A “Better End” to Exposure? Assessing the Effects of the Peak-End Rule on Viewing Blood-Injection-Injury Stimuli

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Abstract

Blood-injection-injury (BII) phobia is associated with avoidance of needed medical treatment. Exposure therapy lessens distress related to viewing BII stimuli. However, many clinicians report difficulty with clients not completing exposure therapy. This study assessed whether the peak-end rule of memory could be manipulated to encourage the acceptability of and lessen the distress associated with exposures to BII stimuli. 201 participants recruited via Amazon.com's MTurk were randomly assigned to view or not view a series of less distressing photos of BII at the end of an exposure session to BII stimuli. Participants who viewed the less distressing photos at the end of the exposure session rated it retrospectively less distressing overall. The results suggest promise for using the peak-end rule to improve exposure therapy outcomes for clients with BII phobia.

Keywords: peak-end rule, exposure therapy, blood-injection-injury phobia

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A "Better End" to Exposure? Assessing the Effects of the Peak-End Rule on Viewing Blood-Injection-Injury Stimuli

The lifetime prevalence rate of specific phobia, blood-injection-injury (BII) type, or BII phobia, is 3.5% among the general population (Bienvenu & Eaton, 1998). According to the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition,* or *DSM-5* (American Psychiatric Association, 2013), those affected by BII phobia are excessively fearful of blood, injuries, or injections, or some combination of the three. People with BII phobia are particularly fearful of fainting upon viewing the phobic stimuli (Öst, 1992); consequently, they frequently avoid them (American Psychiatric Association, 2013).

BII avoidance increases nonadherence to medical regimens among persons with diabetes, multiple sclerosis, and other chronic medical conditions (Cox & Mohr, 2003). For example, Zambanini et al. (1999) examined anxiety related to injection at a diabetes care clinic among 115 patients who required daily self-injections of insulin. Participants with either Type 1 or Type 2 diabetes completed questionnaires pertaining to their injection anxiety, general anxiety, and injection regimen (e.g., number of daily injections). Researchers found a significant negative correlation between injection anxiety score and number of daily injections. Participants with high scores relating to injection anxiety were significantly less likely than participants with low scores to inject once or twice daily, significantly more likely to avoid injections, and significantly more likely to indicate concern about the prospect of injecting more frequently.

Similarly, Mollema et al. (2001) examined the relationship between diabetes management and fear of self-injection of insulin or self-testing of blood glucose among a sample of 1275 adult patient members of the Dutch Diabetes Association. They completed a survey assessing fear of injection, fear of self-testing, diabetes related behaviors, other mental health attributes (e.g.,

state/trait anxiety), and general well-being. The researchers compared scores of participants who scored at the 95th percentile or higher in fear of self-injection or self-testing with participants who scored below this mark. Those in the higher-scoring group reported overall lower well-being and greater mental health difficulties. Most importantly, they also indicated that they checked their blood glucose levels significantly less frequently: 61% checked less than five times per week compared to 45.5% who checked at that rate in the lower-scoring group.

In addition to negatively affecting medical action for chronic conditions, BII phobia also contributes to avoidance of pursuing standard medical care. Poulton et al. (1998) examined the effect of a fear of blood or injections on dental care. Participants were 18-year old New Zealand residents whose health data were collected as part of a longitudinal study. Of 936 total individuals, 96 reported a fear of visiting the dentist, and 52 of these 96 reported a comorbid fear of either blood or injections. The researchers compared oral health among individuals in four groups: dental fear alone, blood or injection fear alone, comorbid dental and blood or injection fear, and no dental, blood or injection fear (the control group). They found that participants with a comorbid blood or injection and dental fear had significantly worse oral health outcomes than the no fear group. Additionally, participants in the comorbid group had experienced tooth decay more recently than those with dental fear alone. They also reported the longest time since their last dental visit of any of the groups. The data suggest that fear of blood or injections may exacerbate poor outcomes among those already predisposed to avoiding the dentist.

Part of standard medical care involves regular appointments with physicians and dentists. BII phobia may prevent individuals from making or keeping appointments due to a fear of coming into contact with BII stimuli. Kleinknecht and Lenz (1989) collected information from university students regarding fears of blood or injury and fainting behaviors in response to seeing

them. Based on their histories, 103 participants were classified as fainters and 101 as non-fainters. Participants were divided into four categories prior to analysis: phobic fainters, fearful fainters, fearful non-fainters, and non-fearful fainters. Phobic and fearful fainters were significantly more likely to report past avoidance of and future intentions to avoid appointments with physicians. Additionally, they indicated they were more likely to avoid appointments with dentists.

The weight of the evidence indicates that BII phobia causes or exacerbates medical avoidance and worsens physical health outcomes. As such, treatment of it via exposure therapy may be associated with improved health outcomes.

Exposure Therapy

In general, the most efficacious treatments for specific phobias are exposure-based (Grös & Antony, 2006; Wolitzky-Taylor et al., 2008). They involve controlled, repeated exposure to the feared stimulus. Through systematic exposure, the individual habituates to the stimulus. Wolitzky-Taylor et al. (2008) conducted a meta-analysis of 33 randomized controlled trials of psychological treatments for specific phobias. Treatments were classified as exposure-based (e.g., *in vivo* exposure, imaginal exposure, virtual reality exposure), non-exposure-based (e.g., cognitive therapy without an exposure component, progressive muscle relaxation), placebo (e.g., watching a nature film, pleasant imagery), or no treatment (i.e., waitlist control). The analysis indicated that individuals receiving a psychological treatment fared significantly better on behavioral and self-report outcome measures than approximately 85% of individuals not receiving treatment. Among those receiving treatment, exposure therapies were significantly more effective than non-exposure-based therapies and placebos.

Several studies support exposure-based therapy as an efficacious treatment for BII phobia. Olatunji et al. (2007) found that 30 minutes of exposure to BII stimuli significantly reduced levels of fear in participants. Other studies have arrived at similar results (e.g., Hirai et al., 2008; Öst, Hellström & Kåver, 1992). Like any therapy, however, the benefits of the treatment depend on clients completing therapeutic regimens as opposed to terminating treatment prematurely.

One of the difficulties with exposure therapy is convincing persons to undergo the actual exposures. Patients are accustomed to fearing and avoiding the stimulus to which they are meant to be exposed. Exposures typically must be carried out over many weeks of treatment. Helping a patient to complete repeated exposures is a challenge for many clinicians (Franklin, Riggs, & Pai, 2005; Leahy, 2007). Investigations regarding how people remember unpleasant events could inform clinicians' strategies for encouraging clients to undergo exposures.

Research on *remembered utility* (that is, "a subject's own global evaluation of a past episode" [Kahneman, 2000]) yields two counter-intuitive findings about memories of distress (Redelmeier & Kahneman, 1996). The first concerns *duration neglect*: the length of a distressing event has little to no effect on one's retrospective evaluation of the amount of distress one experienced during the event (Kahneman et al, 1993). The second concerns the *peak-end rule*: a person's evaluation of how distressing a past experience was derives from an unweighted average of the most intense distress experienced during an event (the peak) with the amount of distress experienced at the event's conclusion (the end) (Fredrickson & Kahneman, 1993). Studies support duration neglect and the peak-end rule's centrality to remembered utility (Fredrickson & Kahneman, 1993; Schreiber & Kahneman, 2000; Varey & Kahneman, 1992). Research also demonstrates that the peak-end rule applies to medicinal domains, including

participants' evaluations of colonoscopies (Redelmeier, Katz, & Kahneman, 2003) and physically painful experiences (Kahneman et al., 1993).One can understand the potential influence of the peak-end in psychotherapy within the context of a hypothetical exposure treatment. Per the peak-end rule, a hypothetical patient, Anita's, overall assessment of the distress of an exposure therapy session would be determined by the most distressing moment of the session (the peak) averaged with the distress she experienced at the close of the session (the end).

Data related to the peak-end rule could inform the use of exposure therapy and favorably improve clients' evaluations of the procedure. For example, Anita's clinician, knowing that her clients often experience difficulty with completing repeated exposure sessions, could structure sessions to decrease the distress experienced at their conclusion. This might improve Anita's retrospective evaluation of the distress experienced in each session. For instance, if Anita rated her peak distress during an exposure session as a 9 on a 10-point Subjective Units of Distress (SUDs; Wolpe, 1969) scale, and her distress at the end of a session as a 7, she should remember the distress of the session as an unweighted average of the two numbers: an 8 in SUDs. Alternatively, if Anita's clinician took care to decrease the distress experienced at the end of the session, Anita might rate the end as a 3. Averaged with her peak rating of a 9, this would decrease the overall amount of distress she remembers experiencing to a 6 in SUDs. Remembering the session as a 6 instead of an 8 in SUDS might encourage Anita to continue with therapy when she would otherwise quit.

This research aims to synthesize literature on exposure therapy for BII phobia with findings concerning the peak-end rule. First, studies on exposure to BII stimuli will be reviewed. Next, studies exemplifying the role of the peak-end rule in determining evaluations of medical

procedures and related stimuli (e.g., pain) will be discussed. Finally, some strategies for utilizing the peak-end rule to improve the acceptability of exposure therapy to BII stimuli will be proposed, and an original empirical study based on these strategies conducted and reviewed.

Exposure to BII Stimuli

Traditional accounts of BII phobia focus on fear and anxiety associated with BII stimuli as the primary causes and maintaining factors of the disorder.[1] For persons with BII phobia, the fear and anxiety are closely linked with fainting. A person with BII phobia confronting a feared stimulus typically experiences a diphasic response: first, an increase in blood pressure and heart rate, symptomatic of anxiety and observed in other anxiety disorders and simples phobias (Öst, Sterner, & Lindahl, 1984b). This is followed by a sharp decrease below baseline in blood pressure and heart rate, a physiological change unique to BII phobia (Öst, Sterner, & Lindahl, 1984b). The decrease in blood pressure and heart rate may result in the person with BII phobia fainting. Consequently, the person with BII phobia fears the prospect of fainting again (Öst, Sterner, & Lindahl, 1984b), and attempts to lessen the chances of fainting occurring by avoiding BII stimuli (American Psychiatric Association, 2013). Proponents of exposure therapy contend that by using exposure to lessen the anxiety-driven increase in blood pressure and heart rate that comprise the first part of the diphasic response, the entire response will be arrested, no further fainting will occur in the presence of BII stimuli, and subsequent fear and avoidance of the stimuli will decrease (Öst et al., 1984a).

[1] Recent evidence suggests that disgust plays a role in the etiology and maintenance of BII phobia (see Olatunji et al., 2012a, for a review). However, exposure to disgusting stimuli is not a necessary component of exposure therapy for BII phobia, nor is it clear if it provides benefit beyond mere exposure to feared stimuli (Hirai et al., 2008, Olatunji et al., 2007; see Williams, 2014, for a review). As such, the present manuscript principally concerns itself with the role of fear in BII phobia and the body of research indicating the benefit of exposure to it (e.g., Öst, Hellström, & Kåver, 1992).

Early research assessing the efficacy of exposure protocols for BII centered on the work of Lars-Göran Öst and colleagues. Previous literature on behavioral treatments of BII involved single-subject designs (e.g., Cohn, Kron, & Brady, 1976; Yule & Fernando, 1980) or were primarily intended to explore a theoretical question regarding a particular behavioral treatment (e.g., demand characteristics in systematic desensitization; McReynolds & Tori, 1972) as opposed to treating BII phobia (Öst et al., 1984a). Öst was the first researcher to investigate exposure treatments for BII stimuli in controlled group trials.

The initial controlled group exposure study for a component of BII phobia compared nine sessions of exposure with nine sessions of training in applied relaxation in the treatment of individuals with blood phobia (Öst et al., 1984a). The exposure component consisted of mere exposure to blood stimuli (e.g., watching someone give blood), while the applied relaxation component consisted of coaching in progressive muscle relaxation and applied tension (tensing and releasing the arms, legs, and torso muscles for the purpose of increasing blood pressure). Participants in the latter condition were taught to use progressive muscle relaxation and applied tension when confronting the blood stimuli. Eighteen participants from a psychiatric hospital were randomized to participate in either exposure or applied relaxation training. After participating in treatment, participants completed self-report measure of fear of blood as well as physiological and behavioral measures. The physiological measures tracked participants' post-treatment heart rates and blood pressure upon viewing blood stimuli. The behavioral measures consisted of a time measurement (zero to 30 minutes) of how long a participant could watch a video consisting of blood stimuli, and a 0-4 Likert scale measurement completed by a trained therapist of participants' fainting behavior (ranging from no fainting reactions to participants actually fainting). The nine participants in the exposure to blood stimuli condition self-reported

less distress than nine participants in the applied relaxation coaching condition. There were no statistically significant differences between the groups on the physiological and behavioral measures. The results indicate that exposure therapy is slightly preferable to applied relaxation in the treatment of blood phobia.

Following research indicating that applied tension by itself yielded more impressive blood phobia treatment results than the applied relaxation treatment package (consisting of applied tension combined with progressive muscle relaxation) (Öst, Sterner, & Fellenius, 1989), Öst and associates became interested in the merits of applied tension versus exposure-only treatment for blood phobia. Öst, Fellenius, and Sterner (1991) compared the efficacy of exposure-only treatment with applied tension and tension-only treatments among patients with blood phobia at a psychiatric hospital. The tension-only condition consisted of training in bodily cues for a drop in blood pressure and muscle tensing techniques that could be used to reverse this drop. The applied tension condition included this training as well as exposure to blood stimuli. Thirty participants were randomized to one of the three conditions, resulting in ten participants per group. Participants in all conditions improved post-treatment on all outcome measures (self-report, behavioral, and physiological). However, while there were no group differences in physiological measures or self-report measures of fear, the applied tension and tension-only groups improved significantly more than the exposure-only group on behavioral measures. As in Öst's earlier work, these behavioral measures consisted of measurements of how long participants could watch a video featuring blood stimuli and the therapists' assessments of participant fainting behaviors. The applied tension group also evidenced an advantage in Clinically Significant Improvement (CSI; that is, their behaviors improved to a degree that was considered clinically meaningful) compared to the exposure-only group. The improvements

across all groups were predominantly intact one year later, as was the advantage in CSI for the applied tension group over the exposure-only group. These data suggest that combining exposure with muscle tensing is superior to exposure alone for blood phobia.

Beyond the specifics of exposure treatments, Öst and colleagues also investigated the effects of the spacing and duration of exposure sessions on the benefits achieved. Öst, Hellström, & Kåver (1992) evaluated one versus five sessions of exposure therapy in the treatment of psychiatric hospital outpatients with injection phobia. The one session condition consisted of a single exposure therapy session that lasted up to three hours. The five session condition consisted of five separate sessions of exposure therapy lasting up to one hour apiece. Forty participants were distributed evenly between the two conditions via random assignment. Both groups improved on physiological, behavioral, and self-report measures. They also evidenced CSI on measures assessing behavioral avoidance. These measures consisted of the patients' progress on a 20-step exposure hierarchy and a self-report measure of injection avoidance. All gains were roughly equal between the two groups (e.g., 80% of the one session group and 79% of the five session group demonstrated clinically significant improvement) and were maintained at one year follow-up, indicating equivalence between five discrete sessions of exposure therapy and a single, lengthy session.

More recently, Hirai et al. (2008) provided a test of the efficacy of single exposure sessions to BII stimuli. The investigators compared a single-session exposure protocol targeting fear versus one addressing fear and disgust (based on research indicating disgust plays a role in the etiology of BII phobia [e.g., Olatunji et al., 2012a]). Their sample included 38 undergraduate students and community members with subclinical BII phobia. Participants in the fear-only condition received psychoeducation and completed a 14 step exposure hierarchy. Examples of

items on the hierarchy included holding an open vial of blood, watching a video of a person receiving an injection, and injecting an orange with a syringe. Participations in the fear and disgust condition received additional psychoeducation about disgust, as well as three additional steps on the exposure hierarchy related to disgust (for example, a participant touching her arm with the same hand that held the open vial of blood). Participants in both groups demonstrated decreased fear, disgust and avoidance of BII stimuli over the course of the exposure session. This study provides additional support for the efficacy of single session exposures to BII stimuli.

Öst and associates' did not examine the treatment of BII phobia as such, addressing blood phobia in two studies and injection phobia in another. If we assume, as per modern diagnostic practices (American Psychiatric Association, 2013), that simple phobias for blood and injection are both components of an overarching BII phobia, then we can make some limited inferences about the use of exposure for BII phobia.

There is evidence that exposure with the addition of applied tension training may provide better results than exposure alone (Öst, Fellenius, & Sterner, 1991). With just one study of ten participants receiving exposure-only versus ten receiving exposure plus applied tension training, the small sample size limits generalizability. The applied tension training, in part, draws on classical conditioning for its theoretical rationale: repeatedly relaxing when presented with the feared BII stimulus should lead to the BII stimulus no longer provoking a fear response and perhaps even eliciting relaxation. However, similar rationales were used in formulating relaxation procedures for the treatment of panic disorder. Recent evidence has suggested the applied tension training for panic disorder may actually act as an interoceptive avoidance mechanism (see Craske & Barlow, 2007), leading to its exclusion in protocols intended to treat panic by authors who previously recommended it (e.g., Barlow et al., 2011). More research is

needed to determine if applied tension may perform a similar avoidance function in the treatment of BII phobia.

Exposure by itself seemed to be effective across studies. It led to improvement in all four studies and CSI in the two studies in which CSI was calculated. There is some evidence that a single, extended session of exposure therapy may function as well as repeated sessions (Öst et al., 1992; Hirai et al., 2008).

Neither exposure protocols for BII phobia nor exposure treatments for general mental health problems have considered the role of the peak-end rule in constructing exposure sessions. This paper will presently review the role of the peak-end rule in retrospective evaluations of events related to BII and health settings.

Peak-End Rule

Research regarding retrospective evaluations of unpleasant events confound "logical principles" that guide intuitions about how evaluations occur (Kahneman et al., 1993). An important example of a "logic"-violating finding concerns the relative unimportance of the duration of a distressing event in one's global evaluation of it (duration neglect) (Kahneman et al., 1993). Instead, the evidence indicates that a person's retrospective evaluation of a distressing event is determined by the peak-end rule: the unweighted average of the most distressing part of the experience (the peak) and the amount of distress experienced at the event's conclusion (the end) (Fredrickson & Kahneman, 1993).

Initial work demonstrating the peak-end rule was conducted by Fredrickson and Kahneman (1993). They examined the role of event duration in participants' evaluations of affective experiences. Relevant to the use of BII visual stimuli in exposure sessions, their investigations utilized visual stimuli of pleasant and unpleasant film clips (e.g., puppy playing

with flowers and pigs being beaten to death with clubs, respectively). In their first study, they randomized 32 university students into four groups and asked them to provide real-time affective (i.e., pleasant or unpleasant) evaluations of different combinations of the clips using a 15-light "affect meter." Participants turned a knob to illuminate colored lights on a video monitor, with the seven left-most lights indicating degrees of negative feelings and the seven right-most light indicating degrees of positive feelings. Some students saw longer versions of pleasant and unpleasant film clips than others. Immediately after each clip ended, students also provided a global evaluation of its pleasantness or unpleasantness. Fredrickson and Kahneman found that the length of the clips had little effect on students' global evaluations. Additionally, a student's peak affective rating of a given clip in unweighted combination with her affective rating at the end of the clip was a significantly better predictor of her global evaluation than the average of her real-time evaluations.

In their second study, Fredrickson and Kahneman showed pleasant and unpleasant film clips to 96 university students. In this instance, the researchers were interested in the effect of clip duration on a participant's global affective rating of a clip if the participant did not make ratings until she had viewed all clips. Half of the participants were prompted at the beginning of the experiment to notice the effect each clip had on their affect because they would be evaluating the clips' pleasantness and unpleasantness at the end of the trial. The other half of participants did not receive this prompt. The researchers found that the former group's ratings of each clip were similar to those in the first study, evidencing little effect for the role of clip duration in determining affective experience. However, the effects were even smaller in the group that was not told ahead of time to notice their affective experience while watching each clip in preparation for later rating them. This group demonstrated more pronounced duration neglect, providing

further support for the notion that retrospective ratings of affective experience are determined by important affective moments during the experience rather than by the length of the experience. The investigators note that the procedures utilized with the latter group probably more closely resemble those used outside of laboratory settings. That is, when an individual retrospectively evaluates the pleasantness or unpleasantness of an experience it is done on an *ad hoc* basis, rather than with the individual having made a continuous, conscious effort to track affect with the intention of providing a global rating of the experience at a later time.

Of particular importance to medical procedures, Kahneman and colleagues (1993) looked beyond pure affect to evaluations of pain. Thirty-two male university students completed two trials of pain evaluation. In one trial, subjects immersed one hand in 14°C water for 60 seconds. In the other trial, they stuck one hand in 14°C water for 60 seconds, then held it in the water for an additional 30 seconds. During the additional 30 seconds, the temperature of the water was raised by the experimenters to 15°C. Following the peak-end rule, one would expect the peak of pain to be the same for both trials, but for the end experience of pain to be less for the longer trial, which concluded with relatively warmer water. Participants' retrospective moment-to-moment ratings of the trials evidenced these expected differences in pain. After completing both trials, participants were told that they would choose which of the two trials to repeat (they ultimately did not actually repeat either one) and were asked about their experiences of them. Sixty-nine percent of participants preferred to repeat the longer trial as opposed to the shorter trial. Additionally, participants rated the longer trial more favorably than the shorter trial on Likert scale items (e.g., "Which trial caused the greater overall discomfort?"). The subjects correctly assessed the longer trial as lasting a greater period of time than the shorter trial, yet they still preferred it. If participants had intended to decrease their total exposure to pain, they would

have selected to repeat the objectively shorter trial. That they did not do so and that they rated the longer trial more favorably than the shorter suggests a significant role for the peak-end rule in affective evaluations.

Redelmeier and Kahneman's (1996) study provides further insight on the potential importance of the peak-end rule to medical procedures. Participants were 154 patients undergoing colonoscopy and 133 patients undergoing lithotripsy at a Canadian hospital. Patients reported real-time evaluations of the pain they were experiencing every one minute via an analogue scale on a hand-held device. Subsequently, they retrospectively rated their experience of the pain on a 10-point scale. The colonoscopy patients provided an additional retrospective rating one month later and the lithotripsy patients provided an additional rating one year later. Physicians also provided assessments immediately after the procedures of how much pain they thought they patients would indicate they had experienced, as well as whether they would have administered more anesthetic if they were to redo the procedures. Retrospective pain ratings did not significantly correlate with the length of the procedures, an example of relative duration neglect. However, retrospective ratings were significantly correlated with the peak pain ratings reported for the procedures, as well as the ratings provided in the last three minutes of the procedures. Additionally, both physicians' estimations of patients' pain ratings and their judgments related to anesthesia levels were significantly correlated with patients' peak and end pain ratings, not the durations of the procedures. The conclusions that one can draw from the study, though, are limited by its correlational nature.

Redelmeier, Katz and Kahneman (2003) followed-up with a study of the peak-end rule in a medical setting using an experimental design. Six hundred-eighty-two patients receiving a colonoscopy were randomized to one of two conditions. In one, they received the procedure as it

is conventionally administered, with the removal of the colonoscope at the end of the colonoscopy. In the other, after the colonoscopy was finished (that is, no more suction, inflation, etc.), physicians rested the tip of the colonoscope in patients' rectums up to three minutes prior to removal. Participants rated their real time experiences of pain during the procedure on a thermometer displayed on a handheld device. They also provided retrospective ratings, both in terms of their overall amount of discomfort and with regard to how the experience compared to other unpleasant life experiences. Additionally, as a measure of adherence, the researchers tracked for close to six years after the start of the investigation whether participants received a second colonoscopy after the original colonoscopy. Results indicated benefits for the longer procedure across the board. As hypothesized, patients who had the colonoscope remain in them for additional time reported the final moments of the procedure as less painful. They subsequently rated their overall experience as less discomforting and compared it more favorably to other unpleasant life events. Of particular note for practical implications, they were more likely to undergo a second colonoscopy.

Finn (2010) demonstrated applicability of the peak-end rule to learning under difficult circumstances (as one would expect learning to be during exposure to a feared stimulus). Across two studies, Finn used procedures similar to those of Kahneman et al.'s (1993) experiment, but with a learning task in place of exposure to cold temperatures. The learning task involved two lists of Spanish-to-English translations that 44 participants were asked to memorize with the belief that they would be quizzed over the 20 toughest items from each list. The Short list consisted of 30 extremely difficult translations. The Extended list consisted of 30 equally difficult translations, followed by 15 translations of moderate difficulty. Twenty-one randomly assigned participants completed the Extended list followed by the Short list, as well as quizzes

for each, while 23 participants completed the lists and quizzes in the opposite order. Participants were then asked which type of list they would prefer used during a third test/quiz combination that they believed they would be completing that day. They were also asked which type of list they would prefer to complete if they were hypothetically returning for a second day of experimentation. Additionally, participants rated the difficulty of each list, how long each took to learn, how much discomfort they experienced with each, and how tough it was to cope with each. Impressively, across all measures, participants favored the Extended list to a statistically significant degree.

Finn's (2010) second study used the same procedures as the first experiment, except that participants provided real time evaluations of their ratings of discomfort. This tested the possibility that participants preferred the Extended list because they found learning moderately difficult translations non-aversive or even enjoyable. Conversely, if participants rated the moderately difficult translations as aversive, yet still preferred the Extended list, this would provide further support for the peak-end rule. Participants did in fact rate the moderately difficult translations as aversive (albeit less so than the extremely difficult translations), while still expressing statistically significant preferences for the Extended list. Taken together, Finn's studies indicate that the peak-end rule may apply to difficult learning broadly considered, not just in situations related to physical pain or discomfort.

Experimental research demonstrates the influence of peak-end rule in shaping retrospective evaluations of affective experiences. The data reviewed support its applicability to a variety of situations, including the viewing of pleasant and unpleasant images, evaluations of pain, evaluations of and willingness to undergo subsequent medical procedures, and learning under difficult circumstances. These findings are potentially relevant for treating BII phobia with

exposure therapy. Exposure treatment involves viewing stimuli that persons with BII phobia find unpleasant. It also entails learning under difficult circumstances. Specifically, exposure treatment involves basic learning (habituation to a phobic stimulus) and more complex learning (the individual realizes that she can experience symptoms of fear or disgust, or even faint, without catastrophic consequences). Additionally, applications of the peak-end rule to medical procedures are likely to generalize to BII phobia. This is the case both for the stimuli used during exposure treatment (e.g., an individual injecting a mock arm with a syringe or viewing a photo of an injury) as well as for therapeutic outcomes (e.g., does a person visit the dentist post-treatment?). Similar to patients' experiences with colonoscopies, lowering the peak-end average could lead to lower distress associated with exposure sessions, better adherence to exposure protocols, and thus, better medical outcomes.

More research addressing the particulars of how the peak-end rule may affect the efficacy of exposure therapy for BII phobia is needed. An empirical study directly testing one permutation of the peak-end rule on exposure therapy is the focus of the next section.

Present Study

In the extant literature, exposure therapy experiments have involved exposure to increasingly fearful stimuli over the course of the sessions. If a clinician's goal, though, is to increase patients' adherence to exposure therapy so that they complete multiple trials, then the present format of exposure treatment may not be ideal. When participants face a fearful stimulus and habituate to it, the experience will likely still be unpleasant. If it is too unpleasant, the participant may be less likely to return for additional exposure sessions.

For example, Tyrone, a hypothetical patient with BII phobia, constructs an anxiety hierarchy with his therapist. He rates various BII-related behaviors (e.g., injecting an orange with

a syringe) on a 10-point SUDs scale. He completes an exposure for holding a syringe, which he rated as a 9 on his hierarchy prior to the exposure. At the end of the exposure, he rates the experience as a 7 in terms of the distress it causes. From the standpoint of exposure therapy as it is usually completed, Tyrone's experience is a success. He has habituated to the experience enough that on that day, he does not feel as much fear around the stimulus as he did before the session. However, a 7 out of 10 may still represent a significant amount of distress; perhaps enough distress for Tyrone to engage in avoidance and skip his future appointments. The peak-end rule offers a potential remedy for this problem.

Exposure sessions which utilize the peak-end rule might end with the participant facing a stimulus that she considers less distressing than the one she faced immediately prior to it. Note that this does not mean the patient avoids the stimuli that prompt the most anxiety. It simply entails an additional exposure trial for after exposure to one of the stimuli that causes high anxiety. Per the peak-end rule, the retrospective evaluation of the session should be influenced significantly by how it concluded (the end). As such, if the session ends with an exposure to a stimulus that is not at the top of the hierarchy, the exposure therapy session will be less likely to be perceived as highly distressing and the patient will be more likely to continue receiving treatment.

In the hypothetical scenario with Tyrone, the therapy session would not conclude as soon as Tyrone's distress lowered from a 9 to a 7 when holding a syringe. Rather, Tyrone would finish therapy with exposure to a stimulus lower on his hierarchy, such as looking at a cartoon picture of a needle, which he rated at a 4 in terms of SUDs. Tyrone proceeds to habituate to the cartoon, eventually rating his distress level at a 3. His retrospective evaluation of the session is more

favorable than it would have been had he ended with the exposure to the more distressing stimulus. Tyrone might be more likely to keep his next appointment.

The present study attempted to assess the role of the peak-end rule in improving the acceptability of and adherence to exposure protocols for BII phobia. The investigator examined the effect that decreasing the aversive nature of the stimuli viewed at the end of a BII exposure session had on global retrospective evaluations of the session. It was hypothesized that participants who view several less aversive stimuli at the end of the session would retrospectively rate the session as less aversive, rate themselves as more willing to complete a hypothetical second exposure session, and ask for less money to complete a hypothetical second exposure session.

Methods

Participants

The University of Kansas Institutional Review Board approved this study. Participants were recruited using Amazon.com's Mechanical Turk (MTurk) service. Evidence suggests that MTurk participants are more representative of the U.S. population than convenience samples frequently used in social science research (Berinsky, Huber & Lenz, 2012; Buhrmester, Kwang & Gosling, 2011). MTurk workers were eligible for the study if they were 18 years old or older, fluent in written English and indicated that they did not become dizzy or faint when presented with images of blood, injections, or injuries. Each worker was offered $1.50 as compensation for participation.

Sample Size Calculation

The investigator conducted a power analysis using G*Power 3.1.7 (Faul, Erdfelder, Lang & Buchner, 2007). It indicated that a sample size of 176 participants would have 80% power to detect a difference, assuming a small effect size (f = .1) using an independent t-test with a 0.05 significance level. The investigator conservatively assumed a small effect size due to the novelty of applying the peak-end rule to exposures.

Procedures

A total of 201 participants were recruited via MTurk. Each participant was asked to log on to a website featuring the Qualtrics (Provo, Utah) survey software to look at pictures of BII. Participants provided basic demographic information and completed the Medical Fear Survey-Short Version (Olatunji et al., 2012b), which assessed their BII anxiety. Following this, the website explained the concept of Subjective Units of Distress (SUDs) and asked them to rate their pre-trial SUDs about looking at pictures of BII. Participants were then exposed to 12 severe photos of blood and injuries which the investigator selected from the International Affective Picture System (IAPS; Lang, Bradley & Cuthbert, 2008). The IAPS photos were presented in order of increasing severity (as determined by their IAPS normed arousal ratings). Photos were presented to participants for five seconds apiece. After each photo, participants rated the maximum amount of SUDs they experienced while viewing the photo. Three additional, less severe photos of blood and injuries (e.g., a scraped knee) were selected from Flickr.com and inserted among the IAPS photos to serve as a validity check; a higher average distress rating for these photos than the IAPS photos would likely indicate a participant had not paid attention to the photos presented.

Half the participants (the “regular end” group) were randomized to have their viewing session end at the conclusion of the fifteenth and most severe photo. They provided a

retrospective global SUDs assessment of their viewing experience, indicated their hypothetical willingness to view more BII photos, and reported how much hypothetical money they would require to complete a second exposure session. They also answered an exploratory question concerning their distress at that moment. The other half of the participants received the "better end," viewing and rating three additional, less severe photos for five seconds apiece. These three photos were also selected from Flickr.com. The better end group then completed the same post-viewing outcome measures as the regular end group. Following this, participants were debriefed.

Table 1 displays the procedures for both groups in sequential order.

Measures

Demographic data. The investigator collected information regarding participants' gender, age, ethnicity and family income.

Medical Fear Survey-Short Version (MFS-SV). Participants' baseline distress concerning BII stimuli was assessed using the MFS-SV. The MFS-SV consists of 25 items across five subscales, measuring medical fears related to Injections and Blood Draws, Sharp Objects, Blood, Mutilation, and Examination and Symptoms. The internal consistency alpha coefficients of its five subscales range from .81 to .89. The subscales also evidence acceptable levels of convergent validity with measures of injection fear, fearfulness and disgust sensitivity (mean r = .53), as well as acceptable levels of discriminant validity with measures of anxiety sensitivity and trait anxiety (mean r = .35) (Olatunji et al., 2012b).

Pre-viewing distress. Participants' baselines distress about viewing BII stimuli was also measured using a 0-8 SUDs scale (the same SUDs scale used in Barlow et al., 2011). The "0" was labeled as "no distress," the "2" as "slight distress," the "4" as "definite distress," the "6" as "strong distress," and the "8" as "extreme distress." SUDs evidences acceptable concurrent

validity with the State/Today Form of the Multiple Affect Adjective Check List, a measure of state anxiousness (r = .53) (Kaplan & Smith, 1995).

***Average distress for first 15 images*.** Participants' distress while viewing the first 15 photos was assessed using SUDs ratings. After each photo, participants rated their SUDs on the same 0-8 scale described previously. From each participant's ratings of the 15 photos, the investigator derived a mean rating that served as that participant's average distress score for these images.

***Primary outcome measure: Retrospective global assessment of distress*.** After viewing all images (15 for the regular end group and 18 for the better end group), participants retrospectively rated their overall level of distress associated with the exposure session on a 0-8 SUDs scale.

***Secondary outcome measure: Willingness to complete hypothetical second session*.** After the end of the exposure session, participants rated on a 0-8 Likert scale how willing they would be to complete a hypothetical second session. The labels on the Likert scale were similar to those used for the SUDs scales (e.g., "0" was labeled as "not willing").

***Secondary outcome measure: Payment required for hypothetical second session*.** After the end of the exposure session, participants indicated how much money ($) they would need to complete a hypothetical second session.

***Exploratory outcome measure: Current distress*.** After the end of the exposure session, participants indicated their distress at that moment.

Results

Demographics

Demographics between groups were compared using either an independent *t*-test (for age) or chi-squared tests (for gender, ethnicity, and family income). No significant differences were detected with respect to gender, age, ethnicity, and family income. Table 2 presents these data.

Baseline comparison

Independent *t*-tests were used to assess for baseline differences between groups on MFS-SV scores and pre-viewing distress ratings. There were no significant baseline differences on MFS-SV scores; t (199) = .55, p = .586, or on pre-viewing distress ratings; t (199) = .34, p = .735. Table 3 displays these data.

Average distress for first 15 images

Average distress ratings for the first 15 pictures were analyzed using an independent *t*-test to detect any differences between groups prior to their randomization to different endings. There were no significant differences between groups for their average distress for the first 15 images; t (199) = 1.18, p = .240. Table 4 presents these data.

Primary outcome measure: Retrospective global assessment of distress

Differences on the retrospective global assessment of distress were assessed between groups using an independent *t*-test. The better end group rated the session as significantly less distressing with a medium effect size; t (199) = 3.54, p <.001, d = .50. Table 5 displays these data.

Secondary outcome measure: Willingness to complete hypothetical second session

Participants' ratings of their hypothetical willingness to view additional BII images were analyzed between groups with an independent *t*-test. There were no significant differences between groups on willingness; t (199) = 1.42, p = .158, d = .20. Table 5 presents these data.

Secondary outcome measure: Payment required for hypothetical second session

The payments ($) participants' indicated they would hypothetically require to view additional BII photos were compared between groups using an independent *t*-test. Five answers that were uninterpretable (e.g., one participant wrote "Depends on the amount of photos") were excluded from the analysis. Eighteen outliers were also excluded on the basis of Tukey's (1977) interquartile criteria. There were no significant differences between groups on hypothetical money required; t (176) = 1.25, p = .214, d = .19. Table 5 displays these data.

Exploratory outcome measure: Current distress

An independent *t*-test was utilized to compare between groups on participants' assessments of their distress at the end of the experiment. One participant did not answer the question. The better end group endorsed lower distress. The effect size was small; t (198) = 2.56, p = .011, d = .36. Table 5 presents these data.

Discussion

This study assessed the effect of the peak-end rule on evaluations of exposure to BII stimuli. The results supported the primary hypothesis. Participants who viewed less severe photos at the end of the session retrospectively rated it as less distressing. The results did not support the two secondary hypotheses. Participants who received the "better end" were not more willing to view hypothetical additional photos. They also did not report that they would require less money to view said hypothetical photos. However, the better end group did indicate they experienced less distress at the end of the experiment.

This investigation represents a novel application of the peak-end rule to exposure therapy. Previous studies examined, for instance, retrospective evaluations of pleasant and

unpleasant film clips of a sometimes graphic nature (Fredrickson & Kahneman, 1993) and an aversive procedure experienced within a health context (colonoscopy; Redelmeier, Katz, & Kahneman, 2003). However, this is the first attempt to apply the peak-end rule to a clinical psychological phenomenon, and the results are consistent with the broader peak-end rule literature.

While the experiment's results are encouraging, they are tempered by several limitations. Most notably, the study's population was not drawn from a clinical sample of persons with BII phobia. While it is possible some MTurk workers who saw the listing for the study have BII phobia, it is unlikely that a financial incentive of $1.50 was sufficient for them to expose themselves to their phobic stimuli. Furthermore, as a safety precaution, those who become dizzy or faint upon viewing BII stimuli – such as those with BII phobia – were specifically excluded from participating in the research. Consequently, the results obtained here may not generalize to a population with BII phobia participating in actual therapeutic exposure sessions; they may accordingly lack in clinical utility.

Data from the secondary outcome measures deal an additional blow to the clinical meaningfulness suggested by the findings from the primary outcome measure; the severity of the blow, though, is uncertain. Participants who viewed less severe photos at the end of the experiment neither evidenced increased willingness nor indicated they would require less money to view more BII photos. These secondary outcome measures required participants to "look forward" and consider participation in future hypothetical exposure sessions – not unlike actual clients undergoing exposure therapy. However, aside from this consideration, the clinical relevance of the secondary outcome measures is unclear. Actual exposure therapy clients are rarely paid for participating in therapy or asked how much money they would require to

participate.[2] Similarly, actual clients are, in part, motivated to participate in exposure sessions by the prospect of improvement of their mental health; participants in the present study had no similar motivation to continue looking at BII stimuli, and this may have moderated their reported willingness to do so.

Results from the exploratory outcome measure regarding current distress also muddy the clinical utility waters. The better end group was less distressed at the end of the experiment, a potential indication that a less severe end to exposure sessions lowers not just retrospective evaluations of distress but distress in the present moment. However, since this outcome measure was included purely on an exploratory basis (i.e., with no hypothesized difference between groups), it cannot be weighted as heavily as the other outcome measures in evaluations of the clinical relevance of the study's findings.

A final question of utility concerns the relative importance of end-of-session distress to therapeutic exposure outcomes. While traditionally assumed to be important in exposure therapy protocols, a review by Craske et al. (2008) indicated that anxiety ratings at the end of exposure sessions are unrelated to improvement. If the findings from Craske and colleagues (2008) are replicated, then the importance of the preliminary data from the present experiment is greatly diminished.

In addition to questions regarding the results' clinical meaningfulness, the interpretation of the findings presented here assumes that participants' retrospective evaluations were in fact determined by the peak and end affective experiences of the exposure session. However, participants' peak and end ratings were not tracked in real-time, as has been the case in some

[2] Though the question was phrased as a hypothetical, MTurk workers may have also suspected that the experimenter was asking how much money they would require to look at more photos as a prelude to his offering another MTurk experiment. This inference could have artificially inflated their responses; mean answers for both groups ($3.79 for the regular end and $3.29 for the better end, respectively) were greater than the $1.50 participants were paid.

other peak-end experiments (e.g., Fredrickson & Kahneman, 1993). As such, it is possible that other factors may have determined their retrospective ratings of the session.

Given the promising data from the primary outcome measure, future experiments should ascertain if the study's results replicate with a population with BII phobia. Similar findings would justify exploring applications of the peak-end rule to actual exposure sessions with clients with BII phobia and other anxiety disorders. This would determine if exposure therapy informed by the peak-end rule could provide important "better ends," producing clinically significant improvements in adherence to therapy, pursuance of standard medical care, and adherence to medical regimens for chronic illnesses.

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Table 1: Procedures for Groups 1 and 2

Group 1 (regular ending)	Demographics	Medical Fear Survey-Short Version	Pre-viewing distress	Distress rating for each of 15 slides	Outcome measures	
Group 2 (less severe photos at end)	Demographics	Medical Fear Survey-Short Version	Pre-viewing distress	Distress rating for each of 15 slides	Distress ratings for each of three additional, less severe slides	Outcome measures

Table 2: Demographic Data

		Group 1 (regular ending)		Group 2 (less severe photos at end)			
		n	*M* or %	*n*	*M* or %	*df*	*p*
Gender (male)		64	58.71%	47	51.08%	1	.279
Age		109	33.70	92	34.03	199	.827
Ethnicity		109		92		6	.439
	American Indian / Native American	-	-	1	1.1%		
	Asian / Asian American	5	5.6%	2	2.2%		
	Black / African American	9	8.3%	6	6.5%		
	Hispanic / Latino	7	6.4%	5	5.4%		
	White / Caucasian	88	80.7%	75	81.5%		
	Pacific Islander	-	-	1	1.1%		
	Other	-	-	2	2.2%		
Family Income		109		92		7	.783
	Under $25,000	20	18.3%	14	15.2%		
	$25,000 to $39,000	40	36.7%	29	31.5%		
	$40,000 to $49,999	9	8.3%	13	14.1%		
	$50,000 to $74,999	17	15.6%	19	20.7%		
	$75,000 to $99,999	17	15.6%	12	13.0%		
	$100,000 to $124,999	2	1.8%	1	1.1%		
	$125,000 to $150,000	2	1.8%	3	3.3%		
	Over $150,000	2	1.8%	1	1.1%		

Table 3: Baseline Data

	Group 1 (regular ending)			Group 2 (less severe photos at end)					
	n	*M*	*SD*	*n*	*M*	*SD*	*t*	*df*	*p*
MFS-SV scores	109	38.08	9.72	92	37.33	9.87	.55	199	.586
Pre-viewing distress ratings	109	3.02	1.81	92	2.93	1.66	.34	199	.735

Table 4: Average Distress for First 15 Images

	n	*M*	*SD*	*t*	*df*	*p*
Group 1 (regular ending)	109	4.28	1.72	1.18	199	.240
Group 2 (less severe photos at end)	92	4.00	1.66			

Table 5: Outcome Data

	Group 1 (regular ending)			Group 2 (less severe photos at end)						
	n	*M*	*SD*	*n*	*M*	*SD*	*t*	*df*	*P*	*d*
Overall, how distressing did you find the experience of looking at the photos?	109	5.47	2.32	92	4.33	2.22	3.54	199	<.001	.50
Hypothetically, how **willing** would you be to view more photos like these? (Note: Your answer will **not** affect the length of the experiment.)	109	3.50	2.52	92	4.00	2.50	1.42	199	.158	.20
Hypothetically, please indicate how much money ($) you would need to be paid to view more photos like these. (Note: Your answer will **not** affect the length of the experiment.)	92	3.79	2.86	86	3.27	2.66	1.25	176	.214	.19
At this moment, how much **distress** are you feeling?	109	4.08	2.40	91	3.26	2.06	2.56	198	.011	.36