Available online at www.sciencedirect.com

ScienceDirect

Cognitive and Behavioral Practice 26 (2019) 130-142

Cognitive and Behavioral Practice

www.elsevier.com/locate/cabp

The Suitability of an Inhibitory Learning Approach in Exposure When Habituation Fails: A Clinical Application to Misophonia

Brandon Frank and Dean McKay, *Fordham University*

Recent findings have led to a reconceptualization of the mechanisms that account for the efficacy of exposure-based treatments. Termed the "inhibitory learning model," this approach emphasizes new learning when confronted with previously avoided stimuli rather than merely the cessation of fear or aversive emotional responding. In this paper, we propose the applicability of the inhibitory learning model for conditions and contexts in which simple exposure does not produce habituation. We illustrate this application from an in-progress randomized controlled treatment trial for adults with misophonia. Misophonia is a condition marked by strong aversive reactions to specific sounds. It is a difficult to treat and understudied syndrome. All participants in the trial received exposure, either before or after a stress management module of treatment. Exposure treatment emphasized altered expectancies for the target sounds as well as deliberate practice in hearing sounds on the individually developed hierarchy. Inhibitory learning strategies were employed to increase treatment adherence and commitment, shape patient behavior during exposures, manufacture negative prediction errors, increase perceived control over reactions, and promote learning that generalized to functional improvements. The findings are discussed in the context of future applications of the inhibitory learning model for psychopathology associated with avoidance.

The efficacy of cognitive-behavioral therapy (CBT) rests on in vivo practice of new tasks, either through direct exposure (Peris et al., 2015) or behavioral exercises designed to elicit cognitive distortions (Bennett-Levy et al., 2004). Abramowitz, Taylor, and McKay (2005) suggested that behavioral exercises, at least in some instances, represent special cases of exposure. Thus, for the purposes of this paper, we define exposure approaches as any intervention that involves contact with an otherwise avoided stimulus. In this paper, we review the relevance of inhibitory learning approaches to exposure and discuss specific application to misophonia (i.e. selective sound aversion), a condition for which exposure has been theorized as contraindicated (see, e.g., Schneider & Arch, 2015).

We hope to illustrate that while habituation may benefit exposure, and can be understood from an inhibitory learning perspective, clinicians must often proceed in treatment without this benefit. In these instances, treatment procedures and contextual variables should be manipulated to shape client behavior during exercises—such shaping of the exposure "process" may promote beneficial outcomes. In our work with misophonia, we have observed that inhibitory learning strategies alter clients' predictions of symptom contingencies, and the salience afforded (e.g., the controllability, manageability, and ephemerality of reactions). This approach to exposure provides a different manner of engaging aversive stimuli, promotes tolerance for stress reactions, manufactures negative prediction errors, and generalizes learning to contexts outside of therapy. As patients learn that reactions can be modified and tolerated, downstream symptom reduction occurs.

Keywords: inhibitory learning; habituation; misophonia; exposure therapy; distress tolerance

Traditional and Contemporary Views of Exposure

Exposure therapies (ETs) are considered treatments of choice in a number of mental health disorders including obsessive-compulsive and related disorders (OCRD; Koran, Hanna, Hollander, Nestadt, & Simpson, 2007), posttraumatic stress disorder (PTSD; Bradley, Greene, Russ, Dutra, & Westen, 2005), and anxiety disorders (Choy, Fyer, & Lipsitz, 2007; Lissek et al., 2005; Rodebaugh, Holaway, & Heimberg, 2004). These syndromes, like misophonia, are thought to be the manifestation of aversive responses to conditioned stimuli (Bentz et al., 2013). However, persons diagnosed with these mental health disorders show deficits in extinction learning (Lissek et al., 2010), and may overestimate potential threat (e.g., stimulus generalization: Wessa & Flor, 2007; exaggerated anticipatory response: Craske, Kircanski, et al., 2008). Thus, while ETs have been found efficacious, there is a need to understand and augment the core mechanisms by which ETs produce benefit.

Recent models of exposure have expanded on the original conceptualization from basic learning theory. In the original model, exposure would be employed to target a conditioned response (CR) through repeated presentations of conditioned stimuli (CS). Foa and Kozak (1986) instructed therapists to activate a conditioned fear and sustain exposure until habituation (i.e. fear reduction) was experienced. This was considered the corrective process of exposure, and hypothesized to have implications at the neural level through alterations in the fear structure and associated brain pathways leading to behavioral expressions (avoidance, rituals, etc.).

The traditional conceptualization of ETs derived from emotion processing theory, which emphasized between and within exposure habituation (Hermans, Craske, Mineka, & Lovibond, 2006). In order for such a reduction to occur, the CS would need to be presented without the unconditional stimulus (US). Accordingly, Foa and Kozak (1986) viewed extinction learning as a true change in the CR. A newer conceptualization, the inhibitory learning model, posits that exposure achieves a temporary deactivation of the US memory, which inhibits the CS-US pairing without altering it (Vervliet, Craske, & Hermans, 2013). Extinction learning enacts behavior change through a newly formed inhibitory association that competes with the original excitatory association (Bouton, 2000). This view is better supported by animal and human conditioning studies (see Hermans et al., 2006, for a review). Most importantly, the inhibitory learning perspective had led to suggested revisions in exposure methodology (see Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014).

Dunsmoor, Niv, Daw, and Phelps (2015) proposed several problems with habituation as a basis for treatment. First, extinction learning relies on negative prediction errors (see Courville, Daw, & Touretzky, 2006). If CS/US pairings occur rarely, their absence may not violate expectancies. For example, in the case of health anxiety, a person may fear a disease that has never been experienced, given a high-intensity outcome. Qualities like intensity and frequency may suppress prediction errors during simple exposure (e.g., "I may not have contracted cancer this time, but if I do the next, it will be fatal"). Alternately, in misophonia, high contingency exists between the CS and CR (as we show in a trial we present later). Sound stimuli reliably and automatically provoke a response, which only escalates with repeated exposure. In both spectrum extremes, negative prediction errors may not occur through traditional exposure protocols. Second, Dunsmoor, Niv, et al., (2015) noted that habituation does not predict between-session CR reduction (e.g., Plendl & Wotjak, 2010) and therapeutic improvement (e.g., Craske, Waters, et al., 2008). Humans are likely predisposed to retain fear memory longer than safety learning, preventing such a lasting impact (Bouton, 1993). Third, exposure renders the feared stimulus more ambiguous (Bouton, 2004). This may cause problems for patients treated by ETs. For instance, high intolerance of uncertainty predicts spontaneous recovery of conditioned fear (Dunsmoor, Campese, Ceceli, LeDoux, & Phelps, 2015). Given the learning deficits present in clinical populations, ambiguity may work against successful outcomes.

In clinical practice, repeated failures to achieve habituation may lead therapists to discontinue exposure. However, inhibitory learning could optimize treatment for difficult cases (Craske, Liao, Brown, & Vervliet, 2012; Craske, Waters, et al., 2008). Modifications to ETs consonant with the inhibitory learning model may also expand the scope of exposure to syndromes not currently deemed suitable to treat with this modality (see Freeman, 2008; Freeman et al., 2016).

Inhibitory Learning Strategies as Good Practice

ETs that focus on inhibitory learning strategies are not the same as those called for by a habituation paradigm. In order to maximize inhibitory learning, Craske et al. (2014) proposed the following: expectancy violation regarding aversive outcomes, extinction of multiple and combined CS, occasional (albeit counterintuitive) reinforcement of the targeted CS, removal of safety signals and behaviors (targeting the fear of fear), stimulus and task variability, instructional cues for extinction learning, use of multiple contexts during exposure, and timed extinction during the memory reconsolidation window. These strategies alter the goal of ETs (e.g., between- vs. within-session habituation) as well as the process (e.g., the use of hierarchies).

Clinicians immediately encounter a challenge in implementing ETs—namely, the degree to which clients are willing to participate. Over the years there have been numerous methods designed to improve client engagement, all centered on the notion of "buy in"—effectively, the extent a particular client recognizes the need to complete exposure exercises. Psychoeducation materials articulate the phenomenology of target conditions, the basic concepts of how exposure works, and best practices for guiding clients through the process (see Abramowitz, Deacon, & Whiteside, 2012, for a detailed discussion). However, once therapists begin to conduct exposure, the process can deviate from this ideal description. To illustrate, a client who reports fears of contamination may describe the problem in highly specific ways to the therapist, resulting in a well-thought-out hierarchy that is used to guide treatment. However, once exposure is initiated, particularly in vivo, it may occur that important details regarding the feared situation, how much distress is experienced, and how likely it is that the client will

experience relief can deviate from the original discussion. In these situations, savvy clinicians must determine additional methods for ensuring the success of a particular exercise. Slavish adherence to an approach that demands habituation can be at odds with effective therapeutic process, particularly given the aforementioned cognitive functions (i.e. motivation, engagement) that can interfere with reducing distress. This is an important hazard for clinicians to avoid, since ending a session with clients experiencing escalating distress may diminish the likelihood of future sessions, and in turn lead to a harmful outcome.

So what is a clinician to do? One option is to abort exposure, but this can fuel avoidance and further sensitize the client (see Dimidjian & Hollon, 2010, for a discussion of generally harmful effects in treatment). Recognizing this potential pitfall, skilled clinicians are likely to shift expectancies regarding outcome through in-session processes such as humor. For a child patient afraid of germs, having tea around a toilet might produce a mixture of contingencies that dampen the threat association. This comports with one facet of the inhibitory learning model, whereby the successful experience of exposure is sufficient to lead to change.

We contend that exposure as understood from a purely conceptual standpoint is not the same as exposure implemented in everyday clinical practice. Many clinicians who regularly practice ETs engage in creative methods for developing exercises. We can again rely on contamination fear to illustrate this point. One of the authors (DM) recently worked with a male client who had contamination fear related to bodily secretions. This would lead one to expect to conduct exposure in bathrooms or around dirty laundry, to name just two sources. In conducting exposure, one could instruct the client to handle dirty laundry brought to the office. However, creative alternatives might be employed to engage the client and augment exposure. In this illustration, modifications were engaged until the client, in the privacy of the office, was comfortable wearing his underwear on his head. The comments that followed centered on how this was an interesting fashion statement, that it was an unusual choice for keeping his head warm, and how wearing garments other than hats on his head would surely be conversation starters. The intent in engaging in such flippant discussion around stimuli that otherwise caused distress was to produce a different emotional reaction (i.e. the client found the situation amusing) and to shift expectancies away from the danger of the stimuli. However, this approach is decidedly inconsistent with the original conceptualization of exposure, whereby habituation to an expected outcome requires the emotional experience to persist until it declines naturally.

Clinicians may be comfortable attempting such a within-exposure modification should the situation call for a change. However, if repeated exposures continue to produce unexpected results, such as the failure to habituate, this may induce clinicians to discontinue exposure as a treatment modality. We propose an alternate perspective. Grounded in the inhibitory learning model, we suggest habituation as a particularly effective mechanism for violating expectancies in session (namely, the expectancy for continuity in a CR). However, client behavioral responses and context provide alternative variables for fostering change. As in the clinical example above, client behaviors related to the feared stimuli can impact the perceived tolerability and salience of a CR, independently from its magnitude. The process modification employed by DM (i.e. flippant discussion and behavior related to the CS) may have provided a sense of control surrounding the "stressor," in that typical stimuli–response behaviors were diverted. It may also have provoked new learning through the unexpected tolerability of the stressor given the behavioral modifier. In addition, the salience of a CR, however powerful, will likely be changed with the context of humor (a form of coping). We propose that inhibitory learning strategies have wide applicability in clinical practice. In the misophonia treatment we present, between-session changes were provoked with little to no within-session habituation present.

Efforts to foster change using inhibitory learning strategies may be understood with the framework of shaping as successive approximations toward a particular set of behavioral responses (Peterson, 2004). Behavior can and perhaps should remain the focus, rather than ratings of distress or other self-report markers of a CR. Of note, recent suggestions to augment core CBT interventions follow a similar rationale to our proposal (see Balán, Lejuez, Hoffer, & Blanco, 2016; Carmel, Comtois, Harned, Holler, & McFarr, 2016). In each case, client behaviors are being shaped through modified contingencies. In motivational interviewing (MI), therapist and client verbal behavior provides the shaping element. In contingency management, external incentives are employed. In a similar way, inhibitory learning strategies can be employed to shape the behavior and experience of clients who are not habituating during exposure. In our opinion, ETs should not be discontinued until these efforts are made.

A Clinical Application of the Inhibitory Learning Model

In what follows we present a clinical illustration of the inhibitory learning model in adults with misophonia, or selective sound aversion. This condition provides an excellent case study for the suitability of process

modifications to exposure. Habituation may rarely or never occur for persons with misophonia, due to the stable nature of the CS/CR pairing (i.e. sounds immediately activate limbic and auditory pathways as an experience similar to synesthesia, with few instances of natural reduction). As mentioned, ETs have been theorized to be contraindicated since repeated exposures to anger- and disgust-provoking stimuli may not lead to habituation (Schneider & Arch, 2015). Cavanna and Seri (2015) suggested that ETs may be useful only for misophonia patients who react with anxiety and distress, rather than anger or other emotional reactions. Therefore, misophonia provides an exemplar of situations in which conscientious therapists may discontinue exposure. While traditional exposure protocols could lead to sensitization for these individuals, we hope to show that an inhibitory learning approach may provide substantial therapeutic benefit.

Jastreboff and Jastreboff (2001) coined the term "misophonia" as an abnormal negative reaction to sounds that derives from prior exposure and contextual factors (i.e. factors other than spectrum and intensity). Physical properties of the sound (pitch, volume, etc.) are considered secondary determinants (Jastreboff & Jastreboff, 2015). This differs from conditions defined by hyperactivity in the auditory pathway, such as hyperacusis (Aazh et al., 2014). Misophonia is triggered by common noises such as "gum popping, food chewing or crunching, nose sniffing, breathing, pen clicking, clock ticking, whistling, lip smacking, and finger or foot tapping" (Cavanna & Seri, 2015, p. 2117). Triggers can include human, animal, and mechanical sounds, as well as physical cues. No functional connection has been found between the threshold of hearing and decreased sound tolerance, which can occur for persons with or without organic cochlear abnormalities (Jastreboff & Jastreboff, 2015).

Jastreboff and Hazell (2004) suggested that misophonia results from enhanced connectivity between auditory and limbic pathways. This hypothesis is supported by the nature of the reaction, which involves both affective and physical components (Cavanna & Seri, 2015). The affective response can involve fear, distress, anxiety, irritability, and anger (Edelstein, Brang, Ramachandran, & Rouw, 2013; Schröder, Vulink, & Denys, 2013; Webber & Storch, 2015; Wu, Lewin, Murphy, & Storch, 2014). Physical manifestations include tightness in the head and chest, tachycardia, hyperthermia, sweating, and labored breath (Schwartz, Leyendecker, & Conlon, 2011). Many individuals with misophonia experience reactions in the mild to moderate range (Edelstein et al., 2013). Nonetheless, due to the pervasive nature of trigger sounds and stimulus-avoidance behaviors, misophonia results in functional impairment in work, school, and social life (Cavanna & Seri, 2015).

Misophonia and Exposure Therapies

While the empirical base for treating misophonia is extremely limited, several case studies have suggested CBT as a helpful modality (e.g., Bernstein, Angell, & Dehle, 2013; McGuire, Wu, & Storch, 2015; Reid, Guzick, Gernand, & Olsen, 2016). In the first published treatment study (n = 201), Jastreboff and Jastreboff (2014) adapted tinnitus retraining therapy (TRT). An inspection of the protocol suggested overlap with inhibitory learning strategies (e.g., expectancy violation, stimulus, and task variability). Jastreboff and Jastreboff (2014) oscillated misophonia triggers with sounds rated as positive by their patients, and oscillated levels of patient control regarding the volume of these sounds. This was intended to create new associations that would compete with previously formed conditioned responses. However, quantitative assessment of symptoms was not employed. More recently, Schröder, Vulink, van Loon, and Denys (2017) reported an open trial of eight biweekly group CBT sessions focusing on task concentration strategies, stimulus manipulation, counterconditioning, and relaxation training. Of note, stimulus manipulation (i.e. participant's ability to change or "swap" trigger sounds) was intended to increase perceived controllability, given that misophonia stimuli are often unpredictable. While only 48% (n = 42) of the participants manifested a meaningful change on the Amsterdam Misophonia Scale (A-MISO-S; Schröder et al., 2013), Schröder et al. (2017) noted that their use of a low-dose group intervention may have been responsible.

In developing our treatment paradigm (see below), we employed similar techniques and strategies. We propose that exposure, when modified to optimize inhibitory learnning, may be useful to treat misophonia. However, in our experience, persons with the condition are very hesitant to engage with ETs. Further, patients insist that simple exposure will increase distress ratings within and between sessions. Trigger stimuli and their associated auditory pathway are uncontrollable, fostering learned helplessness and the fear of fear. These realities create challenges for treatment, and substantial barriers to engagement and compliance.

Such challenges also provide targets of intervention. First, persons with misophonia report a range of emotional and behavioral reactions to stimuli (see Table 1). These reactions provoke a cascade of negative outcomes, including functional disturbance (e.g., avoiding family, unemployment, social isolation). Reactions may also intensify symptoms by reinforcing the salience of triggers. As misophonia patients learn that reactions can be modified and tolerated, we hypothesize that this activates an inhibitory expectancy. Second, when ETs provide inhibitory "control" expectancies, this may compete with future excitatory learning. Williams and Maier (1977) found that controllable stress provided a therapeutic

Table 1
Maladaptive Reactions From the Misophonia Questionnaire

Misophonia Emotions and Behaviors Scale
1. Leave the environment to a place where the sound(s) cannot be heard anymore?
2. Actively avoid certain situations, places, things, and/or people in anticipation of the sound(s)?
3. Cover your ears?
4. Become anxious or distressed?
5. Become sad or depressed?
6. Become annoyed?
7. Have violent thoughts?
8. Become angry?
9. Become physically aggressive?
10. Become verbally aggressive?

"immunization" for subsequent stress. On a neural level, control is an active factor that inhibits the stress response (see Fleshner, Maier, Lyons, & Raskind, 2011, for a review). Therefore, task variability, as proposed by Craske et al. (2014), should be constructed to emphasize patient control over the stimuli. Third, since misophonia reactions are contextual and idiosyncratic (e.g., persons may find a sound bothersome in certain situations but not others), the use of multiple and combined CSs, as well as multiple contexts, may be of import. In our experience, persons with misophonia often expect distress ratings to remain constant or worsen, and therefore, manufacturing changes to such a progression may assist inhibitory learning. Finally, we speculate that a stress management paradigm could work in tandem with ETs for persons with misophonia. As mentioned by Schröder et al. (2017), irritability and concomitant physiological arousal exacerbate misophonia reactions. In our experience, individuals report substantial worsening of symptoms when under stress. An improved ability to manage stress reactions may prime useful behaviors during exposure (e.g., reduced avoidance).

Indirectly, this discussion illustrates the benefit of habituation for clinical practice. It is a natural mechanism by which expectancies are violated. For a condition like misophonia, such a process will not occur unless changes in CS function and CR intensity, as marked by distress ratings, are manufactured. Therefore, in order to achieve negative prediction errors (e.g., encountering misophonia stimuli with diminished reaction), modifications to the exposure protocol should be implemented.

Misophonia Sample

This clinical illustration derives from an in-progress randomized treatment trial. To date, 18 individuals (M_{age} = 34.94, SD = 10.95) have been evaluated, completed baseline assessments, and completed treatment. See Figure 1 for the flow of enrollment in the protocol. These individuals were given the Structured Clinical Interview for DSM-5 (SCID-5; First, Williams, Karg, & Spitzer, 2015) and a battery of self-report scales. Participants were reassessed with self-report scales following every second active treatment session (Sessions 2, 4, 6, 8, 10, and 12) and at 3- and 6-month follow-up periods. Of the baseline sample, 10 individuals (56%) met criteria for a DSM-5 disorder. Of those diagnosed, a median of two comorbid diagnoses were given (range 1–4). Two

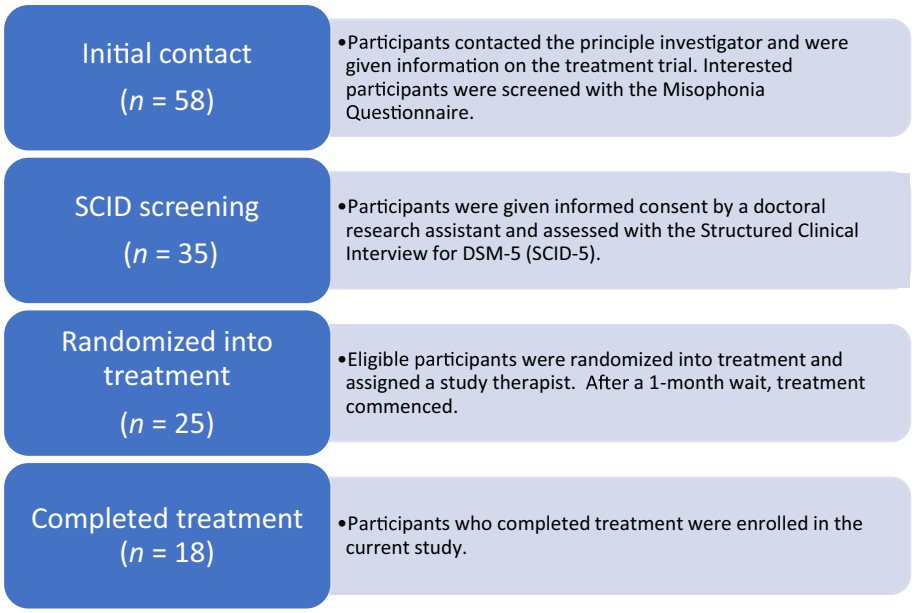

Figure 1. Process of determining treatment eligibility and enrollment.

individuals (22%) met criteria for major depressive disorder and two individuals (11%) met criteria for persistent depressive disorder. One individual (6%) met criteria for premenstrual dysphoric disorder. Two individuals (11%) met criteria for alcohol use disorder. One individual (6%) met criteria for panic disorder (PD), three individuals (17%) met criteria for generalized anxiety disorder, two individuals (11%) for specific phobia, two individuals (11%) for social anxiety disorder, and two individuals (11%) for agoraphobia. Two individuals (11%) met criteria for OCRD and one additional individual (6%) met criteria for excoriation (skin-picking) disorder. Finally, two individuals (11%) met criteria for hypersomnolence disorder and one individual (6%) met criteria for adult attention-deficit/hyperactivity disorder. As can be seen, this was an extremely diverse diagnostic group with a high level of psychopathology present. The median number of individuals in each diagnostic category was 1.5.

Sound aversion was assessed with the Misophonia Questionnaire (MQ; Wu et al., 2014), an 18-item instrument that measures symptoms and reactions on a Likert scale (range 0–4), along with a global severity rating (range 1–15). Participants reported a median of six sounds as at least somewhat bothersome (range 3–8 sounds) with a mean severity of 3.02 (SD = 0.51). Participants also reported a median of eight maladaptive reactions (range 6–11 reactions) with a mean severity of 2.57 (SD = 0.58). Global severity was rated in the moderate to severe range (M = 8.78, SD = 1.83). Our sample endorsed elevated levels of depression (M = 9.44, SD = 8.40), anxiety (M = 6.78, SD = 7.13), and stress (M = 17.11, SD = 9.54), as indexed by the Depression Anxiety Stress Scale–21 (DASS-21; Lovibond & Lovibond, 1995). In comparison with the norms provided by Henry and Crawford (2005), scores were most elevated for stress (z_M = 0.91, z_{SD} = 1.14), next for anxiety (z_M = 0.51, z_{SD} = 1.21), and least elevated for depression (z_M = 0.49, z_{SD} = 1.08).

The majority of all participant reports (79.3%) indicated at least some out-of-session practice. We propose homework completion as a rough proxy for overall treatment engagement, and a useful metric for the acceptability of our approach. Most participant reports indicated that this practice was somewhat to extremely helpful in gaining control over symptoms (71.9%) and therapeutic progress (78.7%). Study therapists rated treatment adherence and engagement using measures taken from Glenn et al. (2013). Participants' homework adherence was rated on a 4-point Likert scale (1 = *missed most*, 2 = *missed half*, 3 = *missed few*, 4 = *missed none*). Engagement and overall commitment to CBT were rated on a Likert scale from 0 (*none*) to 10 (*complete*). These ratings were reported after Sessions 2, 4, 6, 8, 10, and 12. Overall, study therapists reported strong participant adherence (M = 3.28, SD = 0.80) and overall commitment to CBT (M = 8.23, SD = 1.78).

Treatment Paradigm

Exposure

In this study, participants were randomized to stress management followed by exposure or exposure followed by stress management. Both phases of treatment were offered in six biweekly individual sessions (in total, 12 sessions). During exposure, participants practiced engaging with sounds that were deemed difficult to tolerate in accord with their personal hierarchy. Within the constraints of a 45- to 50-minute session, the aim was to complete challenging exposure activities and to identify ways in which the participant could experience neutral or positive emotional reactions to the exposure material. This required that the therapist attend to behavioral and emotional reactions of the participant during the exposure session. We attempted to vary the difficulty of material from a minimum level at which the participant experienced the stimuli, to material of high difficulty that could still be processed by the participant without overwhelming distress. During the introductory session, we developed a careful hierarchy of triggers using the Subjective Units of Distress Scale (SUDS; Wolpe, 1969). In this hierarchy, we attempted to granulate sound and context, as well as produce interactive effects from combinations of sounds (see Table 2 for an example). We understood the hierarchy as an evolving entity that could shift within and between exposures. In accord with

Table 2
Example of a Hierarchy Granulated by Sound, Context, and Combination

Stimulus	SUDS (0–100)
Breathing sounds at night, no one else awake	95
Someone biting into an apple	90
Someone eating fried chicken wings	90
My mother's voice when laughing	85
Breathing sounds with someone else speaking to participant	80
Breathing sounds, daytime with other people awake and speaking normal volume	75
Breathing sounds off in distance, participant listening to music	70
Someone eating soup, quietly	60
My mother's voice, normal speaking volume	55
Pen clicking	45
Someone eating marshmallows	40
Breathing sounds, detected in a crowded room	35
Someone biting a chocolate bar	25

Note. SUDS = Subjective Units of Distress Scale.

Arch and Abramowitz (2015), we proceeded through the hierarchy in a nonlinear rather than progressive manner.

Prior to exposure, we conducted psychoeducation emphasizing the following points. First, the goal of exposure was to help alleviate distress associated with sounds routinely encountered on a daily or regular basis. Second, it was not expected that exposure would lead to enjoyment of the stimuli, only that they might become easier to tolerate. Third, because the focus was on tolerating sounds that were typically avoided, practice between sessions was necessary. Fourth, exposure was to be collaborative with a level of control given to the participant. Fifth, the initial focus was on identifying items from the hierarchy that the participant felt confident he or she could tolerate, and would be able to practice several times a day. Finally, the functional aim of exposure was to allow full mobility to people, places, and experiences that were associated with trigger sounds.

Throughout exposure, the treatment manual specified a focus on employing inhibitory learning strategies (see Table 3). We incrementally incorporated simultaneous exposure to multiple and variable trigger sounds and the use of multiple listening environments or modalities (e.g., headphones, speakers, in vivo). These strategies were intended to optimize the ecological validity and generalizability of exposures. Additionally, we attempted to mismatch expectancies whenever possible, such as instructing participants to "power pose" during exposure, dance, or enact an unrealistic grin. We sought misophonia videos that were odd or ridiculous, such as "Snore-chestra—Silent Night" (www.youtube.com/watch?v=trJJpC-74zQ). These fostered an atmosphere of humor in treatment, which we termed "self-schadenfreude" (i.e. "delighting in the suffering of the self"). We employed affect labeling. This included the use of affect-laden words (e.g., "bomb," "explosion") as well as verbalizations of affective experience. Qualitative evidence suggested this to be helpful. Participants found it challenging and useful to articulate their reactions to sounds using neutral, rather than emotive language (see the "Clinical Themes" section for an example). Following Jastreboff and Jastreboff (2014) and Schröder et al. (2017), we implemented counterconditioning with

Table 3
Inhibitory Learning Strategies and Misophonia

Inhibitory Learning Strategies	Problem Addressed	Specific Strategies
Expectancy violation	Expectation of stability in misophonia reactions. Lack of negative prediction errors with misophonia stimuli.	• Use of odd or ridiculous sounds. • Humor during exposure (e.g., self-mockery or mockery of others). • Distress tolerance exercises focused on emotional and behavioral reactions. • Behavioral modifiers (e.g., power posing, smiling, dancing). • Counterconditioning during exposure.
Deepened extinction	Fear of fear. Inability to transfer skills from exposure into life.	• Multiple and combined stimuli. • Incorporating distress tolerance exercises during exposure.
Stimulus and task variability	Expectation of stability in misophonia reactions. Inability to transfer skills from exposure into life.	• Proceeding through the hierarchy nonlinearly. • Use of stimulus manipulation.
Removal of safety signals	Attempts at avoidance that reinforce the salience of misophonia stimuli.	• Removing behavioral signs of "white knuckling" during exposure. • Using behavioral modifiers to prevent avoidance. • Task concentration exercises.
Multiple contexts	Expectation of stability in misophonia reactions. Inability to transfer skills from exposure into life.	• Employing multiple modalities (headphones, speakers, in vivo, etc.). • Exposure in various environments in session and during homework.
Instructional cues for extinction learning	Propensity to respond to new triggers with previous patterns such as avoidance or aversion.	• Mental reinstatement. • Emphasis on the "training" metaphor for exposure, as well as the concept of incremental change.
Timed extinction during memory reconsolidation window*	This window may not be predictable for clients with misophonia, but may occur naturally with task variability.	• Variation in tasks and stimuli. • Repeat exposure tasks after a 30-minute window.
Occasional reinforcement of the targeted CS*	May occur naturally for nonhabituating clients.	N/A
Affect labeling	Fear of fear. Expectation of stability in misophonia reactions.	• Use of affect -aden words and verbalizations of affective experience.

some clients (i.e. the oscillation paradigm adapted from TRT), as well as stimulus manipulation. The purpose of these techniques was to change expectancies, foster new associations, increase distress tolerance, and generalize extinction learning.

Stress Management

In the stress management phase (adapted from Payne, Ellard, Farchione, Fairholme, & Barlow, 2014), participants identified specific thoughts that contributed to distress and completed behavioral exercises designed to improve distress tolerance. These exercises were chosen to fit client needs, such as exposure to unpleasant experiences (e.g., skipping a meal, hyperventilating, intentionally leaving the house messy) or structured to target avoidance (e.g., having a difficult conversation, being assertive with feelings). The stress management paradigm was chosen due to its importance in the inhibitory learning framework (see Abramowitz & Arch, 2014) and clinical relevance to our sample. Craske et al. (2014) posited that the "fear of fear" mitigates inhibitory learning by preventing a change in CS/US expectancies. For example, Craske et al. (2014) noted that for a person with panic, a reduction in anxiety may not diminish the true threat of a panic attack (e.g., loss of control). In order to change the CS/US expectancy, patients would need to tolerate the CS (e.g., physiological arousal) regardless of whether the US occurs (e.g., the loss of control in a panic attack). Our participants reported that trigger sounds and concomitant emotional and behavioral reactions were unpleasant (see Table 1). Therefore, increased tolerance for these reactions was posited as equal in importance to tolerance for misophonia stimuli.

Stress management was intended to aid participants in developing general coping skills for a wide range of stressors. The following principles were discussed during the psychoeducational component. First, coping with stress can impact how other aversive experiences were tolerated (such as misophonia reactions). Second, developing better coping strategies can improve well-being and facilitate tolerance of other minor aversive experiences. Third, the perception of stress would be lower with better coping resources. A chain analysis was constructed for idiographic stress-relevant situations with descriptions of antecedents, responses (i.e. thoughts, emotions, and behaviors), and consequences.

Participants were encouraged to monitor engagement with, and resistance to, stressful situations. Engagement, or internal willingness, was presented as a useful means of fostering a helpful cognitive mind-set during a stressor. For example, engagement with the stressor could allow a process of perceived control (e.g., "I will embrace the opportunity to think about my hungry feelings"). Resistance to the stressor might exacerbate the experience, both during and after the situation (e.g., "I need to eat to get rid of hunger"). This approach, as well as overall tolerance for adverse experiences, was practiced during interoceptive exposures. These included spinning in a chair followed by standing up and focusing on the dizziness (if there was heightened interoceptive awareness); focusing on a negative emotional state (if, e.g., the participant reported difficulty tolerating adverse emotional experiences); focusing on minor pain, or inducing it in a limited way (i.e. with a cold-presser test for under 2 minutes); and inducing ongoing experiences that were mildly aversive (e.g., skipping a meal, putting a pebble in the shoe and wearing it for a time, or setting an alarm to wake up in the middle of the night). These stress management exercises were conceptualized as directly relevant to fostering inhibitory learning during exposure. The new behaviors shaped by these exercises were intended to prime behavioral responses when participants were triggered by misophonia stimuli.

Study Therapists

Study therapists were doctoral students (n = 5; 60% female) working under the supervision of DM. Prior to the study, therapists were given extensive training in the exposure and stress management paradigms and reviewed the treatment manual. In addition, therapists met for clinical supervision and case conference once per week during treatment. DM was also available via cell phone for any questions or emergencies regarding treatment. Finally, DM randomly selected 50% of all sessions of treatment (grouped by therapist) to review and assess fidelity.

Clinical Themes

Initial Resistance to Exposure

Qualitatively, our sample presented as resistant to exposure and manifested low expectation that ETs would produce benefit. This resistance is regularly reported on dedicated Facebook and sub-Reddit pages, and noted repeatedly at annual misophonia conferences (attended by author DM, who discussed treatment at this meeting; McKay, 2015). Further, participants were often familiar with the concept of habituation and did not consider it relevant to their condition. ETs were viewed as a replication of daily experience, in which trigger sounds were regularly unavoidable. Participants reported efforts to avoid misophonia stimuli that included wearing headphones, avoiding trigger situations, and attempting to internally "block out" the sound. However, these strategies were considered generally ineffective, and often disrupted everyday tasks and relationships. Unlike other conditions, successful avoidance appears uncommon in persons with misophonia. Repeated attempts at avoidance appear normative. As mentioned, we speculate that the uncontrollable and unavoidable nature of misophonia

stimuli and their associated auditory pathway provoke a stable conditioned response. Thus, negative prediction errors do not naturally occur. However, attempts at avoidance may reinforce behavioral and emotional reactions that, in turn, reinforce symptom salience. In sum, these dynamics create a very difficult population for ETs.

We speculate that the inhibitory learning strategies we employed produced increased treatment adherence and commitment independently from other therapeutic skills (e.g., empathy, active listening). Unlike other skills, these strategies were specifically aimed at the process of exposure and shaping participant behavior to shift expectancies from danger or distress to other contingencies (as noted, the controllability, manageability, and ephemerality of reactions). We instructed participants to focus on behavioral reactions to stimuli, and simply notice changes in distress levels over time. In other words, we explicitly avoided fostering an expectancy for habituation. We found that this approach provided individuals with a sense of efficacy regarding their ability to "succeed" at exposure. Success was redefined as the ability to manufacture expectancy violations, to handle multiple stimuli, to remove safety signals, and so on.

For one individual, this entailed oscillating exposure practice with songs that were enjoyed, and encouraging the participant to dance during the songs or during stimuli or while both played. We prompted several participants to listen to bizarre or strange versions of sound clips, such that humor and "self-schadenfreude" provided a modification. In another case, a participant was instructed to focus on the sounds as they were, imagine alternate sources that could provoke similar sounds (e.g., a gorilla can make chewing sounds, motors can make tapping or pen-clicking sounds), and then refocus on the sounds as coming from their original source. This provoked informative granularity in the participant's response as well as a greater perception of control over her reactions. Other participants employed affect labeling during exposures, and reported that this technique increased their capacity to engage with the stimuli. For example, one patient regularly attempted to suppress her reactions during exposure. The use of affect labeling (in this case, a neutral, descriptive language) was in direct contrast to her typical avoidance strategy, and fostered a sense of efficacy when reactions occurred. Throughout, giving occasional control to participants during exposure (whether over volume, modality, or sound) appeared to promote a tolerance for misophonia reactions. However, this was done in conjunction with more challenging exposures, in which we injected unexpected and difficult stimuli.

Shaping Engagement Behavior

In accord with Abramowitz and Arch (2014), therapists strove to foster a "bring it on" attitude. This was particularly true when failures occurred, such that the exposure process and behavioral reactions were emphasized more than reductions in distress. This perspective was applied to compliance failures (e.g., when participants failed to complete homework) as well as within-exposure challenges (e.g., low willingness to engage with the task). Noncompliance was proposed to reveal a meaningful and useful challenge. We encouraged participants to avoid self-recrimination and seek solutions to the behavioral "problem." We suggested that information could be gained through experimental testing of all modifiable factors surrounding noncompliance. For example, participants might modify the time of day in which homework was completed, or the conditions preceding or following practice. This manner of engagement ran counter to participants' normal reactions, in which patterns of self-recrimination fostered avoidance.

Therefore, participants were encouraged to experiment with any contextual or behavioral variables that would foster an engaged attitude. Participants were encouraged to attempt homework with different strategies, and with different contexts. One individual conducted a cold-pressor task during exposure (i.e. a distress tolerance exercise in which persons hold an ice pack against the skin for increasing intervals). This participant noted that she could divert her attention from one stimulus to the next, and use her behavior response to the cold pressor as a model for exposure. Notably, this individual, who suffered from Lyme disease, reported an increase in distress tolerance during the course of treatment and an overflow from pain management strategies into tolerance for misophonia. Another participant was instructed to hold her breath at increasing intervals (specifically, what she perceived to be tolerable plus an additional 5 seconds), and then to apply this same technique to exposure practice. This was found to provoke a sense of confidence that fostered engagement. This individual was also instructed to experiment with relaxation (e.g., making a fist with her toes) during unavoidable misophonia triggers in daily life. Since this was found to promote a sense of control and reduce avoidance, it was not deemed to be a safety signal. However, such approaches are controversial (see below).

Occasionally, the first step toward optimal behavior during exposure was to "surrender" to the reaction. We noted fear and avoidance subsequent to misophonia reactions in almost all participants. This was often expressed as a sense of shame (e.g., "I shouldn't be bothered this much" or "I should be able to handle this better"). For one participant, a hiking analogy was employed. He recalled an incident in which he could not keep up with others in his group, but was able to keep going (thereby achieving the same end at a different pace and via an alternate route). The stress management phase

of treatment provided useful behavioral experiments surrounding this perspective. One participant was encouraged to exercise with boxing gloves and a heavy bag, as a means to learn that an emotional state like anger could be useful as well as harmful. Of note, this was not intended to reduce the participant's aggression, but simply to modify this individual's expectations and behavioral reactions toward aggressive feelings.

For others, humor provided a powerful alternate response pattern. Verbalized self-mockery and mockery of others transferred a positive element to aversive experiences. In session, feelings of annoyance and irritation became occasions of laughter. For example, a disposition of "self-scheudenfreude" (e.g., "This is the worst sound," "I couldn't be more miserable," "I'm going to die") provided an alternative to self-recrimination. Mockery of others (e.g., "My housemates are like elephants banging around upstairs," "That's so rude," "They're the worst") provided an outlet for uncontrollable sounds and reactions. One participant was instructed to vocalize her frustration toward her husband in graphic detail. Her partner was coached to respond nonreactively (e.g., "Oh, that's interesting"). This became a source of humor between them, and substantially improved their interactions. Other participants were encouraged to voice their reactions in song, in "whale voice," or in unusual accents, as a means to upset expectancies. Finally, we promoted the idea that exposure should be viewed as training, whereby participants' ideal reaction to triggers would be obtained through continually refining technique and strategy, remaining flexible, and tracking progress (i.e. thoughts, feelings, and behaviors when triggered). We proposed that this training would begin during therapy sessions but must continue posttreatment. As mentioned, the central goal of these modifications was to foster engaged behavior that would "overflow" into exposure. We assumed that such engagement would be a prerequisite for inhibitory learning.

Promoting Inhibitory Learning

The strategies proposed by Craske et al. (2014) were employed to maximize inhibitory learning during exposure (see Table 3). In order to violate expectancies, we employed odd and ridiculous sounds, humor, and behavioral modifiers (e.g., power posing, smiling, and dancing during exposure). In addition, we integrated counterconditioning with some participants (i.e. oscillating misophonia triggers with sounds or music rated as pleasant). Finally, we constructed distress tolerance exercises that were aimed at behavioral and emotional reactions common to misophonia sounds. These included avoidance, anger, disgust, annoyance, and anxiety. We recognize that anger and irritability, which are normative reactions for persons with misophonia, may be effectively treated by cognitive interventions (see Beck & Fernandez, 1998). However, we agree with Craske et al. (2014) regarding the overlap between the inhibitory learning model and cognitive models of belief disconfirmation. We also concur that inhibitory learning approaches provide a wider array of techniques in comparison with behavioral testing of cognitions. Participants reported that treatment increased their tolerance for misophonia reactions, and in many cases modified their experience of the stimuli. In order to overcome the "fear of fear," and promote the transfer of skills gained during exposure into everyday life, we employed variability in contexts and stimuli. By varying trigger sounds and listening environments in a nonlinear fashion, we were able to upset expectancies and demonstrate granularity in participants' responses. We attempted to deepen extinction by using multiple and combined stimuli, and by combining exposure with distress tolerance exercises. Participants noted that these "challenge" exposures were more difficult, but also better resembled everyday life. As mentioned, we observed that affect labeling and similar vocalizations of experience promoted engagement, tolerance for aversive emotions and sensations, and functional improvements. These inhibitory learning strategies appeared to promote distress tolerance and diminish learned helplessness in our participants.

Along with behavioral reactions (grimacing, covering ears, etc.), avoidance was a commonly observed safety behavior. We attempted to remove behavioral signs of "white knuckling" when they occurred, prompting our participants to maintain a calm demeanor during exposure, or use the aforementioned behavioral modifiers. In addition, some of our exposures focused on task concentration, so that participants could learn to diminish the functional impact of aversive reactions. For example, one participant was instructed to complete work around the house while engaging with distressful emotional experiences or misophonia triggers. This type of exercise was repeated in the office for participants who worked outside the home. We attempted to ensure that all techniques and strategies employed did not become safety signals. However, in our opinion, this remains a risk for modifications on traditional exposure protocols. We emphasized the "training" metaphor during exposure, such that modifications were promoted as enablers for better and more challenging practice. In addition, we encouraged participants to mentally reinstate this engaged demeanor in daily life, and in preparation for future triggers.

Certain inhibitory learning strategies may not be relevant for misophonia. We did occasionally attempt to vary exposure tasks such that participants were reexposed to stimuli in a 30-minute interval. However, there was no qualitative evidence that we achieved timed extinction

during the memory reconsolidation window. Participants did find this technique useful for assessing granularity in experience (i.e. distress ratings were intermittently diminished or elevated the second time around). In addition, occasional reinforcement of the targeted stimuli was unnecessary, as distress ratings did not conform to typical habituation patterns. These two phenomena may occur naturally for persons with misophonia during exposure, but appear difficult to manufacture or promote by therapeutic intervention.

Incremental Change

While the aforementioned improvements were observed, therapists noted a steady pull toward avoidance in participants, the desire for distress reduction, and the hope for treatment to serve as a panacea rather than a challenge. Therefore, therapists emphasized the goal of incremental change, particularly during closing sessions. Many participants exited treatment with a restored sense of hope. One individual voiced this in nuanced fashion:

> I realize that I was stuck in a situation that it's hard to deal with and I could not tell anyone. And it's nice that you opened it and showed me that there are more possibilities and that I can move this concrete block of one ton, even if it's inch by inch. I am sure that in the future, it needs time to integrate, but I'm sure that in situations it's going to be in the back of my mind and it's going to help me to know what to do.

It is possible that conditions that do not respond to ETs with habituation may demand extended exposure protocols (i.e. longer periods of treatment than typically needed). This was a brief feasibility trial with 12 sessions over 6 weeks. However, this study does provide some evidence that when habituation fails, ETs can produce therapeutic gains by focusing on inhibitory learning strategies.

Our participants reported functional impairment as the most disabling component of misophonia symptoms. This was noted in the domains of work, interpersonal relationships, and in familial interactions. Many participants expressed fear and avoidance at the prospect of discussing their symptoms with others, even close family members. Treatment appeared to foster confidence on the part of participants to (a) manage symptoms in a manner that allowed greater mobility to people, places, and experiences; and (b) more effectively discuss symptoms with others when reactions occurred. Numerous participants reported an increased willingness to pursue work or greater capacity managing work environments. The techniques and strategies employed appeared to improve interpersonal relationships, and increase participants' willingness to seek out social interaction. Finally, a few participants expressed the intention of discussing their symptoms directly and calmly with close relations. This could be important as typical discussion of triggers with family, if and when they occurred, tended to be confrontational, nonproductive, and ostracizing.

Conclusions and Future Directions

In this paper, we argued that inhibitory learning approaches could be suitable for conditions in which simple exposure does not produce within-session habituation. Such treatment failures may occur when exposure contingencies prevent negative prediction errors, or when symptoms inculcate learned helplessness and the fear of fear (Craske et al., 2014; Dunsmoor, Niv, et al., 2015). Modifications to the exposure protocol allowed our therapists to manufacture expectancy violations that would not have arisen of their own accord (i.e. to circumvent habituation and safety learning). Thus, the process of exposure demonstrated a new manner of interacting with stimuli, which prompted novel expectancies (regarding, in particular, personal reactions and their manageability). Behavioral responses to misophonia triggers became the focus of treatment, rather than within-session habituation. Further, stress management instilled an ethos of engagement that overflowed into exposure practice. As participants developed skills in tolerating distress and uncertainty, they gained control over their behavioral responses, which led to concomitant inhibitory associations. Each of the inhibitory learning strategies that we employed contributed to this cascade.

Process modifications to ETs in line with the inhibitory learning model may expand the scope of exposure. Some clinicians avoid conducting exposure tasks as a potential "opening of Pandora's box," or out of an abundance of caution should there be concerns that distress cannot be managed within session (often due to poor prediction of outcome at the hierarchy stage of treatment planning). If habituation fails, they reason, clients may be harmed and retreat into avoidance and other maladaptive behavioral patterns (such as through sensitization; Foa & Kozak, 1986). However, such treatment likely fails when simple exposure does not in and of itself violate expectancies. For example, Freeman et al. (2016) employed a paradigm in which participants with persecutory delusions were able to achieve belief disconfirmation, expectancy violation, and the removal of safety behaviors. The study protocol suggests that participants ($n = 30$) accrued benefit largely through inhibitory learning. Of note, the design involved a condition for which exposure is not a frontline treatment, and in which simple exposure was not found helpful.

While we have promoted an inhibitory learning approach in ETs, there are ongoing issues with how this should be implemented. For example, Craske et al. (2014)

noted potential harm in the misuse of retrieval cues. In our treatment protocol for misophonia, certain process modifications (e.g., "power posing" during exposure) could function alternately as expectancy modifiers, retrieval cues, safety behavior, or coping devices. An inhibitory learning approach obliges therapists to closely observe and respond to these nuances. Further, even when therapists provide psychoeducation and motivational enhancers, clients may retreat into avoidance and the desire for a panacea.

In the clinical application provided, conclusions should be tempered by the preliminary nature of results. It is possible that conditions that do not respond to ETs with habituation will demand an extended exposure protocol (as noted, longer periods of treatment than typically needed). Our treatment paradigm was a brief 12 sessions. While homework compliance was notable, there were weeks in which participants failed to complete out-of-session practice. This may have been due to persons' negative views toward exposure, and the low occurrence of habituation. A longer time frame might allow clinicians to elicit increased engagement and compliance. Qualitatively, as participants experienced benefit from exposure, they were more compliant with practice.

In this paper, our emphasis has been on a novel application of exposure, relying on principles of inhibitory learning, to a problem characterized by avoidance. These principles could be applied to other clinical problems in which exposure fails to produce habituation. Exposure can be viewed as a functional process that addresses putative neural bases of psychopathology (see Tryon, Hoffman, & McKay, 2017, for a theoretical discussion). The current clinical illustration qualitatively suggests that inhibitory learning strategies may foster between-session changes even without the aid of habituation. Based on this conceptualization and emerging research regarding inhibitory learning, clinicians may more successfully develop and facilitate exposure for problems associated with avoidance.

References

Aazh, H., McFerran, D., Salvi, R., Prasher, D., Jastreboff, M., & Jastreboff, P. (2014). Insights from the first international conference on hyperacusis: Causes, evaluation, diagnosis and treatment. *Noise and Health*, *16*, 123–126. https://doi.org/10.4103/1463-1741.132100

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. https://doi.org/10.1016/j.cbpra.2013.06.004

Abramowitz, J. S., Deacon, B. J., & Whiteside, S. P. H. (2012). *Exposure therapy for anxiety: Principles and practice*. New York, NY: Guilford Press.

Abramowitz, J. S., Taylor, S., & McKay, D. (2005). Potentials and limitations of cognitive treatments for obsessive-compulsive disorder. *Cognitive Behaviour Therapy*, *34*, 140–147. https://doi.org/10.1080/16506070510041202

Arch, J. J., & Abramowitz, J. S. (2015). Exposure therapy for obsessive-compulsive disorder: An optimizing inhibitory learning approach. *Journal of Obsessive-Compulsive and Related Disorders*, *6*, 174–182. https://doi.org/10.1016/j.jocrd.2014.12.002

Balán, I. C., Lejuez, C. W., Hoffer, M., & Blanco, C. (2016). Integrating motivational interviewing and brief behavioral activation therapy: Theoretical and practical considerations. *Cognitive and Behavioral Practice*, *23*, 205–220. https://doi.org/10.1016/j.cbpra.2015.07.001

Beck, R., & Fernandez, E. (1998). Cognitive-behavioral therapy in the treatment of anger: A meta-analysis. *Cognitive Therapy and Research*, *22*, 63–74. https://doi.org/10.1023/A:1018763902991

Bennett-Levy, J., Butler, G., Fennell, M., Hackmann, A., Mueller, M., & Westbrook, D. (2004). *Oxford guide to behavioural experiments in cognitive therapy*. Oxford, UK: Oxford University Press.

Bentz, D., Michael, T., Wilhelm, F. H., Hartmann, F. R., Kunz, S., von Rohr, I. R. R., & de Quervain, D. J. F. (2013). Influence of stress on fear memory processes in an aversive differential conditioning paradigm in humans. *Psychoneuroendocrinology*, *38*, 1186–1197. https://doi.org/10.1016/j.psyneuen.2012.12.018

Bernstein, R. E., Angell, K. L., & Dehle, C. M. (2013). A brief course of cognitive behavioural therapy for the treatment of misophonia: A case example. *Cognitive Behaviour Therapist*, *6*, E10. https://doi.org/10.1017/S1754470X13000172

Bouton, M. E. (1993). Context, time, and memory retrieval in the interference paradigms of Pavlovian learning. *Psychological Bulletin*, *114*, 80–99. https://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* (1S), 57–63. https://doi.org/10.1037/0278-6133.19.

Bouton, M. E. (2004). Context and behavioral processes in extinction. *Learning and Memory*, *11*, 485–494. https://doi.org/10.1101/lm.78804

Bradley, R., Greene, J., Russ, E., Dutra, L., & Westen, D. (2005). A multidimensional meta-analysis of psychotherapy for PTSD. *American Journal of Psychiatry*, *162*, 214–227. https://doi.org/10.1176/appi.ajp.162.2.214

Carmel, A., Comtois, K. A., Harned, M. S., Holler, R., & McFarr, L. (2016). Contingencies create capabilities: Adjunctive treatments in dialectical behavior therapy that reinforce behavior change. *Cognitive and Behavioral Practice*, *23*, 110–120. https://doi.org/10.1016/j.cbpra.2015.04.001

Cavanna, A. E., & Seri, S. (2015). Misophonia: Current perspectives. *Neuropsychiatric Disease and Treatment*, *11*, 2117–2123. https://doi.org/10.2147/NDT.S81438

Choy, Y., Fyer, A. J., & Lipsitz, J. D. (2007). Treatment of specific phobia in adults. *Clinical Psychology Review*, *27*, 266–286. https://doi.org/10.1016/j.cpr.2006.10.002

Courville, A. C., Daw, N. D., & Touretzky, D. S. (2006). Bayesian theories of conditioning in a changing world. *Trends in Cognitive Sciences*, *10*, 295–300. https://doi.org/10.1016/j.tics.2006.05.004

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*, 5–27. https://doi.org/10.1016/j.brat.2007.10.003

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

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. https://doi.org/10.1016/j.brat.2014.04.006

Craske, M. G., Waters, A. M., Lindsey Bergman, R., Naliboff, B., Lipp, O. V., Negoro, H., & Ornitz, E. M. (2008). Is aversive learning a marker of risk for anxiety disorders in children? *Behaviour Research and Therapy*, *46*, 954–967. https://doi.org/10.1016/j.brat.2008.04.011

Dimidjian, S., & Hollon, S. D. (2010). How would we know if psychotherapy were harmful? *American Psychologist*, *65*, 21–33. https://doi.org/10.1037/a0017299

Dunsmoor, J. E., Campese, V. D., Ceceli, A. O., LeDoux, J. E., & Phelps, E. A. (2015). Novelty-facilitated extinction: Providing a novel outcome in place of an expected threat diminishes recovery of defensive responses. *Biological Psychiatry*, *78*, 203–209. https://doi.org/10.1016/j.biopsych.2014.12.008

Dunsmoor, J. E., Niv, Y., Daw, N., & Phelps, E. A. (2015). Rethinking extinction. *Neuron*, *88*, 47–63. https://doi.org/10.1016/j.neuron.2015.09.028

Edelstein, M., Brang, D., Ramachandran, V. S., & Rouw, R. (2013). Misophonia: Physiological investigations and case descriptions. *Frontiers in Human Neuroscience*, *7*, 1–11. https://doi.org/10.3389/fnhum.2013.00296

First, M. B., Williams, J. B., Karg, R. S., & Spitzer, R. L. (2015). *Structured Clinical Interview for DSM-5—Research Version (SCID-5 for DSM-5, Research Version; SCID-5-RV)*. Arlington, VA: American Psychiatric Association.

Fleshner, M., Maier, S. F., Lyons, D. M., & Raskind, M. A. (2011). The neurobiology of the stress-resistant brain. *Stress*, *14*, 498–502. https://doi.org/10.3109/10253890.2011.596865

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

Freeman, D. (2008). Studying and treating schizophrenia using virtual reality: A new paradigm. *Schizophrenia Bulletin*, *34*, 605–610. https://doi.org/10.1093/schbul/sbn020

Freeman, D., Bradley, J., Antley, A., Bourke, E., DeWeever, N., Evans, N., . . . Clark, D. M. (2016). Virtual reality in the treatment of persecutory delusions: Randomised controlled experimental study testing how to reduce delusional conviction. *British Journal of Psychiatry*, *209*, 62–67. https://doi.org/10.1192/bjp.bp.115.176438

Glenn, D., Golinelli, D., Rose, R. D., Roy-Byrne, P., Stein, M. B., Sullivan, G., . . . Craske, M. G. (2013). Who gets the most out of cognitive behavioral therapy for anxiety disorders? The role of treatment dose and patient engagement. *Journal of Consulting and Clinical Psychology*, *81*, 639–649. https://doi.org/10.1037/a0033403

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, *44*, 227–239. https://doi.org/10.1348/014466505X29657

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

Jastreboff, M. M., & Jastreboff, P. J. (2001). Components of decreased sound tolerance: Hyperacusis, misophonia, phonophobia. *ITHS Newsletter*, *2*, 5–7.

Jastreboff, P. J., & Hazell, J. W. P. (2004). *Tinnitus retraining therapy: Implementing the neurophysiological model*. New York, NY: Cambridge University Press.

Jastreboff, P. J., & Jastreboff, M. M. (2014). Treatments for decreased sound tolerance (hyperacusis and misophonia). *Seminars in Hearing*, *35*(2), 105–120. https://doi.org/10.1055/s-0034-1372527

Jastreboff, P. J., & Jastreboff, M. M. (2015). Chapter 21: Decreased sound tolerance. hyperacusis, misophonia, diplacousis, and polyacousis. In *Handbook of clinical neurology: Volume 129* (pp. 375–387). New York, NY: Elsevier. https://doi.org/10.1016/B978-0-444-62630-1.00021-4

Koran, L. M., Hanna, G. L., Hollander, E., Nestadt, G., & Simpson, H. B. (2007). Practice guideline for the treatment of patients with obsessive-compulsive disorder. *American Journal of Psychiatry*, *164*, 5–53.

Lissek, S., Powers, A. S., McClure, E. B., Phelps, E. A., Woldehawariat, G., Grillon, C., & Pine, D. S. (2005). Classical fear conditioning in the anxiety disorders: A meta-analysis. *Behaviour Research and Therapy*, *43*, 1391–1424. https://doi.org/10.1016/j.brat.2004.10.007

Lissek, S., Rabin, S., Heller, R. E., Lukenbaugh, D., Geraci, M., Pine, D. S., & Grillon, C. (2010). Overgeneralization of conditioned fear as a pathogenic marker of panic disorder. *American Journal of Psychiatry*, *167*, 47–55. https://doi.org/10.1176/appi.ajp.2009.09030410

Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales*. Sydney, Australia: Psychology Foundation.

McGuire, J. F., Wu, M. S., & Storch, E. A. (2015). Cognitive-behavioral therapy for 2 youths with misophonia. *Journal of Clinical Psychiatry*, *76*, 573–574. https://doi.org/10.4088/JCP.14cr09343

McKay, D. (2015). *Evaluation and treatment of misophonia*. Paper presented at the Misophonia Association, Carol Stream, IL.

Payne, L. A., Ellard, K. K., Farchione, T. J., Fairholme, C. P., & Barlow, D. H. (2014). Emotional disorders: A unified transdiagnostic protocol. In D. H. Barlow (Ed.), *Clinical handbook of psychological disorders: A step-by-step treatment manual* (5th ed., pp. 237–274). New York, NY: Guilford Press.

Peris, T. S., Compton, S. N., Kendall, P. C., Birmaher, B., Sherrill, J., March, J., . . . Piacentini, J. (2015). Trajectories of change in youth anxiety during cognitive–behavior therapy. *Journal of Consulting and Clinical Psychology*, *83*, 239–252. https://doi.org/10.1037/a0038402

Peterson, G. B. (2004). A day of great illumination: BF Skinner's discovery of shaping. *Journal of the Experimental Analysis of Behavior*, *82*, 317–328. https://doi.org/10.1901/jeab.2004.82-317

Plendl, W., & Wotjak, C. T. (2010). Dissociation of within- and between-session extinction of conditioned fear. *Journal of Neuroscience*, *30*, 4990–4998. https://doi.org/10.1523/JNEUROSCI.6038-09.2010

Reid, A. M., Guzick, A. G., Gernand, A., & Olsen, B. (2016). Intensive cognitive-behavioral therapy for comorbid misophonic and obsessive-compulsive symptoms: A systematic case study. *Journal of Obsessive-Compulsive and Related Disorders*, *10*, 1–9. https://doi.org/10.1016/j.jocrd.2016.04.009

Rodebaugh, T. L., Holaway, R. M., & Heimberg, R. G. (2004). The treatment of social anxiety disorder. *Clinical Psychology Review*, *24*, 883–908. https://doi.org/10.1016/j.cpr.2004.07.007

Schneider, R. L., & Arch, J. J. (2015). Letter to the editor: Potential treatment targets for misophonia. *General Hospital Psychiatry*, *37*, 370–371. https://doi.org/10.1016/j.genhosppsych.2015.03.020

Schröder, A., Vulink, N., & Denys, D. (2013). Misophonia: Diagnostic criteria for a new psychiatric disorder. *PLoS One*, *8*(1), e54706. https://doi.org/10.1371/journal.pone.0054706

Schröder, A. E., Vulink, N. C., van Loon, A. J., & Denys, D. A. (2017). Cognitive behavioral therapy is effective in misophonia: An open trial. *Journal of Affective Disorders*, *217*, 289–294. https://doi.org/10.1016/j.jad.2017.04.017

Schwartz, P., Leyendecker, J., & Conlon, M. (2011). Hyperacusis and misophonia: The lesser-known siblings of tinnitus. *Minnesota Medicine*, *94*, 42–43.

Tryon, W. W., Hoffman, J., & McKay, D. (2017). Neural networks as explanatory frameworks of psychopathology and its treatment. In D. McKay, J. S. Abramowitz & E. A. Storch (Eds.), *Treatments for psychological problems and syndromes*. Chichester, UK: Wiley.

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

Webber, T. A., & Storch, E. A. (2015). Toward a theoretical model of misophonia. *General Hospital Psychiatry*, *37*, 369–370. https://doi.org/10.1016/j.genhosppsych.2015.03.019

Wessa, M., & Flor, H. (2007). Failure of extinction of fear responses in posttraumatic stress disorder: Evidence from second-order conditioning. *American Journal of Psychiatry*, *164*, 1684–1692. https://doi.org/10.1176/appi.ajp.2007.07030525

Williams, J. L., & Maier, S. F. (1977). Transituational immunization and therapy of learned helplessness in the rat. *Journal of Experimental Psychology: Animal Behavior Processes*, *3*, 240–252. https://doi.org/10.1037/0097-7403.3.3.240.

Wolpe, J. (1969). *The practice of behavior therapy* (2nd ed.). New York, NY: Pergamon Press.

Wu, M. S., Lewin, A. B., Murphy, T. K., & Storch, E. A. (2014). Misophonia: Incidence, phenomenology, and clinical correlates in an undergraduate student sample. *Journal of Clinical Psychology*, *70*, 994–1007. https://doi.org/10.1002/jclp.22098.

The authors declare that there are no conflicts of interest.

Address correspondence to Brandon Frank, M.S., M.A., Department of Psychology, Fordham University, 441 East Fordham Road, Bronx, NY 10458; e-mail: bfrank5@fordham.edu.

Received: February 6, 2017
Accepted: April 27, 2018
Available online 12 June 2018