able to complete without performing a ritual was also calculated (0-5).

Additionally, subjective fear was monitored using the **Subjective Units of Distress Scale** (SUDS; Wolpe, 1973) on a scale from 0 (*No distress/fear/anxiety*) to 100 (*Extreme distress/fear/anxiety*). Participants provided SUDS ratings after the completion of each BAT task, as well as every 1 minute during EXP sessions. From these ratings, I calculated the mean SUDS levels across the 5 BAT tasks. Internal consistency of the SUDS ratings on the BAT was excellent (α =.92). **Skin Conductance (SC)** and **Heart Rate (HR)** were used as objective physiological measures of fearful responding (i.e., arousal) during the BAT and EXP sessions. Both SC and HR be measured using the BioPac MP150 system.

Credibility/Expectancy Questionnaire (CEQ; Devilly & Borkovec, 2000). The CEQ is a 6-item measure that divides into two subscales (3 items each). The treatment rationale credibility (CEQ-C) subscale is more cognitively based (e.g., "How logical does the therapy offered to you seem?"), and items are rated on a scale from 1 (*Not at all)* to 9 (*Very*). The treatment expectancy (CEQ-E) subscale is more emotionally based (e.g., "How much do you really *feel* that therapy will help you to reduce your symptoms?"), with one item on the aforementioned 1-9 Likert scale the other and two items rated on a scale form 0-100%. Thus, CEQ-E subscale scores are calculated by first standardizing the three items to *z*-scores before summing to create total expectancy score. The CEQ has demonstrated adequate internal consistency, and test-retest reliability in previous research (Devilly & Borkovec, 2000). It also predicts favorable CBT treatment outcomes for anxiety (Devilly & Borkovec, 2000; Newman & Fisher, 2010). Internal consistency of the CEQ subscales in the present sample were acceptable to good (α =.75-.81).

Client Satisfaction Questionnaire (CSQ; Nguyen, Attkisson, & Stegner, 1983). The CSQ is a widely used 8-item post-intervention measure of treatment satisfaction. A modified version was used in the present study to more specifically refer to the method participants learned to manage their unwanted intrusive thought (e.g., "Has the method you learned helped you to deal more effectively with your intrusive thought?"). Each item is rated using a 4-point Likert scale, with higher scores reflecting greater treatment satisfaction; total scores range from 8 to 32. In previous studies, the CSQ has demonstrated high internal consistency, as well as criterion and construct validity (Larsen, Attkisson, Hargreaves, & Nguyen, 1979; Nguyen et al., 1983). It has been used previously in studies examining patient satisfaction with exposure

therapy (Tolin, Diefenbach, & Gilliam, 2011). Internal consistency of the CSQ in the present sample was excellent (α = .92).

Procedure

Recruitment and pre-screening. Undergraduates enrolled in Psychology 101 completed the DOCS-UT as part of the Psychology Participant Pre-Screening Instrument, and individuals with the highest scores were invited to participate in the study using the confidential messaging system within the Participant Pool web-based software (SONA). Unselected community members heard about the study from flyers, email advertisements, etc. Specifically, the study was described as being about "Methods for Managing Intrusive Thoughts." Individuals were informed that during this study they would receive 4 twice-weekly 60 minute study sessions that would involve learning a strategy that may help them better manage unwanted intrusive thoughts, and that they would be re-contacted for two follow-up sessions 1- and 3-months later. Those who were interested were asked to contact the study experimenter via email and provide their first name, phone number, and availability for a 15 minute phone conversation. The experimenter then scheduled a phone screening during one of the participant's listed available times. Eighty-three participants conducted a phone screen to determine study eligibility.

In the telephone interview, the experimenter explained the study procedures and asked a series of questions that determine potential participant eligibility. Specifically, the experimenter administered the Y-BOCS checklist in order to identify and obtain a description of an unacceptable, intrusive thought that the individual found most distressing (and determine that it was not primarily related to another construct such as trauma, eating disorders, or generalized worry). The experimenter also assessed the degree of distress caused by this thought (i.e., "How distressing is it when [this thought] comes into your mind?" on a scale from 0 [*No distress*] to 8

[*Extreme distress*]) in order to identify those with "moderate" distress (i.e., score of ≥ 4; Brown & Barlow, 2014).

Of those screened, 45 participants were not eligible for the study (54%). Of those ineligible at the phone screen, 4% ($n = 2$) were not interested in participating after hearing the complete study description (e.g., since financial compensation was not provided for all study visits), 11% ($n = 5$) were not eligible due to endorsing one of the initial exclusionary screening questions (i.e., medical condition, pregnancy, previous diagnosis of bipolar disorder or schizophrenia, problematic use of substances in the last 6 months), and 9% ($n = 4$) were currently taking a psychiatric medication that was exclusionary (e.g., Ritalin). Furthermore, 62% ($n = 28$) were ineligible because they were unable to identify an unacceptable thought in line with the study definition (which was the most common reason for exclusion), and 13% ($n = 6$) reported that their unacceptable thought was only mildly distressing.

Individuals who appeared to meet initial inclusion/exclusion criteria were invited to an in-person appointment ($n = 38$; 46%). Of those scheduled, 5 cancelled before coming in for the first visit saying that they no longer could participate in the study (e.g., due to the time commitment or other personal reasons). Additionally, 3 participants were determined to be ineligible at the in-person assessment at session 1 (e.g., due to substance use problems or suicidal ideation assessed more thoroughly in person), resulting in a final sample size of 30 participants who were eligible and enrolled in the study.

Overview. All participants were tested individually in the Anxiety and Stress Disorders Clinic (ASDC) laboratory in Coker Hall. Data were collected over six sessions: (a) baseline assessment (PRE, Session 1, 60 minutes); (b) three twice-weekly exposure sessions (Sessions 2-4, 45-60 minutes), with the last exposure session followed immediately by post-assessment (POST,

30 minutes); and (c) one follow-up assessment 1-month after post (1MFU, 30 minutes). On the day of study appointments, participants were asked to comply with the following instructions due to their possible effects on physiological measures: (a) on the day of the assessment: refrain from using alcohol, recreational drugs, or any anti-anxiety, sleep, or stimulant medications, (b) for two hours prior to the session: refrain from using caffeinated or tobacco products. Table 2 includes a summary of the components of each study session.

Session 1. Following informed consent, a study experimenter confirmed the most problematic obsessional thought with the participant (identified in the phone screen and to be targeted during the study) and conducted the MINI in order to determine study eligibility. The participant also completed the BDI-II on paper. Emergency procedures were enacted if a participant endorsed suicidal thoughts on either the MINI or BDI-II (score ≥ 1 on either module). As part of this process, the experimenter conducted a direct assessment of suicidality, and immediately contacted Dr. Abramowitz as necessary. Then, the evaluator conducted the Y-BOCS severity scale (10-15 minutes). Subsequently, the participant completed several demographic (age, gender, race/ethnicity, and years of education) and self-report questionnaires (i.e., DOCS-UT) using the secure web survey program Qualtrics (10-15 minutes). Next, participants completed the BAT (described in the Measures section above).

Following these assessment procedures, a separate study experimenter took over the session from the evaluator. This experimenter randomly assigned the participant (using a random number generator) to one of the two experimental conditions: 14 received EXP-G, and 16 received EXP-V. They next provided psychoeducation about the cognitive-behavioral conceptualization of unwanted intrusive thoughts and delivered the rationale for EXP from the appropriate perspective: In EXP-G, this rationale emphasized the goal of habituation in order to

reduce obsessional fear (e.g., 50% reduction in SUDS ratings). In EXP-V, the rationale emphasized exposure to varying levels of fear in order to practice fear tolerance and maximize surprise. The experimenter and participant generated a list of nine total exposure stimuli (see examples in Table 3 that correspond to the clinical case example of Cindy described above and are based on actual participant hierarchies with similar intrusive thoughts), categorized by the intensity of distress they are anticipated to provoke (three stimuli each of mild, moderate, and high intensity). Finally, participants completed the CEQ about the credibility of the EXP rationale and their expectancies for EXP.

Sessions 2-4. When participants first arrived, they were asked about the presence (over the previous 2 hours) of a variety of health-related behaviors that are known affect physiological measures (i.e., caffeine, tobacco, drugs/alcohol, exercise, sleep, food, medications, illnesses). Only one participant endorsed consuming half a cup of coffee in the 2 hours prior to one of the three study visits.[2] Next, several electrodes filled with electrolyte gel were placed on participants' skin. Specifically, to measure SC, two electrodes were placed on the middle segment of the index and middle fingers of the participant's non-dominant hand. To measure HR, three electrodes were placed on the participant's torso (right and left collar bone and below the last rib on the left side). In order to place the HR electrodes, the experimenter first lightly abraded the skin using an abrasion gel.

After a 5 minute acclimation period allowing the electrodes to settle, a 3 minute baseline period was conducted before the exposures begin. During this time, participants read from a neutral reading comprehension passage (i.e., about discoveries in science; 8th grade reading level) and physiological data were collected to determine baseline measures of participants'

[2]Accordingly, given that the majority of participants reported refraining from these health-related behaviors, there was no need to control for these behaviors in statistical analyses.

physiological responding. SUDS levels were also recorded every 1 minute.

Each of these sessions then included three in-session exposures to the identified obsession lasting for approximately 8 minutes each (i.e., approximately 25 minutes total of exposure per session; Foa et al., 2012; Freeston et al., 1997). Three exposure-based sessions were expected to be sufficient for testing hypotheses about processes and outcome because the intervention was targeting only one obsession (i.e., one hierarchy item). In EXP-G, exposure proceeded gradually (hierarchically) from mildly, to moderately, to highly intense stimuli so that exposure intensity would gradually build between (but not within) sessions. The aim of each exposure session was habituation of distress, defined as ≥ 50% reduction in SUDS.

In EXP-V, the exposure stimuli in each session were chosen at random so that mild, moderate, and high intensity exposures could occur in any order during any of the sessions (the participant was not informed which level was coming next). This aimed to maximize (a) uncertainty, (b) variability in exposure intensity, and (c) variability in corresponding physiological arousal – each of which has been shown to facilitate inhibitory learning (Craske et al., 2008; Rescorla & Wagner, 1972). Although the experimenter tracked SUDS ratings, the emphasis was on tolerating the uncertainty and distress provoked by the randomly chosen stimuli rather than on habituation. In both conditions, the experimenter helped the participant refrain from anxiety-reducing behaviors (e.g., rituals, thought suppression). Importantly, across the three exposure sessions, the two EXP conditions involved the same *total amount* of exposure to mildly, moderately, and highly intense stimuli. This allowed us to manipulate *process,* while controlling for average exposure intensity.

Session 4 also included a discussion of relapse-prevention from the appropriate perspective. Moreover, the participant completed the post assessment immediately following the final exposure in Session 4 (see below).

Post and follow-up visits. The POST and 1MFU follow-up assessment visits were conducted by the IE who remained blind to EXP condition and included the administration of the previously described interview, self-report, and behavioral measures. At POST, the participant also complete the CSQ to rate his or her experience in the study, and at the 1MFU visit the experimenter recorded whether the participant had made any changes to his/her pre-existing psychological/psychiatric treatment. At the final visit, the participant was debriefed about the nature of the study and provided with referrals and resources in case they wished to receive treatment or further information about intrusive thoughts or OCD. Any participants who indicated that they wished to withdraw from the study prematurely were followed up with in order to determine reasons for dropout and whether they were either related to the study design (e.g., the procedures were overly anxiety-provoking) or unrelated (e.g., they were studying aboard) in order to determine the extent to which the data obtained was missing "not at random."

Reimbursement. Students received 4 hours of credit toward the research requirement of PSYC 101 for Sessions 1-4 and community members learned methods for managing intrusive thoughts at no charge. All participants received $20 compensation for attending the 1MFU visit.

Data Analytic Strategy

Data reduction. Due to the multiple subjective fear ratings (i.e., SUDS) and the continuous measurement of physiological indices of fear (i.e., SC and HR) during EXP sessions, the following data reduction calculations were made in a manner consistent with previous research (e.g., Kircanski et al., 2012): (a) Baseline Fear: average SUDS, SCL, and HR levels

during the 3 minute baseline period prior to the first EXP task of the session (before the task was described); (b) Peak Fear: highest SUDS, SCL and HR levels for each EXP session, (c) Mean Fear: average SUDS, SCL, and HR levels for each EXP session, (d) Final Fear: final SUDS rating, and mean SCL and HR levels for the final minute of each EXP session.

These values were then used to calculate the following process measures in order to evaluate the degree to which habituation and variability in emotional responding during exposure were predictors of outcome. First, within-session habituation (**WSH**) was calculated (Foa & Kozak, 1986; Foa & McNally, 1996) as peak fear minus final fear level; averaged across the 3 EXP sessions). In addition, fear variability was calculated in two ways: (a) amplitude of intra-individual fluctuations of fear (i.e., intra-individual standard deviation [**ISD**] of fear; averaged across the 3 EXP sessions), and (b) temporal dependency of intra-individual fluctuations of fear (i.e., first-order autoregressive parameter [**AR**] of fear measures; degree to which fear levels close in time are more strongly correlated than fear levels farther apart in time). This parameter was calculated by fitting a first-order autoregressive time series model to each participant's EXP data for each EXP session and extracting the autoregressive parameter for each individual to use as a predictor (averaged across the 3 EXP sessions). A low AR parameter means that an individual's data is characterized by relatively independent (i.e., variable) scores over time.

Preliminary analyses. First, descriptive statistics (means, standard deviations, and range) were computed on all variables. Second, baseline differences between groups on socio-demographic (age, gender, race/ethnicity, and years of education) and clinical (i.e., Y-BOCS, DOCS-UT, BDI-II, BAT) variables were assessed using appropriate chi-square and independent samples *t*-tests. Pearson's correlations examined the simple relationships among baseline study variables in the sample as a whole. I also examined CEQ and CSQ means to determine the

degree to which participants found EXP-G and EXP-V credible and acceptable; group differences on these measures were investigated using independent samples *t*-tests.

Primary analyses. Due to the nested structure of the data (i.e., three primary assessment time points per participant: Session 1/PRE, Session 4/POST, 1MFU), I used multi-level modeling (MLM; Raudenbush & Bryk, 2002) to address each of the hypotheses described below. MLM provides unbiased and accurate estimates of regression coefficients even in small samples (Maas & Hox, 2005), and is the recommended method for analyzing treatment outcome data (Hamer & Simpson, 2009). The model predictors included: (a) experimental condition (Level 2; EXP-G vs. EXP-V; dummy coded 0 and 1 respectively, such that a main effect of experimental condition suggests an effect of EXP-V above and beyond EXP-G), (b) EXP indices of habituation and variability of fear as defined above (Level 2; WSH, ISD, AR averaged across the 3 EXP sessions), and (c) session number (Level 1; nominally coded; i.e., making no assumptions about the time spacing in between sessions). Outcome measure included: (a) interview (i.e., Y-BOCS), (b) self-report (i.e., DOCS-UT), and (c) *in vivo*/behavioral (i.e., mean SUDS, 0-100; BAT number of tasks completed without rituals, 0-5) indices.

RESULTS

Baseline Characteristics and Group Comparisons

Clinical characteristics of unacceptable thoughts. Participants reported a variety of different unacceptable thoughts (UTs). The majority (70%, *n* = 21) identified their primary UT (i.e., the thought they found to be most distressing and thus that they targeted in the study) as having to do with violence, aggression, or harm (e.g., the impulse or image of stabbing a loved one with a sharp object). Seventeen percent of participants reported a primary UT about something immoral or uncharacteristic of them (*n* = 5; e.g., the sudden thought or impulse to yell out a derogatory comment), 3% reported a primary unwanted sexual intrusive thought (*n* = 1; e.g., the doubt having sexually objectified someone else), 3% reported a primary religious intrusive thought (*n* = 1; e.g., the doubt of having done something that might upset God), and 7% reported a primary intrusive thought that did not fall into one of the predetermined categories (*n* = 2; e.g., about needing to know and remember things). The majority of the sample reported experiencing their UT in the past week (73.4%; *n* = 22; 23.3% in the last month; 3.3% in the last 6 months). When asked how often they experience their thought in the last six months, 33.3% said once or more per day (*n* = 10; 60.0% once or more per week; 6.7% once a month). The average level of distress participants reported when experiencing an intrusion was "moderate" (*M* = 3.00, *SD* = 0.81); distress levels covered almost the entire range of the scale (range = 1-4).

EXP group comparisons on demographic variables and baseline self-report measures. First, EXP group differences in recruitment method were examined. There were no differences in the percentage of PSYC 101 versus community member participants in the two

EXP groups (percentage PSYC 101: 42.9% in EXP-G, 62.5% in EXP-V), $\chi^2(1) = 1.16$, $p = .28$. Demographic characteristics of the two EXP groups, and the results of independent samples *t*-tests and chi-square tests examining group differences, appear in Table 4. As can be seen, there were similarly no significant age, gender, race, or education differences between the two groups.

Next, I examined group mean scores on the baseline interview, self-report, and behavioral symptom measures, along with the results of independent samples *t*-tests examining group differences. Group mean scores on these symptom measures by EXP group and by time point (PRE, POST, and 1MFU) appear in Table 5. There were no significant baseline EXP group differences for any of the clinical measures: (a) Y-BOCS scores, $t(28) = -0.08$, $p = .93$, (b) DOCS-UT scores, $t(28) = 0.03$, $p = .98$, (c) BAT mean SUDS levels, $t(28) = -1.04$, $p = .31$, and (d) BAT number of steps completed without rituals, $t(28) = 0.32$, $p = .75$.

In the sample as a whole, the mean pre-treatment Y-BOCS score was moderate and slightly above the clinical cut-off of 16 (Goodman et al., 1989a, 1989b). The DOCS-UT score was slightly lower than a sample of treatment-seeking patients with OCD ($M = 9.73$, $SD = 6.20$) and yet higher than that from a group of unscreened undergraduate students ($M = 3.08$, $SD = 3.25$; Abramowitz et al., 2010). The mean BDI-II score indicated minimal/mild levels of depressive symptoms (Beck et al., 1996). All participants were able to complete either 4 or all 5 steps on the BAT at PRE; however, on average they only completed between 2 – 3 steps without performing a mental ritual or neutralization behavior (range = 0 – 5 steps). Specifically, across the 5 BAT tasks, the frequency of rituals participants employed included: no rituals performed (48%), suppression (8%), distraction (6%), neutralizing (3%), analyzing (7%), reassurance (14%), other (3%; e.g., deep breathing), or more than one ritual (10%). On average, participants experienced moderate levels of subjective distress during the BAT tasks, which was comparable

to subjective fear ratings in a previous study using a BAT for contamination fears in an analog sample (Kircanski et al., 2012).

Correlations among baseline symptom measures. Zero-order Pearson's correlations examined the simple relationships among baseline interview, self-report, and behavioral study measures in the sample as a whole and appear in Table 6. As can be seen, there was a significant, strong positive association between our clinical interview (Y-BOCS) and self-report (DOCS-UT) measures of the UT. In addition, Y-BOCS symptom severity and mean SUDS during the BAT, were each significantly, weakly negatively correlated with our behavioral measure of confronting the UT (i.e., the number of BAT tasks participants completed without performing a ritual). Specifically, the more elevated participant UT symptoms and distress during the BAT, the fewer steps of the BAT they were able to complete without ritualizing. Scores on the BDI-II were not significantly associated with any other study measures.

Group Comparisons of Treatment Credibility/Expectancy, Satisfaction, and Drop-out

Next, I examined CEQ and CSQ means to determine the degree to which participants found EXP-G and EXP-V credible and acceptable (See Table 5); group differences on these measures were investigated using independent samples *t*-tests. First, there were no differences on participant-rated credibility of the two exposure rationales, $t(28) = 0.68$, $p = .50$, or their expectancies of improvement over the course of the two interventions, $t(28) = 1.33$, $p = .20$. On average, participants in both the gradual and variable EXP groups thought the treatment rationale was between "somewhat" and "very" logical and expected to see approximately 50% reduction in their intrusive thought symptoms over the course of the study.

Similarly, there were no group differences in terms of how satisfied participants were with the exposure exercises they received, $t(24) = -0.28$, $p = .78$. Participants reported

satisfaction levels that approached those of individuals receiving a standard package of ERP in a clinical setting (*M*s = 29.00-29.92; Tolin et al., 2011). Participant free-form responses in describing their feedback regarding the interventions stated that they learned a new outlook toward their UT (e.g., that by placing undue focus on unwanted thoughts they keep coming back), that they found the techniques useful (e.g., the "scripts" as a tool to face the UT), that they plan to continue to practice the techniques, and that they saw an improvement in their quality of life.

Of the entire sample, 4 participants (13.3%) dropped out prematurely from the study; all 4 were in the EXP-G condition. Of these, 1 participant dropped after the first session (i.e., before beginning any exposure exercises) and reported that her reason for drop out was realizing the study was too much of a time commitment for her schedule. The other 3 participants dropped after Session 2 (i.e., between the first and second exposure sessions). Each stated a logistical reason for dropping (e.g., difficulty getting to the UNC campus, too many other time commitments) and 2 of the participants explicitly mentioned that the tasks were "anxiety-provoking" and induced additional "emotional stress" as another reason for discontinuing. Only one participant reported any changes in psychological/psychiatric treatment over the course of the follow-up period (he wrapped up his short-term supportive psychological treatment at Counseling and Psychological Services).

Exposure Process Characteristics

There were no EXP group differences on the duration of exposure exercises: EXP-G: 8.07 minutes (*SD* = 0.67) vs. EXP-V: 7.90 minutes (*SD* = 0.63); $t(27) = 0.73$, $p = .47$. Table 7 presents descriptive statistics for the exposure process variables for participants who completed the intervention. The SC and HR data was removed for one participant who reported that she had a diagnosis of hyperhidrosis, which led to abnormal physiological readings. Additionally, SC

data was removed for one participant who failed to display any SC reactivity across the three exposure sessions. As can be seen, participants evidenced mild to moderate subjective distress over the course of the exposure sessions. They experienced 43% reduction in their SUDS, 29% reduction in SCL, and 24% reduction in HR levels on average over the course of the exposure sessions (i.e., from peak to final fear).

Primary Analyses

For the subsequent multi-level model analyses, I compared three different options for modeling the error structures: (1) an unrestricted covariance matrix, (2) compound symmetric residuals (i.e., assuming "homoscedasticity" or constant error variance over time), and (3) autoregressive residual variance (i.e., assuming decaying correlations over time for increasingly spaced time points). I then compared values for the Bayesian Information Criterion (BIC; Schwarz, 1978) for each of the three models. The BIC is a criterion that aids in model selection and applies a penalty based on the number of model parameters such that the optimal fitted model is identified by the minimum BIC. Across the various outcome measures, modeling the residuals using compound symmetric residuals produced the lowest (i.e., preferred) BIC. Given that compound symmetric models are also the most parsimonious (and thus aid in interpretation of estimates), and since visual inspection did not suggest decaying correlations of the error variances, I elected to use the compound symmetric model in subsequent analyses.

To address hypotheses 1-2, I first fit a model with session number as a nominal, time-varying predictor and experimental condition (EXP-G vs. EXP-V) as a time-invariant predictor predicting each of the outcome measures (i.e., Y-BOCS, DOCS-UT, BAT mean SUDS, and BAT number of steps completed without a ritual). Univariate and bivariate residual distribution

plots demonstrated that the Level 1 and Level 2 residuals were normally distributed and homoscedastic and that there were no problematic trends in the data.

Hypothesis 1. First, to examine the hypothesis that both EXP conditions would produce significant immediate (POST) and longer-term (1MFU) reductions in obsessional symptoms, I used planned comparisons to examine whether the changes in each of the four outcome measures from PRE to POST and from POST to 1MFU were significantly different from zero for both the EXP-G and EXP-V groups. For the first outcome of interest, the simple contrast was significant when comparing Y-BOCS scores at PRE vs. POST for both EXP groups, $F(2, 44) = 23.65$, $p < .0001$, suggesting that Y-BOCS scores significantly changed from pre- to post-treatment. Specifically, the model estimated Y-BOCS score decreased significantly by 8.42 points from PRE to POST for the EXP-G group, $t(44) = -4.81$, $p < .0001$, and decreased significantly by 7.13 points from PRE to POST for the EXP-V group, $t(44) = -4.91$, $p < .0001$. However, the simple contrast was not significant when comparing Y-BOCS scores at POST vs. 1MFU for both EXP groups, $F(2, 44) = 0.72$, $p = 0.49$, suggesting that there was not significant return of fear in Y-BOCS scores over the follow-up period. Specifically, the model estimated Y-BOCS score did not change significantly from POST to 1MFU for the EXP-G group (model estimated change = 1.33 points), $t(44) = 0.70$, $p = .49$; or the EXP-V group (model estimated change = -1.44 points), $t(44) = -0.97$, $p = .34$.

For the second outcome, the simple contrast was similarly significant when comparing DOCS-UT scores at PRE vs. POST for both EXP groups, $F(2, 44) = 22.37$, $p < .0001$, suggesting that DOCS-UT scores significantly changed from pre- to post-treatment. Specifically, the model estimated DOCS-UT score decreased significantly by 2.93 points from PRE to POST for the EXP-G group, $t(44) = -3.93$, $p = .0003$, and decreased significantly by 3.31 points from PRE to

POST for the EXP-V group, $t(44) = -5.42$, $p < .0001$. However, the simple contrast was not significant when comparing DOCS-UT scores at POST vs. 1MFU for both EXP groups, $F(2, 44) = 2.82$, $p = 0.07$, suggesting that there was not significant return of fear in DOCS-UT scores over the follow-up period. Specifically, the model estimated DOCS-UT score did not change significantly from POST to 1MFU for the EXP-G group (model estimated change = -0.87 points), $t(44) = -1.09$, $p = .28$. The model estimated DOCS-UT score did, however, continue to decrease significantly by 1.32 points from POST to 1MFU for the EXP-V group, $t(44) = -2.11$, $p = .04$.

For the third outcome, the simple contrast was significant when comparing BAT mean SUDS levels at PRE vs. POST for both EXP groups, $F(2, 44) = 20.57$, $p < .0001$, suggesting that BAT mean SUDS levels significantly changed from pre- to post-treatment. Specifically, the model estimated BAT mean SUDS levels decreased significantly by 20.46 units from PRE to POST for the EXP-G group, $t(44) = -3.64$, $p = .0007$, and decreased significantly by 24.29 units from PRE to POST for the EXP-V group, $t(44) = -5.28$, $p < .0001$. However, the simple contrast was not significant when comparing BAT mean SUDS levels at POST vs. 1MFU for both EXP groups, $F(2, 44) = 0.09$, $p = 0.92$, suggesting that there was not significant return of fear in BAT mean SUDS levels over the follow-up period. Specifically, the model estimated BAT mean SUDS levels did not change significantly from POST to 1MFU for the EXP-G group (model estimated change = -1.53 units), $t(44) = -0.25$, $p = .80$; or the EXP-V group (model estimated change = -1.54 units), $t(44) = -0.33$, $p = .76$.

For the fourth and final outcome, the simple contrast was significant when comparing the BAT number of steps completed without performing a ritual at PRE vs. POST for both EXP groups, $F(2, 44) = 18.68$, $p < .0001$, suggesting that the number of steps completed significantly changed from pre- to post-treatment. Specifically, the model estimated BAT steps completed

without rituals increased significantly by 1.61 steps from PRE to POST for the EXP-G group, $t(44) = 4.02$, $p = .0002$, and increased significantly by 1.50 steps from PRE to POST for the EXP-V group, $t(44) = 4.60$, $p < .0001$. However, the simple contrast was not significant when comparing BAT steps completed without rituals at POST vs. 1MFU for both EXP groups, $F(2, 44) = 0.36$, $p = 0.70$, suggesting that there was not significant return of fear measured behaviorally using the BAT over the follow-up period. Specifically, the model estimated BAT steps completed without rituals did not change significantly from POST to 1MFU for the EXP-G group (model estimated change = -0.35 steps), $t(44) = -0.82$, $p = .42$; or the EXP-V group (model estimated change = -0.08 steps), $t(44) = -0.23$, $p = .82$.

Hypothesis 2. To examine the second hypothesis that individuals receiving EXP-V would demonstrate superior outcome at long-term follow-up relative to individuals receiving EXP-G, I used planned comparisons to examine whether experimental condition (EXP-G vs. EXP-V) predicted changes in each of the four outcome measures from PRE to POST and from POST to 1MFU (i.e., two-way cross-level EXP condition x time interactions). For the first outcome of interest, the simple contrast was not significant when comparing the difference between the EXP-G and EXP-V Y-BOCS changes from PRE to POST, $t(44) = -0.57$, $p = 0.57$. This suggests that the changes in Y-BOCS scores from PRE to POST were not significantly different for the two groups (model estimated difference in changes = -1.30 points). The simple contrast was also not significant when comparing the difference between the EXP-G and EXP-V Y-BOCS changes from POST to 1MFU, $t(44) = 1.15$, $p = 0.26$. This suggests that the changes in Y-BOCS scores from POST to 1MFU were not significantly different for the two groups (model estimated difference in changes = 2.77 points).

For the second outcome, the simple contrast was not significant when comparing the difference between the EXP-G and EXP-V DOCS-UT changes from PRE to POST, $t(44) = 0.39$, $p = 0.70$. This suggests that the changes in DOCS-UT score from PRE to POST were not significantly different for the two groups (model estimated difference in changes = 0.38 points). The simple contrast was also not significant when comparing the difference between the EXP-G and EXP-V DOCS-UT changes from POST to 1MFU, $t(44) = 0.44$, $p = 0.66$. This suggests that the changes in DOCS-UT scores from POST to 1MFU were not significantly different for the two groups (model estimated difference in changes = 0.45 points).

For the third outcome, the simple contrast was not significant when comparing the difference between the EXP-G and EXP-V BAT mean SUDS changes from PRE to POST, $t(44) = 0.53$, $p = 0.60$. This suggests that the changes in BAT mean SUDS levels from PRE to POST were not significantly different for the two groups (model estimated difference in changes = 3.83 units). The simple contrast was also not significant when comparing the difference between the EXP-G and EXP-V BAT mean SUDS changes from POST to 1MFU, $t(44) = 0.00$, $p = 0.99$. This suggests that the changes in DOCS-UT scores from POST to 1MFU were not significantly different for the two groups (model estimated difference in changes = 0.002 units).

For the fourth and final outcome, the simple contrast was not significant when comparing the difference between the EXP-G and EXP-V changes in BAT number of steps completed without performing a ritual from PRE to POST, $t(44) = 0.21$, $p = 0.83$. This suggests that the changes in BAT steps completed without rituals from PRE to POST were not significantly different for the two groups (model estimated difference in changes = 0.11 steps). The simple contrast was also not significant when comparing the difference between the EXP-G and EXP-V changes in BAT steps completed without rituals from POST to 1MFU, $t(44) = -0.50$, $p = 0.62$.

This suggests that the changes in BAT steps completed without rituals from POST to 1MFU were not significantly different for the two groups (model estimated difference in changes = -0.27 steps).

Calculations of effect size. Given these overall findings that changes in outcome measures were not significantly different for the two EXP groups, I next collapsed across exposure condition and examined the effect sizes of changes in the outcome measures from PRE to POST and PRE to 1MFU for the entire sample of participants who completed the study intervention (n = 26). Cohen's d calculations for paired samples (Cohen, 1988) demonstrated large effect sizes for changes in Y-BOCS scores from PRE (M = 18. 73, SD = 4.75) to POST (M = 10.88, SD = 5.19; d = 1.58) and from PRE to 1MFU (M = 10.25, SD = 5.24; d = 1.70). Similarly, there were large effect sizes for changes in DOCS-UT scores from PRE (M = 7.50, SD = 2.45) to POST (M = 4.19, SD = 2.66; d = 1.29) and from PRE to 1MFU (M = 3.00, SD = 2.45; d = 1.84) as well as for changes in BAT mean SUDS from PRE (M = 39.72, SD = 22.81) to POST (M = 18.25, SD = 16.05; d = 1.09) and from PRE to 1MFU (M = 17.07, SD = 17.78; d = 1.11) and changes in BAT steps completed without rituals from PRE (M = 2.42, SD = 1.58) to POST (M = 3.92, SD = 1.23; d = 1.06) and from PRE to 1MFU (M = 3.71, SD = 1.57; d = 0.82).

Hypothesis 3. Finally, to examine the third hypothesis that in both conditions, average subjective (SUDS) and physiological (HR, SC) fear variability during exposure, but not habituation, would predict outcome for the target obsessional thought (i.e., POST and FU average together), I fit models including: (a) session number as a time varying predictor (re-coded as 0 for POST and 1 for 1MFU), (b) pre-treatment scores and baseline fear measures (i.e., SUDS, SC, or HR measured during the 3 minute baseline period) as covariates, and (c) fear variability (ISD, AR) and within-session habituation (WSH) as the time-invariant predictors of

interest. Three separate models were run for the three types of fear measurements (i.e., SUDS, SC, and HR) for each outcome variable (i.e., Y-BOCS, DOCS-UT, BAT mean SUDS, BAT number of steps completed without performing a ritual).

For the first outcome of interest, after controlling for PRE Y-BOCS scores and baseline SUDS, the ISD, AR, and WSH SUDS values did not significantly-predict Y-BOCS scores, $ts(43) < 0.12$, $ps > .90$. Similarly, after controlling for PRE Y-BOCS scores and baseline SCL, the ISD, AR, and WSH SCL values did not significantly-predict Y-BOCS scores, $ts(39) < 1.86$, $ps > .07$. Finally, after controlling for PRE Y-BOCS scores and baseline HR, the ISD, AR, and WSH HR values did not significantly-predict Y-BOCS scores, $ts(42) < 1.58$, $ps > .12$. Null results of models with the other three outcomes (i.e., DOCS-UT, BAT mean SUDS, BAT steps completed without rituals) parallel those of the Y-BOCS, and thus the numeric results are not reported here.

DISCUSSION

While preliminary research has demonstrated that varying the intensity of exposures (and associated anxious arousal; i.e., introducing "desirable difficulties") enhances long-term outcomes relative to taking a gradual hierarchical approach for some anxiety-related problems (Lang & Craske, 2000; Rowe & Craske, 1998), no previous studies had empirically examined this question in the treatment of individuals with primary obsessions (i.e., about sex, immorality, religiosity, or harm). This is a clinically important question given: (a) predictions that patients with primary obsessions might *especially* benefit from exposures maximizing surprise and variability, since these types of thoughts often intrude abruptly without identifiable evoking stimuli (Lee & Kwon, 2003), and since (b) these individuals are particularly likely to have attenuated outcomes in response to ERP (e.g., Mataix-Cols et al., 2002; Williams et al., 2014). Accordingly, the current study sought to translate laboratory findings on inhibitory learning to exposure therapy for obsessions in order to ultimately improve ERP for this especially at-risk group.

Results from the present study indicate that, in line with my first hypothesis, both gradual and random/variable exposure led to significant reductions in obsessional symptoms as measured by interview, self-report, and behavioral measures; with large effect sizes from pre- to post-treatment and from pre-treatment to 1-month follow-up. More specifically, participants entered the present study with a mean Y-BOCS score of 19 (which is in the moderate range and above the clinical-cut off of 16) and completed treatment with a score of 11 (which is in the mild range), thus evidencing a 42% reduction in interview symptom scores (they similarly demonstrated a

44% reduction in self-report scores, 54% reduction in *in vivo* distress, as well as 62% improvement in behavioral assessments). These changes are in line with meta-analytic findings demonstrating the efficacy of ERP for OCD (Olatunji et al., 2012). Furthermore, despite the fact that individuals with primary obsessions have attenuated outcomes relative to other OCD symptom dimensions (e.g., Mataix-Cols et al., 2002; Williams et al., 2014), the present study demonstrates the potential effectiveness of exposure for obsessional thoughts; a problem once considered to be rare and "treatment-resistant" (Christensen et al., 1987).

One main caveat to this finding, however, is that in order to maximize statistical power to test hypotheses about the different methods of delivering exposure, the present study did not employ a non-active psychological control group. Thus, the effects of symptom reduction might be inflated due to non-specific components of the interventions (e.g., talking to someone about the intrusive thought, psychoeducation about unacceptable thoughts, "placebo" effects due to participant expectations of their symptoms improving) or simply the passage of time (e.g., regression to the mean). However, numerous carefully conducted randomized controlled trials provide consistent evidence that ERP outperforms control treatments (e.g., relaxation) in the treatment of OCD (Olatunji et al., 2012), and wait-list-controlled studies have more specifically demonstrated efficacy for patients with primarily obsessional thoughts (Freeston et al., 1997). Nonetheless, future replication with viable psychological control groups (e.g., stress management skills) remains warranted.

Next, despite overall significant reductions in symptoms from pre- to post-treatment, there were no significant differences in the degree of improvement (i.e., from pre- to post-treatment or post-treatment to 1-month follow-up) when comparing the two exposure groups (EXP-G vs. EXP-V). These findings are contrary to my second hypothesis that individuals

receiving EXP-V would demonstrate superior outcomes at long-term (i.e., 1-month) follow-up relative to individuals receiving EXP-G. It is, however, in line with previous null findings from studies comparing gradual versus random/variable exposure for individuals with fears of contamination (Kircanski et al., 2012). There are a variety of potential reasons as to why this primary hypothesis was not supported, which also suggest directions for future research as I discuss in turn next.

First, it is possible that conducting exposure from these two perspectives simply does not result in meaningful differences in treatment outcome. Many previous "horse race" studies that have attempted to compare ways of conducing or "framing" exposure have failed to produce significant differences in outcome (e.g., Abramowitz, Foa, & Franklin, 2003; Fedoroff & Taylor, 2001; Resick, Nishith, Weaver, Astin, & Feuer, 2002; van Balkom et al., 1994; van Oppen et al., 2010), suggesting that exposure therapy, no matter how it is packaged, is a highly effective treatment for addressing anxiety and fear. Accordingly, there may be ceiling effects that limit the detection of differential outcomes with this intervention (especially in the present non-treatment seeking sample, as will be discussed further below).

Indeed, some of the studies mentioned previously that *did* demonstrate superior long-term outcomes for random/variable exposure (e.g., Rowe & Craske, 1998) used a constant exposure condition as a comparison group (i.e., conducting exposure repeatedly to the *same* stimulus; e.g., the same spider) instead of a gradual exposure condition (i.e., working up a fear hierarchy). While constant stimulus exposure is more of a true "control" condition (since only one feared stimulus is used), it is not truly testing the question of whether random/variable exposure is superior to treatment as usual (i.e., gradual, hierarchical exposure confronting increasingly challenging stimuli). Additionally, even studies that did use a gradual exposure group (e.g., Lang

& Craske, 2000) evidenced benefits for only certain outcome measures (e.g., reduced general anxiety) but not others (e.g., no differences on more specific measures of fear or physiological indices). Accordingly, it may be that as demonstrated by the null findings from the current and previous studies (e.g., Kircanski et al., 2012), as long as participants are confronting various levels of exposure difficulty, doing so either gradually or randomly is similarly effective.

Furthermore, the fact that the current study did not find significant differences between exposure groups suggests that conducting exposures hierarchically (as is traditionally done) is sufficient, but not essential to produce significant improvement in obsessional fears. Specifically, the fact that there was no evidence that conducting exposure from a random/variable perspective is significantly better or worse than gradual exposure still speaks to the fact that it may not be *harmful* to conduct exposure utilizing this approach. Indeed, clinicians have anecdotally expressed concerns that patients might be "unwilling" or "unable" to engage in random/variable exposure therapy due to high levels of fear and avoidance. Prior to the present study, research had not yet investigated the extent to which a random/variable approach would be feasible and appear credible to participants with anxiety and obsessional thoughts.

To this end, participants in the two exposure conditions in the present study expressed no differences in the credibility of the treatment rationales (i.e., fear reduction vs. fear tolerance), and both expected to see substantial reductions in their obsessional symptoms over the course of the intervention. Previous studies (Arch, Twohig, Deacon, Landy, & Bluett, 2015; England et al., 2012) have also demonstrated that participants perceived rationales for exposure to be similarly credible when presented according to a variety of empirically-derived theoretical perspectives (and these rationales were seen as more credible compared to a basic definition of exposure without a theoretical explanation). Thus, it may be that as long as a convincing rationale is

provided, the specific theoretical explanation does not significantly impact exposure credibility. Furthermore, in the present study there were no differences in participant satisfaction with the exposure intervention they received, with comparable satisfaction levels to individuals receiving a standard package of ERP in a clinical setting (Tolin et al., 2011). These findings, therefore, provide preliminary evidence contrary to concerns that random/variable exposures would seem unappealing or even intolerable to those participating, at least in comparable samples with moderate distress.

A second explanation for the present findings is that while varying the intensity of exposures enhances long-term outcomes relative to the conventional gradual hierarchical approach for some more circumscribed anxiety-related problems (e.g., phobias; Lang & Craske, 2000; Rowe & Craske, 1998), differentiating between these two exposure approaches is practically challenging with more complex and heterogeneous problems such as obsessions/OCD. In contrast to phobias in which feared consequences are fairly immediate, specific, and triggered by known stimuli (e.g., "I'm scared the dog will bite me"), OCD requires adaptation of exposure to a variety of different feared consequences that vary from the immediate (e.g., "I won't be able to stand the feeling of uncertainty about whether something bad has happened to my mother"), long-term (e.g., "Thinking about stabbing my spouse will cause me to lose control and commit this act one day"), and even unknowable (e.g., "What if I go to hell because I had a blasphemous thought?"). Fears also vary in terms of whether the unwanted consequences are directed toward oneself (e.g., "What if I suddenly "snap" and harm myself?") versus toward others ("What if I blurt out an offensive derogatory comment?"). And, as previously mentioned, these types of obsessional fears often intrude abruptly without identifiable evoking stimuli (Lee & Kwon, 2003). Hence, the many ways variability can be induced within the session becomes complex,

and individuals may not even be aware of all these possible factors and that they should be considered as ways to vary the exposure stimuli.

Along these lines, one potentially important factor in the current study was that in generating the exposure "hierarchy" in the gradual exposure group, participants were not always adept at anticipating which exercises would truly generate low, moderate, and high levels of anxiety. More specifically, they were often surprised by how challenging the imaginal exposure scripts were relative to other tasks (e.g., news articles or videos) since the anxiety-provoking material generated as part of these scripts was especially personal, vivid, and targeted to their own feared consequences. Thus, exposure from a gradual perspective appeared to be more "variable" than expected, such that the two exposure conditions might have been more alike than was desirable. This is in contrast to previous research with individuals with contamination fears in which low, medium, and high intensity exposure items evoked increasingly elevated levels of subjective distress (Kircanski et al., 2012). While this is a methodological challenge in the field of OCD research relative to other anxiety disorders, it is also a problem that is inherent to studying the phenomenon, and thus will be a continued challenge for future research on inhibitory learning applications to OCD.

Relatedly, BATs for intrusive thoughts are less straightforward than BATs for other more circumscribed fears such as spiders (Olatunji, Huijding, de Jong, & Smits, 2011; Woody, McLean, & Klassen, 2005), public-speaking (Amir, Weber, Beard, Bomyea, & Taylor, 2008; Culver et al., 2012), and contamination (Cougle, Wolitzky-Taylor, Lee, & Telch, 2007; Najmi, Tobin, & Amir, 2012) in which there typically is a series of rank ordered behavioral steps each increasingly difficult in magnitude (e.g., "Hold the tarantula in your hands"). Furthermore, rituals and other escape behaviors (e.g., hand washing, not holding the tarantula for the specified

duration of time) in the course of such BATs is easier to quantify. In contrast, the present BAT relied upon participants' self-report of their own mental rituals (e.g., analyzing, neutralizing) in order to determine whether a step was fully completed. Thus, the relative ease with which mental rituals can be enacted without the evaluator's awareness presents methodological challenges for behavioral assessment of primary obsessions. Accordingly, despite the fact that the items included in the BAT for the current study were effective in generating anxiety (and were correlated with OC symptom severity), there may have been a ceiling effect in terms of the number of BAT steps participants could complete (and even the number of steps completed without rituals). Given the heterogeneity of fears in OCD, future studies may wish to utilize an idiographic approach to determining potential BAT items in order to generate more possible steps for future research (Steketee et al., 1996).

Third, it may be that the differential impact of gradual versus variable exposure on obsessional symptoms in a pre-clinical (i.e., analog) sample is different than the results would be in a clinical, treatment-seeking sample. This explanation is tempered by the fact that we successfully recruited a sample of participants who were moderately distressed by their intrusive thought. Specifically, the mean Y-BOCS score in the current study was slightly above the clinical cut-off (Goodman et al., 1989a, 1989b) and the DOCS-UT score was elevated relative to a group of unscreened undergraduate students (Abramowitz et al., 2010). Furthermore, the study of non-clinical intrusive thoughts has the potential to inform the mechanisms involved in the treatment of clinically severe obsessions since non-clinical and clinical obsessions have similar content (e.g., Belloch et al., 2004; Radomsky et al., 2014), and are associated with the same developmental and maintenance factors (Abramowitz et al., 2014). Furthermore, as has been discussed by previous researchers (Vervliet, Craske, & Hermans, 2013), clinical analog (or "pre-

clinical") studies that target extinction of pre-existing fears in anxious individuals are useful for testing the application of fundamental scientific principles to real world fears (to be later translated to clinical efficacy studies).

Nonetheless, there are differences between pre-clinical and clinical samples in the implementation of exposure that may have implications for future research. For instance, it may be that the moderate level of distress participants in the current study experienced as a result of their intrusive thought was not sufficiently impairing for them to fully invest high levels of anxiety in certain exposure exercises. In contrast, those with clinical levels of anxiety may be highly motivated to tackle exercises aimed to improve their quality of life. Indeed, in the present study there appeared to be individual differences in terms of participants' effort levels in ensuring exposures were as anxiety provoking (and thus as useful) as possible. For instance, some participants appeared to be more engaged in the script-writing process such that they used more vivid descriptions of their feared consequences. Future research, therefore, may wish to code information such as the vividness of the exposure scripts as rated by either participants (e.g., on a scale from 0 = *Cannot see the image at all* to 100 = *Very vivid, feels as if it were happening now*; Rauch, Foa, Furr, & Filip, 2004), therapists, or independent evaluators in order to explore the extent to which these ratings may predict outcome.

Moreover, the current study examined the effectiveness of an intentionally brief and specific analog treatment (i.e., 4 sessions) for one target obsessional thought. While this design aimed to maximize the study's internal validity (without sacrificing clinical utility), future studies could examine the introduction of variability to a more complete package of ERP. For instance, a relevant question would be whether outcome is enhanced by not only varying levels of exposure intensity for one target thought (as in the current study), but also by varying the

target obsessional thought itself for individuals with more than one obsessional fear (e.g., related to violence/harm and also symmetry/exactness). Additionally, the current study did not involve the assignment of any homework exercises between exposure sessions (as is traditionally done in clinical settings), and future investigations could see whether encouraging participants to also incorporate variability into their exposure practice between sessions (i.e., varying exposure intensity in different environmental contexts) would demonstrate any effects. In summary, therefore, future studies should recruit samples with clinical levels of obsessional symptoms and administer more comprehensive treatments in order to better understand how these inhibitory learning models may translate to treatment-seeking individuals.

A fourth potential explanation for the lack of group differences is that the present study was underpowered. Based on previous research (Lang & Craske, 2000; Rowe & Craske, 1998), with a sample size of 15 per group, the present study has estimated power of 0.6 to detect significant group differences at the .05 level. However, from examining the mean differences in outcomes, it appears that even if sample size were increased, the magnitude of the group differences is so minimal to as not be clinically meaningful (e.g., a difference of 1-3 points on the Y-BOCS between the two groups at post-treatment and follow-up). Similarly, it could be that a 1-month follow-up period was not sufficiently long to be able to capture differential return of fear among the two exposure groups. The present study's hypotheses were that individuals in the gradual exposure group would perform well at the end of treatment, but be vulnerable to return of fear during the follow-up period. However, neither group experienced significant return of fear as measured by interview, self-report, or behavioral measures over the course of the 1-month follow-up period. At 1-month follow-up, however, participants in the EXP-G condition evidenced a 1.33 point (non-significant) increase in their Y-BOCS scores, whereas individuals in

the EXP-V group evidenced a (non-significant) 1.43 point *decrease*; thus, it could be that at a later follow-up period these scores might continue to diverge. Accordingly, future research should extend the assessment period in order to monitor return of fear for a longer period of time.

Fifth, it may be that the effect of differing exposure conditions is more subtle or nuanced than was measured in the current study. For instance, rather than having an impact on global symptom outcomes, it may be that the framing and implementation of exposure therapy influences other cognitive measures regarding beliefs about exposure. For example, several participants in the gradual exposure condition anecdotally made comments during debriefing following the high intensity exposures (i.e., session 4) that although the exposures went better than expected, they "*never*" could have done these exercises at the first session. Thus, it appears that confronting exposures gradually perpetuates beliefs about one's self-efficacy to approach feared stimuli (i.e., that one can only confront more challenging exposure tasks after achieving success during "easier" ones) that may warrant future study. Specifically, measures have been developed in previous research to examine participant perceived self-efficacy over the course of exposure therapy (e.g., using an *in vivo* scale from 0-100 during exposures or BATs; Kircanski et al., 2012). Such measures could compare changes in fear-related self-efficacy in gradual vs. random/variable exposure conditions.

Furthermore, of the participants that withdrew over the course of the exposure intervention, all four were from the gradual exposure group. While two of the participants named solely logistical reasons for leaving the study (i.e., the time commitment, difficulty getting to the UNC campus), the other two directly cited high levels of provoked anxiety as a reason for leaving the study (e.g., mentioning the "emotional stress" of the tasks) and both dropped after the first (i.e., low intensity) exposure session and before the second (i.e., moderate intensity) session.

With such a small number of participants who dropped from the study, it is not possible to make decisive interpretations of this information. However, these drops may potentially be due to treatment assignment (i.e., they are not "missing at random"), and had these participants continued in the study they may have done worse by post and follow-up than those who continued on in treatment. Accordingly, future studies should continue to assess participants who withdraw from the exposure interventions over the course of the follow-up period (to the extent that it is possible) in order to track possible return of fear.

Another related empirical question for future study is whether conducting exposure from a gradual perspective perpetuates "fear of fear" (relative to random/variable exposure) such that anxiety in anticipation of more difficult exposure sessions (e.g., moving from "mild" to "moderate" tasks) leads participants to discontinue treatment. Indeed, the challenging and anxiety-provoking nature of exposure-based techniques contributes to the fact that between 11-31% of patients drop out prematurely (e.g., Mancebo, Eisen, Sibrava, Dyck, & Rasmussen, 2011; Simpson et al., 2008; Tolin et al., 2007). Given the effectiveness of exposure, developing ways to make these techniques more tolerable and reduce patient dropout, while not compromising therapeutic integrity, is an important next step in OCD treatment research. For instance, an ecological momentary assessment approach could be utilized in which participants are asked their levels of anticipatory anxiety in real time prior to each exposure session (e.g., the day before, a few hours before, etc.) in order to examine whether these *in vivo* measures predict whether a participant will skip a session or discontinue the intervention.

Finally, there may be important moderators of treatment outcome that the current study was underpowered to measure that may differentially impact the effectiveness of these exposure treatment frameworks. For example, it may be that individuals with obsessions who demonstrate

high intolerance of uncertainty (IU) would particularly benefit from interventions that maximize variability and uncertainty during exposure. Several participants in the variable exposure group mentioned that while they found the uncertainty of not knowing which exposure exercise was coming next to be anxiety-provoking, that this was useful given how central uncertainty was to their intrusive thought. Thus, conducting exposure exercises randomly may serve to maximize levels of uncertainty during exposure therapy to confront this aversive (but ubiquitous) experience. Similarly, those with elevated anxiety sensitivity (i.e., the tendency to misconstrue benign sensations of anxious arousal as dangerous; or the "fear of fear"; Taylor et al., 2007) might benefit from variable exposure conditions in which their anxiety levels are rapidly shifting and changing. Future research utilizing larger sample sizes should examine these extent to which these baseline, trait-level variables predict who will benefit most from each exposure treatment. Accordingly, it would be advantageous for exposure therapists working with individuals with anxiety disorders to be able to "prescribe" different ways of conducting exposure (i.e., gradual vs. random/variable approaches) depending on their patients' levels of these constructs pre-treatment.

If future research were able to demonstrate a clinical benefit to conducting exposure from a random/variable perspective, this could impact the ways in which exposure therapy is delivered in clinical settings. First, as previously alluded to, it would be important to demonstrate feasibility of implementation in clinical populations. For instance, one potential adaptation of the methods in the present study would be for patient and therapist to agree in advance on a *subset* of exposure items to be randomly selected if the patient were not yet willing to confront certain items on the list. Furthermore, the fact that that there is no evidence in the present study of differential outcomes when conducting exposures out of order versus proceeding in a graduated fashion, suggests that exposures could also be selected based on life interference (i.e., values and

goals for treatment). For example, a new mother with unacceptable intrusive thoughts that one day she might "snap" and smother her newborn baby, may decide that she wants to engage in an exposure where she puts the baby down for a nap (i.e., with pillows nearby; SUDS = 85) before conducting later imaginal exposure to related words (e.g., pillow, smother, child; SUDS = 50) or news stories (e.g., about infamous criminal cases of mothers harming their children; SUDS = 70), so that she can spend time with her new baby again as soon as possible. Conducting exposures in this manner allows patient goals and values to drive the progression of treatment, introduces desirable difficulties, fosters fear tolerance, and does not over-rely on habituation of anxiety.

Additionally, an important area for future study would be to understand the mechanisms by which random/variable exposure leads to improvements in treatment outcome. For example, although a component of exposure debriefing for those in the variable exposure condition in the present study involved discussing participants' level of surprise during the exposure exercises, future studies could empirically measure the degree of participant surprise regarding the discrepancy between their predicted and actual exposure task outcomes (e.g., on a scale from 0 = *no surprise* to 100 = *extreme surprise*). Given the theoretical rationale that introducing elements of variability maximizes surprise and provides patients with repeated opportunities for corrective learning (Rescorla & Wagner, 1972; Wagner & Rescorla, 1972), measuring participant surprise levels would allow for questions of meditation (i.e., does the degree of participant surprise mediate reductions in obsessional symptom severity in the variable exposure group).

Similarly, BAT measurement at follow-up could be improved by including a generalization test in order to measure the extent to which learned skills extend to novel stimuli (e.g., Bjork & Bjork, 2006; Rowe & Craske, 1998; Schmidt & Bjork, 1992). Specifically, participants could be asked to confront a novel "step" in the post-treatment and follow-up BAT

(i.e., a "surprise" item; e.g., putting the notecard in their pocket, visualizing and verbalizing a feared scenario related to their intrusive thought; repeatedly writing the phrase "I hope and pray [the thought] comes true"). It may be that if the random/variable exposure condition allows individuals to better adapt to conditions of exposure that are shifting and changing, they may be more likely to complete these novel steps without performing a ritual.

A secondary question in the current study was the extent to which measures of habituation and fear variability predict outcome following the exposure interventions. The results of this study add to a growing body of literature that within-session habituation is not associated with clinical outcomes (Baker et al., 2010; Jaycox et al., 1998; Kozak et al., 1988; Meuret et al., 2012). Since decline in anxiety during exposure may occur, but is not *necessary* for optimal long-term outcome, therapists in real-world clinical settings may be over-relying on habituation as an indicator of patient improvement. Second, contrary to hypotheses, average subjective (SUDS) and physiological (HR, SC) fear variability during exposure did not predict outcome for the target obsessional thought. These findings are in contrast to previous studies suggesting that variability of subjective fear responding during exposure predicts superior long-term outcomes (i.e., lower anticipatory and self-reported fear at follow-up testing) in samples fearful of public speaking (Culver et al., 2012) and contamination (Kircanski et al., 2012). However, these previous results did not extend to variability in *psychophysiological* responses during exposure, suggesting that more research is needed.

In particular, one area for future research based on these discrepant findings would be to further examine the disconnect between self-reported and physiological indices of anxious arousal since longstanding work suggests that there is often a "desynchrony" (Craske et al., 2012) between subjective and physiological measures (Craske, Sanderson, & Barlow, 1987;

Gauthier & Marshall, 1977; Lande, 1982). Frequently, participants in the present study reported an increase in subjective distress during exposures, whereas their heart rate and skin conductance measures would remain level (and vice versa). Accordingly, it would be useful to know the extent to which this discrepancy is meaningful for outcome (i.e., whether there are differences in exposure outcome for individuals who experience higher subjective distress with lower physiological reactivity or vice versa) versus whether the difference is due to imperfect measurement (e.g., artifactual noise in physiological measurement).

Additionally, it may also be that subjective fear variability has greater importance for the outcomes of exposure for fears of public speaking and contamination, but does not apply to the treatment of obsessions. For instance it could be that precisely *because* individuals with primary obsessions cannot reach absolute certainty about their feared consequences and frequently experience fear cues that intrude abruptly without known triggers, that there is not much room for improvement in terms of maximizing uncertainty and variability. Future research examining variability of fear in exposure across various presenting problems could directly address this empirical question. Similarly, an additional avenue for future research would be to better understand individual-level predictors of fear variability during exposure. For instance, it may be that factors such as exposure credibility or baseline levels of distress tolerance (i.e., one's willingness or ability to experience, tolerate, and function in the context of emotional/psychological distress; Simons & Gaher, 2005) allow individuals to fully engage in the difficult tasks (thus maximizing their own fear variability). If these predictors could be identified, it may be that directly targeting such constructs could result in heighted fear variability and improved subsequent treatment outcomes.

Conclusions

In summary, the current study sought to translate laboratory research on inhibitory learning to the use of ERP for primary obsessions (i.e., sexual, violent, and immoral/religious content), with the ultimate aim of maximizing outcome and reducing the need for follow-up services for this group of at-risk patients. Specifically, I compared two frameworks for conducting exposure therapy: (a) gradual exposure (EXP-G) emphasizing fear reduction, and (b) variable exposure (EXP-V), maximizing variability in exposure intensity. Methodological strengths of the study included: (a) the use of objective biological measures of therapeutic mechanisms and processes (i.e., skin conductance and heart rate) for more complete understanding of fear learning, and (b) experimenter-aided ideographic exposure stimuli selection and delivery of a theoretical rationale for EXP to enhance clinical utility.

Both EXP interventions were associated with significant decreases in interview, self-report, and behavioral measures of fear at POST, with no significant differences in PRE/POST between the two groups. Furthermore, there was no significant return of fear for either group from POST to 1MFU. Thus, the random/variable method of exposure warrants future study to better understand the implications of this novel approach (e.g., mechanisms of change, potential moderators of outcome, etc.), and how the findings extend to studies with longer-term follow-up periods or utilizing clinical samples. Subjective (SUDS) and physiological (HR and SC) indices of fear variability did not predict treatment outcomes, which is in contrast to previous studies suggesting benefits of variability in subjective fear level during exposure for other anxiety-related problems. Investigations of the desynchrony between subjective and physiological measures of fear may be an area for future research.

TABLE 1. Administration schedule for study measures

	Session 1 PRE	Session 2	Session 3	Session 4 POST	1MFU
MINI	X				
Y-BOCS	X			X	X
DOCS-UT	X	X	X	X	X
BDI-II	X			X	X
BAT	X			X	X
CEQ	X				
CSQ				X	

Note. MINI = Mini-International Neuropsychiatric Interview; Y-BOCS = Yale-Brown Obsessive Compulsive Scale; DOCS-UT = Dimensional Obsessive-Compulsive Scale–Unacceptable Thoughts; BDI-II = Beck Depression Inventory; BAT = Behavioral Approach Test; CEQ = Credibility/Expectancy Questionnaire; CSQ = Client Satisfaction Questionnaire.

TABLE 2. Session-by-session components for the two EXP conditions

Session	EXP-G	EXP-V
1	• Assessment and identification of the target obsessional thought • Present the model of obsessions and rationale for EXP (from the appropriate perspective) • Generate the exposure list	
2	• Experimenter-supervised exposure to 3 "mild" stimuli (8 min each)	• Experimenter-supervised exposure to 3 randomly selected stimuli of varying intensity (8 min each)
3	• Experimenter-supervised exposure to 3 "moderate" stimuli (8 min each)	• Experimenter-supervised exposure to 3 randomly selected stimuli of varying intensity (8 min each)
4	• Experimenter-supervised exposure to 3 "intense" stimuli (8 min each) • Discussion of relapse-prevention	• Experimenter-supervised exposure to 3 randomly selected stimuli of varying intensity (8 min each) • Discussion of relapse-prevention

Note. EXP-G = Gradual exposure condition; EXP-V = variable exposure condition.

TABLE 3. Sample exposure list

Obsession: Unwanted thought of stabbing spouse	
Item	**Intensity**
1. The word "stab"	Mild
2. Hold a pen and imagine stabbing spouse	Mild
3. Image of garden shears	Mild
4. Image of a kitchen knife	Moderate
5. Hold scissors and imagine stabbing spouse	Moderate
6. Image of someone holding a knife in a stabbing motion	Moderate
7. Write a script about stabbing husband	High
8. Read news stories of stabbings	High
9. Write husband's obituary	High

TABLE 4. Socio-demographic characteristics of the sample by EXP group

	Total Sample $N = 30$	EXP-G $n = 14$	EXP-V $n = 16$	Test for difference
Age (years), *M* (*SD*)	22.97 (6.17)	23.79 (5.79)	22.25 (6.59)	$t(28) = 0.67$, $p = .51$
Gender, % female (*n*)	73.3% (22)	64.3% (9)	81.3% (13)	$\chi^2(2) = 1.13$, $p = .57$
Race, % (*n*) [1]				$\chi^2(1) = 0.26$, $p = .87$
African American or Black	6.7% (2)	0.0% (0)	12.5% (2)	
White or Caucasian	70.0% (21)	71.4% (10)	68.8% (11)	
Asian	10.0% (3)	7.1% (1)	12.5% (2)	
Biracial or Multiracial	13.3% (4)	21.4 (3)	6.3% (1)	
Years of Education, *M* (*SD*)	15.20 (3.63)	16.21 (3.79)	14.31 (3.36)	$t(28) = 1.46$, $p = .16$

[1] Chi-square for participant race compares percentages of white vs. non-white participants due to small sample size of certain racial groups (ns < 5).

TABLE 5. Descriptive statistics for clinical measures by EXP group and time point

	EXP-G Group			EXP-V Group		
	PRE *n* = 14	POST *n* = 10	1MFU[1] *n* = 9	PRE *n* = 16	POST *n* = 16	1MFU *n* = 15
Y-BOCS	18.29 (6.32)	10.20 (3.65)	11.33 (2.40)	18.44 (3.29)	11.31 (6.03)	9.60 (6.37)
DOCS-UT	7.21 (2.64)	4.70 (2.83)	3.78 (1.92)	7.19 (2.40)	3.88 (2.58)	2.53 (2.67)
BDI-II	8.50 (6.75)	6.44 (4.39)	5.89 (4.29)	12.81 (7.71)	12.13 (8.28)	8.07 (6.84)
BAT						
	37.43 (20.83)	12.96 (10.91)	10.46 (9.67)	45.85 (23.13)	21.56 (18.10)	21.03 (20.53)
Steps completed without rituals (0-5)	2.43 (1.56)	4.20 (1.23)	3.89 (1.27)	2.25 (1.53)	3.75 (1.24)	3.60 (1.77)
CEQ						
Credibility	18.86 (4.24)			17.88 (3.70)		
Expectancy[2]	0.71 (3.35)			-0.62 (2.13)		
CSQ		25.10 (3.98)			25.62 (4.95)	

Note. Y-BOCS = Yale-Brown Obsessive Compulsive Scale; DOCS-UT = Dimensional Obsessive-Compulsive Scale–Unacceptable Thoughts; BDI-II = Beck Depression Inventory; BAT = Behavioral Approach Test; SUDS = Subjective Units of Distress Scale; CEQ = Credibility/Expectancy Questionnaire; CSQ = Client Satisfaction Questionnaire.

[1] Two participants (one from the EXP-G and one from the EXP-V group were in the middle of their 1-month follow-up period at the time of this defense).

[2] Expectancy subscale scores have been transformed to *z*-scores

TABLE 6. Associations among baseline interview, self-report, and behavioral study measures (*N* = 30)

Measure	1	2	3	4	5
1. Y-BOCS	___	.63**	.29	.09	-.37*
2. DOCS-UT		___	.22	.09	-.29
3. BDI-II			___	.21	-.33
4. BAT mean SUDS				___	-.51**
5. BAT steps completed without rituals					___

Note. * $p < .05$; ** $p < .01$; Y-BOCS = Yale-Brown Obsessive Compulsive Scale; DOCS-UT = Dimensional Obsessive-Compulsive Scale–Unacceptable Thoughts; BDI-II = Beck Depression Inventory; BAT = Behavioral Approach Test; SUDS = Subjective Units of Distress Scale

TABLE 7. Descriptive statistics for exposure process variables for those who completed the exposure intervention.

	M (*SD*)
Baseline measures	
Mean SUDS	6.37 (6.49)
Mean SCL	4.23 (2.20)
Mean HR	84.57 (8.21)
EXP subjective measures (*N* = 26)	
Mean SUDS	27.05 (13.78)
ISD SUDS	10.60 (4.24)
Peak SUDS	46.37 (17.10)
Final SUDS	26.50 (16.65)
WSH SUDS	19.87 (10.58)
AR SUDS	0.57 (0.23)
EXP skin conductance measures (*N* = 24)[1]	
Mean SCL	5.25 (2.47)
ISD SCL	0.69 (0.29)
Peak SCL	7.71 (3.09)
Final SCL	5.41 (2.53)
WSH SCL	2.29 (1.39)
AR SCL	0.87 (0.08)
EXP heart rate measures (*N* = 25)	
Mean HR	79.61 (7.63)
ISD HR	4.34 (0.94)
Peak HR	103.49 (7.44)
Final HR	78.68 (7.70)
WSH HR	24.81 (6.40)
AR HR	0.51 (0.13)

Note. SUDS = Subjective Units of Distress Scale; ISD = intra-individual standard deviation; WSH = within-session habituation; AR = autoregressive parameter; SCL = skin conductance level; HR = heart rate.

[1] Abnormal SC data was removed for 2 participants and HR data was removed for one participant.

REFERENCES

Abramowitz, J. S. (1996). Variants of exposure and response prevention in the treatment of obsessive-compulsive disorder: A meta-analysis. *Behavior Therapy*, *27*(4), 583–600. http://doi.org/10.1016/S0005-7894(96)80045-1

Abramowitz, J. S. (2006). *Understanding and treating obsessive-compulsive disorder: A cognitive-behavioral approach*. Mahwah, NJ US: Lawrence Erlbaum Associates Publishers.

Abramowitz, J. S., & Arch, J. J. (2014). Strategies for improving long-term outcomes in cognitive behavioral therapy for obsessive-compulsive disorder: Insights from learning theory. *Cognitive and Behavioral Practice*, *21*, 20–31. http://doi.org/10.1016/j.cbpra.2013.06.004

Abramowitz, J. S., & Deacon, B. J. (2006). Psychometric properties and construct validity of the Obsessive-Compulsive Inventory-Revised: Replication and extension with a clinical sample. *Journal of Anxiety Disorders*, *20*(8), 1016–1035.

Abramowitz, J. S., Deacon, B. J., Olatunji, B. O., Wheaton, M. G., Berman, N. C., Losardo, D., … Hale, L. R. (2010). Assessment of obsessive-compulsive symptom dimensions: Development and evaluation of the Dimensional Obsessive-Compulsive Scale. *Psychological Assessment*, *22*(1), 180–198.

Abramowitz, J. S., Fabricant, L. E., Taylor, S., Deacon, B. J., McKay, D., & Storch, E. A. (2014). The utility of analogue studies for understanding obsessions and compulsions. *Clinical Psychology Review*, *34*(3), 206–217. http://doi.org/10.1016/j.cpr.2014.01.004

Abramowitz, J. S., Foa, E. B., & Franklin, M. E. (2003). Exposure and ritual prevention for obsessive-compulsive disorder: Effects of intensive versus twice-weekly sessions. *Journal of Consulting and Clinical Psychology*, *71*(2), 394–398. http://doi.org/10.1037/0022-006X.71.2.394

Abramowitz, J. S., Taylor, S., & McKay, D. (2009). Obsessive-compulsive disorder. *The Lancet*, *374*(9688), 491–499. http://doi.org/10.1016/S0140-6736(09)60240-3

Alonso, P., Menchon, J. M., Pifarre, J., Mataix-Cols, D., Torres, L., Salgado, P., & Vallejo, J. (2001). Long-term follow-up and predictors of clinical outcome in obsessive-compulsive patients treated with serotonin reuptake inhibitors and behavioral therapy. *Journal of Clinical Psychiatry*, *62*(7), 535–540. http://doi.org/10.4088/JCP.v62n07a06

Amir, N., Weber, G., Beard, C., Bomyea, J., & Taylor, C. T. (2008). The effect of a single-session attention modification program on response to a public-speaking challenge in socially anxious individuals. *Journal of Abnormal Psychology*, *117*(4), 860–868. http://doi.org/10.1037/a0013445

Arch, J. J., Twohig, M. P., Deacon, B. J., Landy, L. N., & Bluett, E. J. (2015). The credibility of exposure therapy: Does the theoretical rationale matter? *Behaviour Research and Therapy*, *72*, 81–92. http://doi.org/10.1016/j.brat.2015.05.008

Baker, A., Mystkowski, J., Culver, N., Yi, R., Mortazavi, A., & Craske, M. G. (2010). Does habituation matter? Emotional processing theory and exposure therapy for acrophobia. *Behaviour Research and Therapy*, *48*(11), 1139–1143. http://doi.org/10.1016/j.brat.2010.07.009

Baum, M. (1988). Spontaneous recovery from the effects of flooding (exposure) in animals. *Behaviour Research and Therapy*, *26*(2), 185–186. http://doi.org/10.1016/0005-7967(88)90118-0

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Corporation.

Belloch, A., Morillo, C., Lucero, M., Cabedo, E., & Carrió, C. (2004). Intrusive thoughts in non-clinical subjects: The role of frequency and unpleasantness on appraisal ratings and control strategies. *Clinical Psychology & Psychotherapy*, *11*(2), 100–110. http://doi.org/10.1002/cpp.397

Bjork, R. A. (1994). Memory and metamemory considerations in the training of human beings. In J. Metcalfe & A. P. Shimamura (Eds.), *Metacognition: Knowing about knowing.* (pp. 185–205). Cambridge, MA US: The MIT Press.

Bjork, R. A., & Bjork, E. L. (1992). A new theory of disuse and an old theory of stimulus fluctuation. In A. F. Healy, S. M. Kosslyn, & R. M. Shiffrin (Eds.), *From learning theory to connectionist theory: Essays in honor of William K. Estes* (pp. 35–67). Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.

Bjork, R. A., & Bjork, E. L. (2006). Optimizing treatment and instruction: Implications of a new theory of disuse. In L.-G. Nilsson & N. Ohta (Eds.), *Memory and society: Psychological perspectives.* (pp. 116–140). New York, NY US: Psychology Press.

Bouton, M. E. (1993). Context, time, and memory retrieval in the interference paradigms of Pavlovian learning. *Psychological Bulletin*, *114*(1), 80–99. http://doi.org/10.1037/0033-2909.114.1.80

Bouton, M. E. (2000). A learning theory perspective on lapse, relapse, and the maintenance of behavior change. *Health Psychology*, *19*(1, Suppl), 57–63. http://doi.org/10.1037/0278-6133.19.Suppl1.57

Bouton, M. E. (2002). Context, ambiguity, and unlearning: Sources of relapse after behavioral extinction. *Biological Psychiatry*, *52*(10), 976–986. http://doi.org/10.1016/S0006-3223(02)01546-9

Bouton, M. E., & Bolles, R. C. (1979). Contextual control of the extinction of conditioned fear. *Learning and Motivation*, *10*(4), 445–466.

Bouton, M. E., & Brooks, D. C. (1993). Time and context effects on performance in a Pavlovian discrimination reversal. *Journal of Experimental Psychology: Animal Behavior Processes*, *19*(2), 165–179. http://doi.org/10.1037/0097-7403.19.2.165

Bouton, M. E., & King, D. A. (1983). Contextual control of the extinction of conditioned fear: Tests for the associative value of the context. *Journal of Experimental Psychology: Animal Behavior Processes*, *9*(3), 248–265. http://doi.org/10.1037/0097-7403.9.3.248

Bouton, M. E., & Swartzentruber, D. (1991). Sources of relapse after extinction in Pavlovian and instrumental learning. *Clinical Psychology Review*, *11*(2), 123–140.

Bouton, M. E., Woods, A. M., & Pineño, O. (2004). Occasional reinforced trials during extinction can slow the rate of rapid reacquisition. *Learning and Motivation*, *35*(4), 371–390. http://doi.org/10.1016/j.lmot.2004.05.001

Brown, T. A., & Barlow, D. H. (2014). *Anxiety and Related Disorders Interview Schedule for DSM-5* (1st edition). Oxford ; New York: Oxford University Press.

Buhr, K., & Dugas, M. J. (2002). The Intolerance of Uncertainty Scale: Psychometric properties of the English version. *Behaviour Research and Therapy*, *40*(8), 931–946.

Christensen, H., Hadzi-Pavlovic, D., Andrews, G., & Mattick, R. (1987). Behavior therapy and tricyclic medication in the treatment of obsessive-compulsive disorder: A quantitative review. *Journal of Consulting and Clinical Psychology*, *55*(5), 701–711. http://doi.org/10.1037/0022-006X.55.5.701

Clark, D. A., & de Silva, P. (1985). The nature of depressive and anxious, intrusive thoughts: Distinct or uniform phenomena? *Behaviour Research and Therapy*, *23*(4), 383–393. http://doi.org/10.1016/0005-7967(85)90166-4

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). New York, NY: Lawrence Erlbaum Associates.

Cougle, J. R., Wolitzky-Taylor, K. B., Lee, H.-J., & Telch, M. J. (2007). Mechanisms of change in ERP treatment of compulsive hand washing: Does primary threat make a difference? *Behaviour Research and Therapy*, *45*(7), 1449–1459. http://doi.org/10.1016/j.brat.2006.12.001

Craske, M. G., Kircanski, K., Zelikowsky, M., Mystkowski, J., Chowdhury, N., & Baker, A. (2008). Optimizing inhibitory learning during exposure therapy. *Behaviour Research and Therapy*, *46*(1), 5–27. http://doi.org/10.1016/j.brat.2007.10.003

Craske, M. G., Liao, B., Brown, L., & Vervliet, B. (2012). Role of inhibition in exposure therapy. *Journal of Experimental Psychopathology*, *3*(3), 322–345. http://doi.org/10.5127/jep.026511

Craske, M. G., & Mystkowski, J. L. (2006). Exposure therapy and extinction: Clinical studies. In M. G. Craske, D. Hermans, & D. Vansteenwegen (Eds.), *Fear and learning: From basic processes to clinical implications.* (pp. 217–233). Washington, DC US: American Psychological Association.

Craske, M. G., Sanderson, W. C., & Barlow, D. H. (1987). How do desynchronous response systems relate to the treatment of agoraphobia: A follow-up evaluation. *Behaviour Research and Therapy*, *25*(2), 117–122. http://doi.org/10.1016/0005-7967(87)90082-9

Craske, M. G., Treanor, M., Conway, C. C., Zbozinek, T., & Vervliet, B. (2014). Maximizing exposure therapy: An inhibitory learning approach. *Behaviour Research and Therapy*, *58*, 10–23. http://doi.org/10.1016/j.brat.2014.04.006

Culver, N. C., Stoyanova, M., & Craske, M. G. (2011). Clinical relevance of retrieval cues for attenuating context renewal of fear. *Journal of Anxiety Disorders*, *25*(2), 284–292. http://doi.org/10.1016/j.janxdis.2010.10.002

Culver, N. C., Stoyanova, M., & Craske, M. G. (2012). Emotional variability and sustained arousal during exposure. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*(2), 787–793. http://doi.org/10.1016/j.jbtep.2011.10.009

Devilly, G. J., & Borkovec, T. D. (2000). Psychometric properties of the Credibility/Expectancy Questionnaire. *Journal of Behavior Therapy and Experimental Psychiatry*, *31*(2), 73–86.

Dirikx, T., Hermans, D., Vansteenwegen, D., Baeyens, F., & Eelen, P. (2004). Reinstatement of extinguished conditioned responses and negative stimulus valence as a pathway to return of fear in humans. *Learning & Memory*, *11*(5), 549–554. http://doi.org/10.1101/lm.78004

Dirikx, T., Hermans, D., Vansteenwegen, D., Baeyens, F., & Eelen, P. (2007). Reinstatement of conditioned responses in human differential fear conditioning. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*(3), 237–251. http://doi.org/10.1016/j.jbtep.2006.04.001

Eddy, K. T., Dutra, L., Bradley, R., & Westen, D. (2004). A multidimensional meta-analysis of psychotherapy and pharmacotherapy for obsessive-compulsive disorder. *Clinical Psychology Review*, *24*(8), 1011–1030.

Eelen, P., Hermans, D., & Baeyens, F. (2001). Learning perspectives on anxiety disorders. In E. J. L. Griez, C. Faravelli, D. Nutt, & J. Zohar (Eds.), *Anxiety disorders : An introduction to clinical management and research* (pp. 249–264). New York: Wiley.

Eelen, P., & Vervliet, B. (2006). Fear conditioning and clinical implications: What can we learn from the past? In M. G. Craske, D. Hermans, & D. Vansteenwegen (Eds.), *Fear and learning: From basic processes to clinical implications.* (pp. 17–35). Washington, DC US: American Psychological Association.

Eisen, J. L., Sibrava, N. J., Boisseau, C. L., Mancebo, M. C., Stout, R. L., Pinto, A., & Rasmussen, S. A. (2013). Five-year course of obsessive-compulsive disorder: Predictors of remission and relapse. *Journal of Clinical Psychiatry*, *74*(3), 233–239. http://doi.org/10.4088/JCP.12m07657

England, E. L., Herbert, J. D., Forman, E. M., Rabin, S. J., Juarascio, A., & Goldstein, S. P. (2012). Acceptance-based exposure therapy for public speaking anxiety. *Journal of Contextual Behavioral Science*, *1*(1–2), 66–72. http://doi.org/10.1016/j.jcbs.2012.07.001

Estes, W. K. (1955). Statistical theory of distributional phenomena in learning. *Psychological Review*, *62*(5), 369–377. http://doi.org/10.1037/h0046888

Fedoroff, I. C., & Taylor, S. (2001). Psychological and pharmacological treatments of social phobia: A meta-analysis. *Journal of Clinical Psychopharmacology*, *21*(3), 311–324. http://doi.org/10.1097/00004714-200106000-00011

Foa, E. B., Grayson, J. B., Steketee, G. S., Doppelt, H. G., Turner, R. M., & Latimer, P. R. (1983). Success and failure in the behavioral treatment of obsessive-compulsives. *Journal of Consulting and Clinical Psychology*, *51*(2), 287–297. http://doi.org/10.1037/0022-006X.51.2.287

Foa, E. B., Huppert, J. D., & Cahill, S. P. (2006). Emotional Processing Theory: An update. In B. O. Rothbaum (Ed.), *Pathological anxiety: Emotional processing in etiology and treatment.* (pp. 3–24). New York, NY, US: Guilford Press.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin*, *99*(1), 20–35. http://doi.org/10.1037/0033-2909.99.1.20

Foa, E. B., Liebowitz, M. R., Kozak, M. J., Davies, S., Campeas, R., Franklin, M. E., … Tu, X. (2005). Randomized, placebo-controlled trial of exposure and ritual prevention, clomipramine, and their combination in the treatment of obsessive-compulsive disorder. *The American Journal of Psychiatry*, *162*(1), 151–161. http://doi.org/10.1176/appi.ajp.162.1.151

Foa, E. B., & McNally, R. J. (1996). Mechanisms of change in exposure therapy. In R. Rapee (Ed.), *Current controversies in the anxiety disorders* (pp. 329–343). New York: Guilford Press.

Foa, E. B., Yadin, E., & Lichner, T. K. (2012). *Exposure and response (ritual) prevention for obsessive-compulsive disorder: therapist guide*. Oxford; New York: Oxford University Press.

Freeston, M. H., Ladouceur, R., Gagnon, F., Thibodeau, N., Rhéaume, J., Letarte, H., & Bujold, A. (1997). Cognitive-behavioral treatment of obsessive thoughts: a controlled study. *Journal of Consulting and Clinical Psychology*, *65*(3), 405–413.

Gauthier, J., & Marshall, W. L. (1977). The determination of optimal exposure to phobic stimuli in flooding therapy. *Behaviour Research and Therapy*, *15*(5), 403–410. http://doi.org/10.1016/0005-7967(77)90044-4

Goodman, W. K., Price, L. H., Rasmussen, S. A., & Mazure, C. (1989a). The Yale-Brown Obsessive Compulsive Scale: I. Development, use, and reliability. *Archives of General Psychiatry*, *46*(11), 1006–1011.

Goodman, W. K., Price, L. H., Rasmussen, S. A., & Mazure, C. (1989b). The Yale-Brown Obsessive Compulsive Scale: II. Validity. *Archives of General Psychiatry*, *46*(11), 1012–1016.

Grayson, J. B., Foa, E. B., & Steketee, G. S. (1982). Habituation during exposure treatment: Distraction vs. attention-focusing. *Behaviour Research and Therapy*, *20*(4), 323–328. http://doi.org/10.1016/0005-7967(82)90091-2

Grey, S., Sartory, G., & Rachman, S. J. (1979). Synchronous and desynchronous changes during fear reduction. *Behaviour Research and Therapy*, *17*(2), 137–147. http://doi.org/10.1016/0005-7967(79)90022-6

Groves, P. M., & Thompson, R. F. (1970). Habituation: A dual-process theory. *Psychological Review*, *77*(5), 419–450. http://doi.org/10.1037/h0029810

Hamer, R. M., & Simpson, P. M. (2009). Last observation carried forward versus mixed models in the analysis of psychiatric clinical trials. *The American Journal of Psychiatry*, *166*(6), 639–641. http://doi.org/10.1176/appi.ajp.2009.09040458

Hermans, D., Craske, M. G., Mineka, S., & Lovibond, P. F. (2006). Extinction in human fear conditioning. *Biological Psychiatry*, *60*(4), 361–368. http://doi.org/10.1016/j.biopsych.2005.10.006

Hermans, D., Dirikx, T., Vansteenwegenin, D., Baeyens, F., Van den Bergh, O., & Eelen, P. (2005). Reinstatement of fear responses in human aversive conditioning. *Behaviour Research and Therapy*, *43*(4), 533–551. http://doi.org/10.1016/j.brat.2004.03.013

Holaway, R. M., Heimberg, R. G., & Coles, M. E. (2006). A comparison of intolerance of uncertainty in analogue obsessive-compulsive disorder and generalized anxiety disorder. *Journal of Anxiety Disorders*, *20*(2), 158–174.

Jacoby, R. J., Fabricant, L. E., Leonard, R. C., Riemann, B. C., & Abramowitz, J. S. (2013). Just to be certain: Confirming the factor structure of the Intolerance of Uncertainty Scale in patients with obsessive-compulsive disorder. *Journal of Anxiety Disorders*, *27*(5), 535–542. http://doi.org/10.1016/j.janxdis.2013.07.008

Jaycox, L. H., Foa, E. B., & Morral, A. R. (1998). Influence of emotional engagement and habituation on exposure therapy for PTSD. *Journal of Consulting and Clinical Psychology*, *66*(1), 185–192.

Kircanski, K., Mortazavi, A., Castriotta, N., Baker, A. S., Mystkowski, J. L., Yi, R., & Craske, M. G. (2012). Challenges to the traditional exposure paradigm: Variability in exposure therapy for contamination fears. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*(2), 745–751. http://doi.org/10.1016/j.jbtep.2011.10.010

Kozak, M. J., Foa, E. B., & Steketee, G. (1988). Process and outcome of exposure treatment with obsessive-compulsives: Psychophysiological indicators of emotional processing. *Behavior Therapy*, *19*(2), 157–169. http://doi.org/10.1016/S0005-7894(88)80039-X

Krohne, H. W. (1993). Vigilance and cognitive avoidance as concepts in coping research. In *Attention and avoidance: Strategies in coping with aversiveness.* (pp. 19–50). Ashland, OH US: Hogrefe & Huber Publishers.

Lader, M. H., & Mathews, A. M. (1968). A physiological model of phobic anxiety and desensitization. *Behaviour Research and Therapy*, *6*(4), 411–421. http://doi.org/10.1016/0005-7967(68)90021-1

Lande, S. D. (1982). Physiological and subjective measures of anxiety during flooding. *Behaviour Research and Therapy*, *20*(1), 81–88. http://doi.org/10.1016/0005-7967(82)90011-0

Lang, A. J., & Craske, M. G. (2000). Manipulations of exposure-based therapy to reduce return of fear: A replication. *Behaviour Research and Therapy*, *38*(1), 1–12. http://doi.org/10.1016/S0005-7967(99)00031-5

Lang, A. J., Craske, M. G., & Bjork, R. A. (1999). Implications of a new theory of disuse for the treatment of emotional disorders. *Clinical Psychology: Science and Practice*, *6*(1), 80–94. http://doi.org/10.1093/clipsy/6.1.80

Larsen, D. L., Attkisson, C. C., Hargreaves, W. A., & Nguyen, T. D. (1979). Assessment of client/patient satisfaction: Development of a general scale. *Evaluation and Program Planning*, *2*, 197–207.

Lee, H.-J., & Kwon, S.-M. (2003). Two different types of obsession: Autogenous obsessions and reactive obsessions. *Behaviour Research and Therapy*, *41*(1), 11–29.

Maas, C. J. M., & Hox, J. J. (2005). Sufficient sample sizes for multilevel modeling. *Methodology: European Journal of Research Methods for the Behavioral and Social Sciences*, *1*(3), 86–92. http://doi.org/10.1027/1614-2241.1.3.86

Magill, R. A., & Hall, K. G. (1990). A review of the contextual interference effect in motor skill acquisition. *Human Movement Science*, *9*(3–5), 241–289. http://doi.org/10.1016/0167-9457(90)90005-X

Mancebo, M. C., Eisen, J. L., Sibrava, N. J., Dyck, I. R., & Rasmussen, S. A. (2011). Patient utilization of cognitive-behavioral therapy for OCD. *Behavior Therapy*, *42*(3), 399–412. http://doi.org/10.1016/j.beth.2010.10.002

Marks, I. M., Viswanathan, R., Lipsedge, M. S., & Gardner, R. (1972). Enhanced relief of phobias by flooding during waning diazepam effect. *The British Journal of Psychiatry: The Journal of Mental Science*, *121*(564), 493–505.

Mataix-Cols, D., Marks, I. M., Greist, J. H., Kobak, K. A., & Baer, L. (2002). Obsessive-compulsive symptom dimensions as predictors of compliance with and response to behaviour therapy: Results from a controlled trial. *Psychotherapy and Psychosomatics*, *71*(5), 255–262. http://doi.org/10.1159/000064812

Meuret, A. E., Seidel, A., Rosenfield, B., Hofmann, S. G., & Rosenfield, D. (2012). Does fear reactivity during exposure predict panic symptom reduction? *Journal of Consulting and Clinical Psychology*, *80*(5), 773–785. http://doi.org/10.1037/a0028032

Myers, K. M., & Davis, M. (2007). Mechanisms of fear extinction. *Molecular Psychiatry*, *12*(2), 120–150. http://doi.org/10.1038/sj.mp.4001939

Mystkowski, J. L., & Mineka, S. (2007). Behavior therapy for specific fears and phobias: Context specificity of fear extinction. In T. A. Treat, R. R. Bootzin, & T. Baker (Eds.), *Psychological clinical science : Papers in honor of Richard M. McFall* (pp. 197–222). New York: Psychology Press.

Mystkowski, J. L., Mineka, S., Vernon, L. L., & Zinbarg, R. E. (2003). Changes in caffeine states enhance return of fear in spider phobia. *Journal of Consulting and Clinical Psychology*, *71*(2), 243–250. http://doi.org/10.1037/0022-006X.71.2.243

Najmi, S., Tobin, A. C., & Amir, N. (2012). Psychometric properties of a behavioral test of contamination-related obsessive–compulsive symptoms. *Cognitive Therapy and Research*, *36*(3), 228–233. http://doi.org/10.1007/s10608-010-9332-0

Newman, M. G., & Fisher, A. J. (2010). Expectancy/credibility change as a mediator of cognitive behavioral therapy for generalized anxiety disorder: Mechanism of action or proxy for symptom change? *International Journal of Cognitive Therapy*, *3*(3), 245–261. http://doi.org/10.1521/ijct.2010.3.3.245

Nguyen, T. D., Attkisson, C. C., & Stegner, B. L. (1983). Assessment of patient satisfaction: development and refinement of a service evaluation questionnaire. *Evaluation and Program Planning*, *6*(3–4), 299–313.

Norberg, M. M., Calamari, J. E., Cohen, R. J., & Riemann, B. C. (2008). Quality of life in obsessive-compulsive disorder: An evaluation of impairment and a preliminary analysis of the ameliorating effects of treatment. *Depression and Anxiety*, *25*(3), 248–259.

Obsessive Compulsive Cognitions Working Group. (1997). Cognitive assessment of obsessive-compulsive disorder. *Behaviour Research and Therapy*, *35*(7), 667–681.

Obsessive Compulsive Cognitions Working Group. (2003). Psychometric validation of the Obsessive Beliefs Questionnaire and the Interpretation of Intrusions Inventory: Part I. *Behaviour Research and Therapy*, *41*(8), 863–878.

Obsessive Compulsive Cognitions Working Group. (2005). Psychometric validation of the Obsessive Belief Questionnaire and Interpretation of Intrusions Inventory - Part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy*, *43*(11), 1527–1542.

Olatunji, B. O., Davis, M. L., Powers, M. B., & Smits, J. A. J. (2012). Cognitive-behavioral therapy for obsessive-compulsive disorder: A meta-analysis of treatment outcome and moderators. *Journal of Psychiatric Research*. http://doi.org/10.1016/j.jpsychires.2012.08.020

Olatunji, B. O., Huijding, J., de Jong, P. J., & Smits, J. A. J. (2011). The relative contributions of fear and disgust reductions to improvements in spider phobia following exposure-based treatment. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*(1), 117–121. http://doi.org/10.1016/j.jbtep.2010.07.007

Parkinson, L., & Rachman, S. J. (1980). Are intrusive thoughts subject to habituation? *Behaviour Research and Therapy*, *18*(5), 409–418. http://doi.org/10.1016/0005-7967(80)90006-6

Pavlov, I. P. (1927). *Conditioned Reflexes*. London: Oxford University Press.

Quirk, G. J. (2002). Memory for extinction of conditioned fear is long-lasting and persists following spontaneous recovery. *Learning & Memory*, *9*(6), 402–407. http://doi.org/10.1101/lm.49602

Rachman, S. J. (1979). The return of fear. *Behaviour Research and Therapy*, *17*(2), 164–166. http://doi.org/10.1016/0005-7967(79)90028-7

Rachman, S. J. (1989). The return of fear: Review and prospect. *Clinical Psychology Review*, *9*(2), 147–168. http://doi.org/10.1016/0272-7358(89)90025-1

Rachman, S. J., Craske, M. G., Tallman, K., & Solyom, C. (1986). Does escape behavior strengthen agoraphobic avoidance? A replication. *Behavior Therapy*, *17*(4), 366–384. http://doi.org/10.1016/S0005-7894(86)80069-7

Rachman, S. J., & de Silva, P. (1978). Abnormal and normal obsessions. *Behaviour Research and Therapy*, *16*(4), 233–248.

Radomsky, A. S., Alcolado, G. M., Abramowitz, J. S., Alonso, P., Belloch, A., Bouvard, M., … Wong, W. (2014). Part 1—You can run but you can't hide: Intrusive thoughts on six continents. *Journal of Obsessive-Compulsive and Related Disorders*, *3*(3), 269–279. http://doi.org/10.1016/j.jocrd.2013.09.002

Rauch, S. A. M., Foa, E. B., Furr, J. M., & Filip, J. C. (2004). Imagery vividness and perceived anxious arousal in prolonged exposure treatment for PTSD. *Journal of Traumatic Stress*, *17*(6), 461–465. http://doi.org/10.1007/s10960-004-5794-8

Raudenbush, S. W., & Bryk, A. (2002). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks: Sage.

Rescorla, R. A. (1988). Pavlovian conditioning: It's not what you think it is. *American Psychologist*, *43*(3), 151–160. http://doi.org/10.1037/0003-066X.43.3.151

Rescorla, R. A. (1996). Preservation of Pavlovian associations through extinction. *The Quarterly Journal of Experimental Psychology B: Comparative and Physiological Psychology*, *49B*(3), 245–258.

Rescorla, R. A. (2001). Experimental extinction. In R. R. Mowrer & S. B. Klein (Eds.), *Handbook of contemporary learning theories.* (pp. 119–154). Mahwah, NJ US: Lawrence Erlbaum Associates Publishers.

Rescorla, R. A., & Heth, C. D. (1975). Reinstatement of fear to an extinguished conditioned stimulus. *Journal of Experimental Psychology: Animal Behavior Processes*, *1*(1), 88–96. http://doi.org/10.1037/0097-7403.1.1.88

Rescorla, R. A., & Wagner, A. R. (1972). A theory of Pavlovian conditioning: Variations in the effectiveness of reinforcement and nonreinforcement. In A. H. Black & W. F. Prokasy (Eds.), *Classical conditioning II: Current research and theory* (pp. 64–99). New York: Appleton-Century-Crofts.

Resick, P. A., Nishith, P., Weaver, T. L., Astin, M. C., & Feuer, C. A. (2002). A comparison of cognitive-processing therapy with prolonged exposure and a waiting condition for the treatment of chronic posttraumatic stress disorder in female rape victims. *Journal of Consulting and Clinical Psychology*, *70*(4), 867–879. http://doi.org/10.1037/0022-006X.70.4.867

Rowe, M. K., & Craske, M. G. (1998). Effects of varied-stimulus exposure training on fear reduction and return of fear. *Behaviour Research and Therapy*, *36*(7–8), 719–734.

Rufer, M., Fricke, S., Moritz, S., Kloss, M., & Hand, I. (2006). Symptom dimensions in obsessive- compulsive disorder: Prediction of cognitive-behavior therapy outcome. *Acta Psychiatrica Scandinavica*, *113*(5), 440–446. http://doi.org/10.1111/j.1600-0447.2005.00682.x

Salkovskis, P. M., & Harrison, J. (1984). Abnormal and normal obsessions: A replication. *Behaviour Research and Therapy*, *22*(5), 549–552. http://doi.org/10.1016/0005-7967(84)90057-3

Sartory, S. J., Rachman, S., & Grey, S. (1977). An investigation of the relation between reported fear and heart rate. *Behaviour Research and Therapy*, *15*(5), 435–438. http://doi.org/10.1016/0005-7967(77)90048-1

Schmidt, R. A., & Bjork, R. A. (1992). New conceptualizations of practice: Common principles in three paradigms suggest new concepts for training. *Psychological Science*, *3*(4), 207–217. http://doi.org/10.1111/j.1467-9280.1992.tb00029.x

Schwarz, G. (1978). Estimating the dimension of a model. *The Annals of Statistics*, *6*(2), 461–464. http://doi.org/10.1214/aos/1176344136

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., … Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry*, *59*, 22–33.

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Janavs, J., Weiller, E., Keskiner, A., … Dunbar, G. C. (1997). The validity of the Mini International Neuropsychiatric Interview (MINI) according to the SCID-P and its reliability. *European Psychiatry*, *12*(5), 232–241.

Simons, J. S., & Gaher, R. M. (2005). The Distress Tolerance Scale: Development and validation of a self-report measure. *Motivation and Emotion*, *29*(2), 83–102. http://doi.org/10.1007/s11031-005-7955-3

Simpson, H. B., Foa, E. B., Liebowitz, M. R., Ledley, D. R., Huppert, J. D., Cahill, S., … Petkova, E. (2008). A randomized, controlled trial of cognitive-behavioral therapy for augmenting pharmacotherapy in obsessive-compulsive disorder. *The American Journal of Psychiatry*, *165*(5), 621–630. http://doi.org/10.1176/appi.ajp.2007.07091440

Simpson, H. B., Franklin, M. E., Cheng, J., Foa, E. B., & Liebowitz, M. R. (2005). Standard criteria for relapse are needed in obsessive-compulsive disorder. *Depression and Anxiety*, *21*(1), 1–8. http://doi.org/10.1002/da.20052

Sprinkle, S. D., Lurie, D., Insko, S. L., Atkinson, G., Jones, G. L., Logan, A. R., & Bissada, N. N. (2002). Criterion validity, severity cut scores, and test-retest reliability of the Beck Depression Inventory-II in a university counseling center sample. *Journal of Counseling Psychology*, *49*(3), 381–385. http://doi.org/10.1037/0022-0167.49.3.381

Steer, R. A., Ball, R., Ranieri, W. F., & Beck, A. T. (1999). Dimensions of the Beck Depression Inventory-II in clinically depressed outpatients. *Journal of Clinical Psychology*, *55*(1), 117–128. http://doi.org/10.1002/(SICI)1097-4679(199901)55:1<117::AID-JCLP12>3.0.CO;2-A

Steketee, G., Chambless, D. L., Tran, G. Q., & Worden, H. (1996). Behavioral Avoidance Test for obsessive compulsive disorder. *Behaviour Research and Therapy*, *34*(1), 73–83.

Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., … Cardenas, S. J. (2007). Robust dimensions of anxiety sensitivity: Development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment*, *19*(2), 176–188. http://doi.org/10.1037/1040-3590.19.2.176

Tolin, D. F., Brady, R. E., & Hannan, S. (2008). Obsessional beliefs and symptoms of obsessive-compulsive disorder in a clinical sample. *Journal of Psychopathology and Behavioral Assessment*, *30*(1), 31–42.

Tolin, D. F., Diefenbach, G. J., & Gilliam, C. M. (2011). Stepped care versus standard cognitive-behavioral therapy for obsessive-compulsive disorder: A preliminary study of efficacy and costs. *Depression and Anxiety*, *28*(4), 314–323. http://doi.org/10.1002/da.20804

Tolin, D. F., Hannan, S., Maltby, N., Diefenbach, G. J., Worhunsky, P., & Brady, R. E. (2007). A randomized controlled trial of self-directed versus therapist-directed cognitive-behavioral therapy for obsessive-compulsive disorder patients with prior medication trials. *Behavior Therapy*, *38*(2), 179–191. http://doi.org/10.1016/j.beth.2006.07.001

Tsao, J. C. I., & Craske, M. G. (2000). Timing of treatment and return of fear: Effects of massed, uniform-, and expanding-spaced exposure schedules. *Behavior Therapy*, *31*(3), 479–497. http://doi.org/10.1016/S0005-7894(00)80026-X

van Balkom, A. J. L. M., van Oppen, P., Vermeulen, A. W. A., van Dyck, R., Nauta, M. C. E., & Vorst, H. C. M. (1994). A meta-analysis on the treatment of obsessive compulsive disorder: A comparison of antidepressants, behavior, and cognitive therapy. *Clinical Psychology Review*, *14*(5), 359–381. http://doi.org/10.1016/0272-7358(94)90033-7

van Minnen, A., & Hagenaars, M. (2002). Fear activation and habituation patterns as early process predictors of response to prolonged exposure treatment in PTSD. *Journal of Traumatic Stress*, *15*(5), 359–367. http://doi.org/10.1023/A:1020177023209

van Oppen, P., van Balkom, A. J. L. M., Smit, J. H., Schuurmans, J., van Dyck, R., & Emmelkamp, P. M. G. (2010). Does the therapy manual or the therapist matter most in treatment of obsessive-compulsive disorder? A randomized controlled trial of exposure with response or ritual prevention in 118 patients. *Journal of Clinical Psychiatry*, *71*(9), 1158–1167. http://doi.org/10.4088/JCP.08m04990blu

Vansteenwegen, D., Dirikx, T., Hermans, D., Vervliet, B., & Eelen, P. (2006). Renewal and reinstatement of fear: Evidence from human conditioning research. In M. G. Craske, D. Hermans, & D. Vansteenwegen (Eds.), *Fear and learning: From basic processes to clinical implications.* (pp. 197–215). Washington, DC US: American Psychological Association.

Vansteenwegen, D., Hermans, D., Vervliet, B., Francken, G., Beckers, T., Baeyens, F., & Eelen, P. (2005). Return of fear in a human differential conditioning paradigm caused by a return to the original acquistion context. *Behaviour Research and Therapy*, *43*(3), 323–336. http://doi.org/10.1016/j.brat.2004.01.001

Vervliet, B. (2008). Learning and memory in conditioned fear extinction: effects of D-cycloserine. *Acta Psychologica*, *127*(3), 601–613. http://doi.org/10.1016/j.actpsy.2007.07.001

Vervliet, B., Craske, M. G., & Hermans, D. (2013). Fear extinction and relapse: state of the art. *Annual Review of Clinical Psychology*, *9*, 215–248. http://doi.org/10.1146/annurev-clinpsy-050212-185542

Wagner, A. R., & Rescorla, R. A. (1972). Inhibition in Pavlovian conditioning: Application of a theory. In R. A. Boakes & M. S. Halliday (Eds.), *Inhibition and learning* (pp. 301–336). London: Academic Press.

Watson, J. P., Gaind, R., & Marks, I. M. (1972). Physiological habituation to continuous phobic stimulation. *Behaviour Research and Therapy*, *10*(3), 269–278. http://doi.org/10.1016/0005-7967(72)90043-5

Watts, F. N. (1979). Habituation model of systematic desensitization. *Psychological Bulletin*, *86*(3), 627–637. http://doi.org/10.1037/0033-2909.86.3.627

Williams, M. T., Farris, S. G., Turkheimer, E. N., Franklin, M. E., Simpson, H. B., Liebowitz, M., & Foa, E. B. (2014). The impact of symptom dimensions on outcome for exposure and ritual prevention therapy in obsessive-compulsive disorder. *Journal of Anxiety Disorders*, *28*(6), 553–558. http://doi.org/10.1016/j.janxdis.2014.06.001

Williams, M. T., Farris, S. G., Turkheimer, E., Pinto, A., Ozanick, K., Franklin, M. E., … Foa, E. B. (2011). Myth of the pure obsessional type in obsessive--compulsive disorder. *Depression and Anxiety*, *28*(6), 495–500. http://doi.org/10.1002/da.20820

Williams, M. T., Mugno, B., Franklin, M., & Faber, S. (2013). Symptom dimensions in obsessive-compulsive disorder: phenomenology and treatment outcomes with exposure and ritual prevention. *Psychopathology*, *46*(6), 365–376. http://doi.org/10.1159/000348582

Wolpe, J. (1973). *The practice of behavior therapy. (2nd ed.)*. Oxford England: Pergamon.

Woody, S. R., McLean, C., & Klassen, T. (2005). Disgust as a motivator of avoidance of spiders. *Journal of Anxiety Disorders*, *19*(4), 461–475. http://doi.org/10.1016/j.janxdis.2004.04.002