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An Inhibitory Learning Approach to Cognitive-Behavioral Therapy for Children and Adolescents

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Although exposure-based cognitive-behavioral therapy (CBT) is efficacious for childhood anxiety and obsessive–compulsive disorder (OCD), many youth do not adequately respond to treatment. Extinction learning is an important process in exposure-based CBT. However, youth with anxiety disorders and OCD exhibit impairments in extinction processes that are best characterized by deficits in inhibitory learning. Therefore, the utilization of strategies to optimize inhibitory learning during exposures may compensate for these deficits, thereby maximizing extinction processes and producing more robust treatment outcomes for exposure-based CBT. This paper reviews several strategies to optimize inhibitory learning in youth with anxiety disorders and OCD, and presents practical examples for each strategy. This paper also highlights the difference between inhibitory learning-based exposures and prior conceptual approaches to exposure therapy in clinical practice. It concludes with a discussion of future directions for clinical research on inhibitory learning and exposure-based CBT in youth.

Anxiety disorders and obsessive–compulsive disorder (OCD) are psychiatric conditions that collectively affect up to 30% of youth (Merikangas et al., 2010; Zohar, 1999) and are characterized by clinically significant fear and distress in response to stimuli and/or situational cues perceived as threats. These psychiatric conditions are associated with significant impairment (Langley et al., 2014; Piacentini, Peris, Bergman, Chang, & Jaffer, 2007) and a diminished quality of life (Lack et al., 2009; Stevanovic, 2013). Childhood anxiety and OCD typically become chronic conditions in the absence of treatment, with childhood anxiety serving as a strong predictor of anxiety and mood disorders in adulthood (Pine, Cohen, Gurley, Brook, & Ma, 1998). Therefore, the effective treatment of these conditions in childhood can minimize morbidity across the life span.

Current evidence-based treatments for these psychiatric conditions include cognitive-behavioral therapy (CBT) and pharmacotherapy. CBT is recommended for youth with mild to moderate symptom severity and recommended in combination with pharmacotherapy for moderate to severe cases (Bloch & Storch, 2015; Connolly & Bernstein, 2007). Thus, regardless of severity, youth with these conditions should receive a course of CBT (although it should be noted that limited access hinders this ideal). Although some differences exist across individual CBT protocols, evidence-based CBT largely consists of psychoeducation, symptom hierarchy development, anxiety management skills, cognitive restructuring, and exposure and response prevention (ERP). Given that exposures represent a critical element of CBT (Peris et al., 2015), the emphasis of treatment has historically been placed on ERP sessions. Although various CBT protocols initiate exposures at different times in treatment (Kendall & Hedtke, 2006; March & Mulle, 1998), research suggests that the earlier initiation of exposures is associated with better clinical outcomes (Gryczkowski et al., 2013). However, it is important to balance exposure initiation with clinical indicators that may suggest that slower exposure titration is needed.

Although exposure-based CBT has demonstrated considerable efficacy in large multisite randomized clinical trials (Pediatric OCD Treatment Study, 2004; Walkup et al., 2008), 43–80% of youth remain symptomatic after receiving a standard course of CBT, with a limited number achieving diagnostic remission (Ginsburg et al., 2011; McGuire et al., 2015). Moreover, a naturalistic 6-year follow-up of anxious youth treated with CBT found that relapse occurred in up to 50% of initial treatment responders (Ginsburg et al., 2014). Taken together, these findings highlight the need to improve therapeutic outcomes of existing exposure-based CBT protocols in order to effectively treat these psychiatric conditions and their associated morbidities across the life span.

Keywords: exposure therapy; cognitive-behavioral therapy; anxiety disorders; obsessive–compulsive disorder; extinction learning

Historically, the predominant rationale guiding exposure-based CBT has been emotion processing theory (Foa, Huppert, & Cahill, 2006; Foa & Kozak, 1986). This theory emphasizes the reduction of within- and between–session subjective units of distress (SUDS) as the primary process underlying successful exposure-based treatment. When implementing this rationale during exposures in CBT, experts recommend a minimum 50% reduction of within-session SUDS for exposure exercises (Kendall et al., 2006). While the within- and between-session reduction of SUDS (commonly called *habituation* in clinical practice[1]) likely plays a role in treatment, there has been mixed evidence linking these two exposure metrics with positive treatment outcomes in individual exposure-based CBT for youth with OCD (Kircanski & Peris, 2015; Kircanski, Wu, & Piacentini, 2014) and anxiety disorders (Benjamin et al., 2010). Instead, experimental studies suggest that youth with anxiety disorders and OCD exhibit impairments in fear extinction, predominantly characterized by deficits in inhibitory learning (see McGuire, Orr, Essoe, et al., 2016, for a comprehensive review). Therefore, the implementation of strategies that optimize inhibitory learning during exposures may compensate for identified deficits and maximize extinction processes during treatment. This would likely produce more robust treatment outcomes for exposure-based CBT.

First, we briefly discuss the evidence for inhibitory learning deficits during extinction processes in youth with anxiety disorders and OCD. Next, we provide several strategies to maximize extinction learning and extinction recall based on deficits in inhibitory learning—synergizing experimental evidence with clinical experience. Finally, we discuss the differences between an inhibitory learning approach to exposures, and prior therapeutic approaches such as habituation-based ERP and behavioral experiments used in cognitive therapy. We conclude with future directions for clinical research on inhibitory learning strategies in exposure therapy for youth.

Deficits in Extinction Learning in Youth With Anxiety Disorder and OCD

Although the etiology of anxiety disorders and OCD is multifactorial, the processes of fear conditioning and extinction learning are suggested to play an important role in the development, persistence, and treatment of these conditions (Duits et al., 2015; Lewin, Wu, McGuire, & Storch, 2014; Lissek et al., 2005). *Fear conditioning* refers to the process of learning that something is dangerous. It takes place when an emotionally neutral stimulus (called a conditioned stimulus,(CS) becomes paired with an aversive unconditioned stimulus (US), eliciting an unconditioned response (UR). Later encounters with the CS become capable of producing reactions similar to the UR, called a conditioned response (CR) when elicited by a CS. Conditioned responses typically include behavioral responses (e.g., flight, fight, freezing, avoidance, compulsive rituals) and/or physiological reactivity (e.g., changes in electrodermal activity, heart rate, respiration). Conditioning processes are evident across anxiety disorders and OCD. For instance, in the case of a specific phobia, a child may encounter a friendly dog (a CS) on multiple occasions. However, on one occasion, the child plays too rough and the dog bites the child's hand (a US), which evokes distress and withdrawal/avoidance in the child (UR). Subsequent encounters with dogs (CS) may increase the child's heart rate and result in flight from dogs (CR). Similarly, an adolescent with OCD may meet a new person and shake his or her hand (CS). This handshake (CS) may be paired with a distressing obsessive thought that the adolescent's hands are now contaminated by noxious germs (US), a thought that evokes distress and is partially alleviated by hand washing (UR). Subsequent contact with other hands and/or items touched by other hands (CS) also becomes capable of inducing contamination-related distress, and results in ritualized hand-washing behaviors and/or avoidance (CR). When encountering a CS and experiencing the associated CR, youth with these conditions commonly engage in behavioral responses such as avoidance and/or ritualized behaviors (e.g., compulsions) to alleviate the distress. The reduction in distress serves to reinforce the behavioral response and leads to its maintenance and enhancement.

Extinction learning is a process during which the response to a CS declines through repeated exposure in the absence of the US and/or engagement in the behavioral response (e.g., avoidance, compulsions). During this process, the original CS–US association developed in the conditioning process is not eradicated. Instead, extinction learning creates a new CS-no US association that competes with the conditioned CS–US association for expression (Bouton, 1993). Over repeated encounters, the new CS–no US association becomes stronger and inhibits the CR previously generated by the CS–US association. The inhibition of the original fear association (i.e., CS–US) by the new non-fear association (i.e., CS–no US) is referred to as *inhibitory learning*. For instance, the child who was bitten by a dog might be exposed to the same and/or other dogs without any negative consequences (i.e., biting) in order to establish a new learned association. As the new association (e.g., "Dogs do not always bite me" or "Not all dogs are

[1] While habituation and extinction learning are commonly used interchangeably in the clinical literature, there are distinctions between the two that are evident in experimental studies. In experimental studies, habituation refers to the decrease of a natural response that is elicited by an unconditioned stimulus, whereas extinction learning refers to the decrease of a conditioned response.

harmful") is strengthened through repetition, the original fear association and the accompanying CR (e.g., increased heart rate, flight/avoidance) becomes inhibited. However, when youth engage in avoidance behaviors, it prohibits new learning from taking place that is necessary to establish and strengthen a non-fear association. *Extinction retention* (also called *extinction recall*) is a related process that refers to the extent to which a learned inhibitory response is retained (or recalled) over time. Therefore, while extinction learning focuses on the acquisition and strengthening of nonfear associations during nonreinforced exposures (i.e., CS–no US associations), extinction retention focuses on the retention and/or recall of the learned non-fear association over time.

While there are clear differences between laboratory experiments that use conditioning/extinction tasks and CBT, these tasks serve as analogues for the exposures that comprise evidence-based CBT protocols. When reviewing the literature on differential conditioning/extinction studies of youth with anxiety disorders (McGuire, Orr, Essoe, et al., 2016), findings collectively suggested that when extinction learning deficits were identified relative to unaffected control youth, they were best characterized by deficits in inhibitory learning (Britton et al., 2013; Craske, Waters, et al., 2008; Lau et al., 2008; Liberman, Lipp, Spence, & March, 2006; Pliszka, Hatch, Borcherding, & Rogeness, 1993; Shechner et al., 2015; Waters, Henry, & Neumann, 2009). Interestingly, pretreatment extinction learning in anxious youth has been associated with changes in child-reported anxiety symptoms after group exposure-based CBT (Waters & Pine, 2016). When reviewing the limited literature of differential conditioning/extinction studies in youth with OCD, youth with OCD were found to exhibit extinction learning deficits characterized by impaired inhibitory learning in comparison to unaffected control youth (Geller et al., 2017; McGuire, Orr, Wu, et al., 2016).

Inhibitory Learning Strategies to Maximize Extinction During Exposures

Given the identified deficits in extinction learning among youth with anxiety disorders and OCD, there is likely clinical value to utilizing strategies that optimize inhibitory learning in order to strengthen extinction learning and improve clinical outcomes. Based on experimental studies, several clinical strategies to optimize inhibitory learning during exposure therapy have been suggested for adults with anxiety disorders and OCD (Abramowitz & Arch, 2014; Arch & Abramowitz, 2015; Craske, Liao, Brown, & Vervliet, 2012; Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). While these are important contributions to a scant literature, there are differences in disorder phenomenology (Farrell, Barrett, & Piacentini, 2006; Geller et al., 2001), neural architecture of fear extinction (Britton et al., 2013; Lau et al., 2011), and age effects in differential fear conditioning (Glenn et al., 2012; Jovanovic et al., 2014; Lau et al., 2011) that challenge the broad generalization of adult findings to youth. Thus, the approaches recommended to strengthen inhibitory learning in adults may not directly translate to youth and/or may require considerable modification. To our knowledge, there have been no experimental or clinical studies that have directly examined strategies to enhance inhibitory learning in youth. However, given the need to improve CBT outcomes and the evidence of inhibitory learning deficits among youth with anxiety and OCD, there may be a benefit to modifying inhibitory learning strategies from the adult literature and applying them to youth. Accordingly, we present several strategies from the adult literature to optimize inhibitory learning in order to strengthen the processes of extinction learning and extinction recall—synergizing experimental evidence with clinical experience. While the empirical basis for these approaches comes from experimental studies that have been conducted in either animals or adult human populations (see Craske, Kircanski, et al., 2008; Craske et al., 2012, 2014, for a comprehensive review of the empirical basis for these strategies), many of these strategies are already being applied in clinical practice by child CBT experts.

Appropriate Initial Psychoeducation

At the outset of treatment, it is important to orient the patient and his or her family to the multifactorial model of his or her condition and its treatment. There are several evidence-based treatment manuals that can serve as guides for this orientation in a developmentally appropriate manner (Kendall & Hedtke, 2006; Piacentini, Langley, & Roblek, 2007). When presenting this information, the clinician should also describe the role conditioning and extinction learning play in symptom development, persistence, and treatment. This discussion should educate patients and families about how avoidance, accommodation, and compulsive behaviors interfere with the naturally occurring process of extinction learning. When seeking treatment for anxiety and/or OCD, patients and families are often experiencing considerable distress and desire immediate relief. While traditional approaches to exposures emphasize a within-session reduction of subjective distress (often called *habituation*), the clinician should highlight that the overarching goal of treatment is not to achieve short-term fear reduction. Instead, the goal of treatment (and the exposures that comprise treatment) is to strengthen extinction learning and extinction recall in order to help the patient gain long-term symptom remission. Given that the patient and family will be confronting feared stimuli and/or situations that were previously avoided, there may be an initial increase in distress that

leads patients and parents to perceive treatment as more difficult at first. However, as youth learn to confront distressing stimuli and situations through further exposures that optimize inhibitory learning (alongside appropriate parental support), this initial distress will subside and treatment will lead to positive outcomes in the long term.

At first, this concept may be somewhat counterintuitive for patients and their families. As such, the incorporation of a developmentally appropriate and relatable analogy can be helpful. For instance, take the case of an adolescent with OCD who plays baseball. The clinician might offer a baseball analogy to parallel the exposure-based treatment process. When first starting to play baseball, the patient might have found the games difficult and the practice drills too challenging. The patient might have felt overwhelmed and even wanted to quit the sport at first due to its perceived difficulty. However, as the patient's skills developed over time with practice, the exercises and games became easier and more enjoyable. Notably, as the patient's skills increased, the practice exercises likely increased in intensity and difficulty to further build his or her skills. This analogy works well as the clinician serves as "the coach," the in-session exposures serves as the "practice drills," and the out–of-session exposures serves as "the games." Other analogies used in empirically supported treatment protocols (e.g., anxiety/distress as a "false alarm") can be adapted to fit this approach.

When using an inhibitory learning approach to exposures, it is important to consider two things related to the patient's subjective distress. First, although subjective distress is not used to determine the completion of an exposure exercise (i.e., completion upon a 50% reduction in SUDS), subjective distress remains clinically informative (see the paper in this special issue on habituation-focused exposures). Thus, SUDS should be regularly assessed (especially early in treatment) to monitor the patient's distress level throughout an exposure. This information can be used to characterize the patient's baseline distress in early exposures and calibrate subsequent exposure exercises on the patient's treatment hierarchy accordingly.

Second, an inhibitory learning approach to exposures focuses on maximizing extinction learning and extinction recall, and does not directly address the patient's subjective distress. Rather, subjective distress in this model may be viewed as a different internal context/state in which the patient practices exposure exercises and engages in extinction learning. Although not directly addressed in this theoretical model, the patient's distress level is clinically relevant as a patient experiencing constant and severe distress may be less willing to remain in treatment. Thus, it may be clinically useful to supplement inhibitory learning strategies (discussed below) with developmentally appropriate therapeutic strategies that promote distress tolerance as clinically indicated (e.g., mindfulness, acceptance of uncertainty, value-based action). Notably, the goal of these supplemental strategies should not be to eliminate all distress, but rather for the patient to learn the skills to better tolerate distress. The successful integration of these therapeutic approaches may enhance mindfulness and engagement, while providing the skills to strengthen extinction processes and tolerate distress. Thus, the patient may be more willing to complete challenging exposures, encode more information about experiences needed for expectancy violations, and mindfully tolerate the variability and spontaneity in exposures within an inhibitory learning approach to CBT.

Challenging Patient Expectations of Feared Outcomes

After developing a symptom hierarchy, one inhibitory learning strategy is to craft exposures that maximally challenge the youth's expectation regarding the frequency and/or intensity of aversive outcomes. Whether the expectancies are explicit or implicit, the exposure exercises serve to disconfirm the occurrence of the feared outcome in its frequency and/or intensity. Therefore, it is preferable to define clear and objective aversive outcomes instead of more subjective distress. For example, in the case of a child with OCD who has aggressive obsessions about harming his mother, the expectation might be that the patient "will stab his mother if he holds a sharp object." Although initially appearing to be an adequate expectancy, the parameter of time needs to be established. The revised expectancy that drives this exposure is that the patient "will stab his mother if he holds a sharp object *for 2 minutes in the same room as his mother*." In this capacity, the exposure serves to test the expectation (or belief) that the child will stab his mother in an objective manner. This expectancy (and its violation during an exposure) serves as the primary within-session marker of response, but should be balanced by monitoring the patient's subjective distress as described above.

After completing the exposure, it is helpful for the clinician to have some discussion of whether the feared outcome occurred and how the patient knows the outcome did or did not occur using objective anchors. In this case, the objective anchor would be that the patient's mother remained alive and well (not stabbed) during the exposure. It is important to clarify that a reduction in SUDS is not needed for the expectation to be violated and new learning to take place. Rather, the exposure is complete when the expectation is violated (i.e., the child held a knife for 2 minutes in the same room as his mother and did not harm her). This approach to designing exposures allows for easy modification of the duration (e.g., 2 minutes to 10 minutes) and intensity (e.g., in the room to holding the knife against

mom's wrist) in order to continue to violate the patient's expectations. In this approach, a patient might be encouraged to identify as a "scientist" who is "conducting experiments" on anxiety/OCD and needs to test out his or her fears. Alternatively, clinicians may present the exposures as a game (especially for younger children), in which the clinician and the patient have to challenge themselves to beat anxiety/OCD.

Before implementing this strategy, it is important to consider a few points. First, it is helpful to start with low to moderate symptoms on the patient's hierarchy. This will facilitate a youth's confidence in successfully completing exposures, and demonstrate initial mastery before progressing to more challenging and complex exposures. Second, it is important to limit ambiguity when conducting exposures. Take the case of a child with OCD who fears that "If I eat after not washing my hands, I will get sick." In this case, it would be helpful to provide objective anchors for the aversive outcome (e.g., "I will *vomit* after I eat with dirty hands"), in time (e.g., "I will *vomit in an hour* after I eat with dirty hands"), and/or intensity (e.g., "I will *vomit for 5 minutes within an hour* after I eat with dirty hands"). Third, while it is informative to monitor the patient's subjective distress during the exposures via SUDS, it is important to remember that it is not necessary for SUDS to reduce for an expectancy to be violated and the exposure to be complete. As SUDS may not reduce prior to the violation of the expectancy, it can be helpful to validate the patient's feelings (as the patient just faced his or her fears) and remind the patient that distress is not anticipated to dissipate in the moment. Fourth, expectancy violation may be more challenging to implement for certain symptoms. For instance, a child with OCD who has scrupulosity symptoms may have the expectation that he or she will go to hell if he or she says a bad word. While it would be impossible to violate this expectancy in session, a clinician might try to reframe the expectation to be less ambiguous and incorporate objective anchors of the aversive outcome. Finally, as this approach requires conscious appraisal of expectancies, some youth may not be able to adequately identify and/or articulate the maximal objective aversive outcome. This may be particularly true for younger children, youth with poor insight, and/or those with developmental disabilities.

Intermittent Reinforced Extinction

Another exposure strategy to improve inhibitory learning is intermittent encounters with aversive outcomes during exposures. This strategy possesses ecological validity as negative outcomes can happen when confronting fears outside of therapy sessions, but to a lesser degree than the patient expects. As youth demonstrate competency with early exposures, this strategy can serve to violate the expectation that negative outcomes will never occur when facing their fears. For example, in the case of an adolescent with social anxiety about peer rejection, it may be beneficial to have the patient encounter some form of mild social rejection in the context of a treatment session (e.g., one or two comments ignored in a group conversation, but not full exclusion from the group). Similarly, for a child with OCD who has aggressive obsessions related to harm coming to his or her parents, the clinician may ask the patient's parents to report some mild negative event (e.g., stubbing a toe) during an exposure in which the child is refraining from engaging checking behaviors. However, this strategy should be incorporated only after youth have demonstrated initial mastery of exposures.

Variability in Exposures

A third strategy to improve inhibitory learning is to incorporate variability in exposure sessions. This strategy can manifest in several different ways by varying the stimuli used in exposures, duration of exposures, intensity of exposures, and/or even the progression of exposures in the session. While prior exposure models recommend a 50% reduction in SUDS before progressing to the next incremental step of an exposure hierarchy, an inhibitory learning approach is markedly different. In the case of an adolescent with contamination OCD symptoms, stimuli could be varied by touching different trash cans around the clinician's office, rather than touching only the *same* trash can in the *same* office filled with the *same* office items. Exposure duration can also be varied for each individual exposure trial, with early trials progressing more consistently (e.g., 1-minute interval increases), but later trials incorporating more random time intervals (e.g., rolling two dice to see how long the exposure will last). Exposure intensity can also be varied outside of the stepwise progression. While early exposure trials might involve the patient touching the office trash can, the exposure intensity could be increased by asking the patient to keep both hands buried in the trash can filled with trash. Similarly, exposure intensity could also be modified by changing the contents of the trash can. Finally, while traditionally exposures have progressed in a linear fashion up an exposure hierarchy, inhibitory learning can be strengthened by introducing variability in exposure progression. For instance, all of the patient's exposures for a specific contamination symptom could be written down on flash cards and randomly selected for use in a treatment session. This level of variability is best introduced after the patient demonstrates initial mastery of lower-level exposures for the specific contamination symptom. It is important to note that initial mastery is not needed to strengthen inhibitory learning, but rather is recommended to minimize patient dropout. Although some clinicians have recommended incorporating variability in the

time of day exposures are conducted, this specific approach may not generalize to either inpatient or outpatient practice as youth and families may have a variety of scheduling conflicts (e.g., school, extracurricular activities). However, variability in timing could be incorporated by having youth practice out-of-session exposure exercises at different times of the day for homework assignments.

Compound Extinction to Stimuli and/or Situations

A fourth strategy to strengthen inhibitory learning during extinction is to combine exposure stimuli and/or situations (referred to as *compound extinction* or *deepened extinction*). In this strategy, clinicians conduct exposures to individual stimuli and/or situations, and combine them in subsequent exposures. Clinicians can also combine previously extinguished stimuli/situations with non-extinguished stimuli/situations. For example, when conducting exposures for a child with OCD who has aggressive harm obsessions, a clinician might initially conduct three separate exposures: an imagined exposure of stabbing a parent, an exposure of being in the room with the parent and a knife, and an exposure holding a knife. These three separate exposures can later be combined into a single exposure in which the child holds a knife while sitting next to the parent and imaging stabbing him or her. Alternatively, two previously extinguished exposures (e.g., an imagined exposure of stabbing a parent and holding a knife) could be combined with an unextinguished fear of being in the room sitting next to the parent holding a knife (e.g., imagine stabbing parent while holding knife and sitting next to him or her).

Practice Exposures in Multiple Contexts

Several studies have highlighted that extinction learning is context dependent (Bouton, 2004; Milad, Orr, Pitman, & Rauch, 2005). Therefore, a fifth strategy is to practice exposures in multiple contexts to facilitate the generalization of extinction learning across contexts, thereby promoting inhibitory learning. Context variability pertains not only to in vivo exposures conducted within therapy sessions, but also to internal states as well (e.g., interoceptive and imaginal exposures). When applying this strategy, the in vivo exposures should be conducted both in the clinician's office and outside of the office. For example, consider the case of the adolescent with social anxiety about peer rejection. The clinician might initially start exposures in the office, but then incorporate exposures in community settings under the clinician's supervision (e.g., ordering coffee at a coffee shop, asking to join someone at a shared table in a cafeteria). The context can also be varied as the patient will practice exposure exercises initially with the clinician (in the first context), later by him- or herself or with his or her family for homework (a separate context), and a variety of settings away from the clinician's office (yet another context).

As previously noted, internal states can also serve as contexts. Therefore, it can be helpful to practice exposures across varying internal states (e.g., anxious/distressed and nonanxious/nondistressed states). For example, young patients may prefer to practice exposure exercises only when they are calm, collected, and not experiencing any physiological symptoms of anxiety or distress. However, when using this strategy, it can help to practice exposures when experiencing physiological symptoms of anxiety or distress, so that youth learn they can overcome their fears even when experiencing these challenging physiological symptoms. Using the previously mentioned case of an adolescent with social anxiety, one might consider identifying the physiological symptoms of anxiety that the patient experiences (e.g., increased heart rate, shortness of breath, sweating) and conducting interoceptive exposures prior to social anxiety exposures so that the patient is completing social exposures while experiencing varying internal anxious/distressed states.

Removal of Safety Signals/Behaviors and Accommodation

Safety signals and/or safety behaviors (e.g., avoidance, ritualized behaviors) can interfere with extinction learning. Safety signals may be any person, item, or passive action that the child believes is needed for a safe outcome (whether implicit or explicit). These may include the presence of parents, clinicians, medications, clothing, and/or cell phones. Meanwhile, safety behaviors (e.g., avoidance, ritualized behaviors) are actions the youth engages in to ensure a safe outcome. For example, a child who has contamination OCD might be able to complete a variety of exposures in session, but engage in ritualized washing behaviors when returning home to remove any perceived contaminants from therapy. The ritualized washing impedes the development and strengthening of the inhibitory extinction association (i.e., CS–no US). Similarly, family accommodation also impedes extinction learning from naturally occurring. Using the previous example, family accommodation (e.g., removing possible contaminants at home) does not allow the young patient to encounter the feared contaminants and limits extinction associations from naturally developing (e.g., "Eating food with contaminated hands will not make me sick"). Therefore, another strategy to improve inhibitory learning is to eliminate safety signals, safety behaviors, and accommodation. Given that youth (and/or parents) may find this difficult, a gradual removal and discontinuation process of safety signals/behaviors is recommended at first to minimize patient dropout and distress. However, if the patient and family are in agreement, a more expedited

removal of these signals and behaviors is preferred. By removing safety signals, safety behaviors, and accommodation, youth learn to become less reliant on these items and/or actions in their daily lives. Moreover, the signals and behaviors are no longer impeding inhibitory learning associations from developing during exposures.

Consider the case of a child who has a specific phobia of vomiting and sips water from a water bottle after every bite of food (i.e., a safety signal or behavior). A clinician could set limits on the number of sips allowed for each meal, or limit the overall water intake at each meal. Removal of the preferred water bottle would also be useful, as the bottle itself could act as a safety signal. Similarly, limiting and/or discontinuing any parental accommodation regarding providing water during meals would be helpful. Through this process, the youngster would learn that the extra sips of water are not needed to prevent vomiting when eating.

Reminder Cues

The completion of out-of-session exposures is an important component of exposure-based CBT. This practice serves to strengthen inhibitory associations learned in therapy sessions and generalize the learning across contexts. Given that increased practice of exposures (in the absence of safety cues/behaviors) strengthens extinction learning, small reminder cues may be helpful to cue exposure practice and facilitate extinction recall across contexts. Therefore, a seventh strategy to improve inhibitory learning is the incorporation of reminder cues in treatment. For example, patients may be provided with a reminder cue to carry with them (e.g., wristband, pen), or post in challenging rooms at home (e.g., certificate on the wall) to remind them of the extinction learning they completed earlier. Therefore, whenever the patient looks at the wristband, uses the pen, or sees the certificate on the wall, he or she recalls the successful exposures completed in treatment (i.e., extinction learning) and is encouraged to practice exposures in the new setting. Although physical reminders may be easier and preferred by younger patients, they may not always be necessary. For more mature adolescents, a clinician could ask the patient to remind him- or herself of the successful exposures completed in treatment (i.e., extinction learning) before the adolescent encounters a previously feared stimuli or situation in a new context (e.g., talking to new people in a new social setting).

Consider the case of a child with OCD who has contamination symptoms. Toward the end of treatment, a clinician may reward the patient with a reminder wristband for all of the patient's hard work completing exposures, and ask the child to recall all of his or her hard work in therapy every time he or she looks at the wristband. In this particular case, the wristband could also serve as a visual reminder to limit any excessive hand-washing behaviors in the future. Given that some younger patients could potentially view a physical reminder cue as a safety signal (i.e., "I can only complete these exposures when I am wearing my wristband"), it is best to integrate this strategy toward the end of treatment when planning for relapse prevention.

There are several other strategies that have been suggested to optimize inhibitory learning that have been extrapolated from translational research studies. Some of these strategies include the reconsolidation of extinction learning (Johnson & Casey, 2015), affect labeling (Kircanski, Lieberman, & Craske, 2012), and increasing time intervals between sessions (Abramowitz & Arch, 2014). While these strategies and others may be useful for youth, we have not included them in the context of this review based on our clinical experience and the limited literature on youth.

Differences Between Inhibitory Learning-Based Exposures, Classic Habituation-Based Exposures, and Behavioral Experiments Used in Cognitive Therapy

There are clear differences in theoretical orientation between inhibitory learning-based exposures and the classic habituation-based exposures or the behavioral experiments employed in cognitive therapy. Table 1 outlines the differences between these three approaches to exposures across several variables: overarching exposure goal, primary purpose, exposure hierarchy, gradation, distress level, frequency, duration, and discontinuation of safety signals/behaviors. While the overarching goal, primary purpose, and duration of exposures/experiments are dramatically different between the three theoretical approaches (see Table 1), several similarities exist. For instance, inhibitory learning and habituation-based exposures largely share features of symptom hierarchy use, gradation of exposures, evoking fear/anxiety/distress during exposures, exposure frequency, and discontinuation of safety signals/behaviors. However, inhibitory learning exposures distinguish themselves in at least two nuanced ways in these areas. First, inhibitory learning exposures incorporate more variability and do not necessarily follow the stepwise graded progression of habituation-based exposures (see variability in exposures section above). Thus, a clinician may initially follow a stepwise progression, but incorporate more variability in later hierarchy/exposure items. Second, while both approaches to exposures can evoke fear/anxiety/distress, it is noteworthy that for inhibitory learning exposures, a patient may practice them when not experiencing these distress states. This allows patients to engage in extinction learning in a variety of internal contexts/states (distressed and nondistressed states) that would lead to greater extinction learning and recall.

Table 1
Similarities and Differences Between Inhibitory Learning-Based Exposures, Habituation-Based Exposures, and Behavioral Experiments in Cognitive Therapy

	Inhibitory learning-based exposures	Habituation-based exposures	Behavioral experiments in cognitive therapy
Primary goal of exposures/ experiments	Violation of expectancies	Within- and between-session habituation	Evaluate the validity of specific cognitions and/or beliefs
Purpose of exposures/ experiments	Strengthen inhibitory extinction learning	Discontinue negative reinforcement cycle	Change dysfunctional cognitions and/or beliefs
Symptom hierarchy use in exposures/experiments	Symptom hierarchy developed to guide initial exposures and monitor progress	Development and strong adherence to a symptom hierarchy	Symptom hierarchy is not necessary for behavioral experiments
Gradation of exposure/ experiments	Initial exposures can be graded, with variability in exposures introduced later in treatment	Exposures are traditionally systematically graded from least distressing to most distressing	Behavioral experiments are not graded in any particular order
Fear/anxiety/distress evoked by experiments/exposures	Exposures that evoke fear/ anxiety/distress are important	Exposures that evoke fear/ anxiety/distress are essential	Behavioral experiments that evoke fear/anxiety/distress are not essential
Frequency of exposures/ experiments	Exposures conducted as many times as needed to violate expectancy	Exposures often repeated multiple times until habituation is achieved	Behavioral experiments are usually conducted only once
Duration of exposures/ experiments	Exposures last until expectation is violated	Exposures last until habituation is reached, usually considered to be a 50% reduction in subjective distress	Behavioral experiments are typically brief in nature
Discontinuation of safety signals and safety signal behaviors	Discontinuation of safety signals and behaviors necessary	Discontinuation of safety signals and behaviors necessary	Discontinuation of safety signals and behaviors is irrelevant

Inhibitory learning exposures and behavioral experiments in cognitive therapy also share some features. First, both approaches are driven by similar appraisals/ expectations that are "tested" in treatment. Second, both approaches do not necessarily follow a systematic graded method to exposures/experiments in treatment. However, as with habituation-based exposures, inhibitory learning exposures distinguish themselves across the aforementioned categories. Specifically, while behavioral experiments in cognitive therapy are entirely driven by evaluation of cognitive appraisals, expectations in inhibitory learning exposures may be distress based. For example, in the case of an adolescent with OCD who has not-just-right sensations, the expectancy may be related to distress reduction (e.g., "This uncomfortable feeling will not go away until I even out the picture that is crooked on the wall"). Similarly, there is an important distinction between the two exposure/ experimental approaches related to subjective fear/ anxiety/ distress experienced by the patient. While experiencing fear/anxiety/distress is not a prerequisite for behavioral experiments in cognitive therapy, it is an important feature for exposures in inhibitory learning, as it helps patients engage in extinction learning across multiple internal contexts/states. Thus, when comparing the various approaches to exposures and behavioral experiments, both traditional habituation-based exposures and behavioral experiments approaches incorporate strategies to strengthen inhibitory learning. This may partially explain why both prior approaches have demonstrated efficacy in clinical trials, with neither establishing definitive "superiority" over the other in meta-analytic investigations (McGuire et al., 2015).

Discussion

Evidence-based CBT for youth with anxiety disorders and OCD is efficacious, but there is a clear need to enhance both the short- and long-term therapeutic outcomes. Several approaches to enhance outcomes have been explored, and include the augmentation of CBT with psychiatric medications and cognitive enhancers to facilitate extinction learning. The augmentation of CBT with serotonin reuptake inhibitor (SRI) medications has led to greater therapeutic outcomes in some clinical trials (Pediatric OCD Treatment Study, 2004; Walkup et al., 2008), but no significant differences in others (Storch et al., 2013). Similarly, augmentative approaches using cognitive enhancers such as d-cycloserine have demonstrated mixed results (McGuire, Wu, Piacentini, McCracken, & Storch, 2017; Storch et al., 2016), with some studies suggesting that improvement is observed only when

within- and/or between-session habituation is achieved (Rothbaum et al., 2014; Smits, Rosenfield, Otto, Marques, et al., 2013; Smits, Rosenfield, Otto, Powers, et al., 2013).

While there has been variable evidence for such augmentation approaches, the incorporation of inhibitory learning strategies in exposure therapy presents another theoretical option to enhance therapeutic outcomes. This approach seeks to compensate for impaired inhibitory learning during extinction processes in youth with anxiety disorders and OCD, and strengthen extinction learning and extinction recall. Several inhibitory learning strategies have been suggested to strengthen extinction learning and recall. Notably, these strategies are largely based on animal and adult nonclinical populations, and thus require empirical evaluation in youth. While these strategies would benefit from rigorous empirical evaluation to determine their specific utility to strengthen inhibitory learning among youth, child CBT experts already employ many of these strategies in clinical practice. Accordingly, we have provided recommendations that may be useful to optimize inhibitory learning among youth with anxiety disorders and OCD using pragmatic examples.

As the field of exposure-based CBT progresses, there are several questions that warrant further attention. First, these recommended inhibitory learning-based strategies should be tested in child clinical populations to determine whether they improve extinction learning, extinction recall, and clinical outcomes. While there is a strong theoretical rationale for using these approaches for youth, there has been limited clinical application. Therefore, such an empirical evaluation would be informative to clinicians and researchers alike. Second, findings from rigorous empirical evaluation of inhibitory learning strategies in youth should be disseminated to clinicians in order for them to implement exposure-based CBT using these new approaches. While this special issue and its content serve as an important first step, it is important to supplement this educational overview with didactic instruction and hands-on learning for clinicians. Given that these strategies can be challenging to implement, it may prove useful for clinicians interested in applying these strategies to consult with child CBT experts who have firsthand experience in their application. Finally, given previous research seeking to augment exposure therapy with cognitive enhancers, it would be interesting to see whether different types of approaches to exposures influence extinction learning and/or clinical outcomes when augmented with cognitive enhancers. Given the mixed evidence across augmentation trials and research suggesting that within- and/or between–session habituation is needed for therapeutic benefit, this line of research may offer a new augmentative algorithm to improve therapeutic learning and clinical outcomes. Indeed, one could hypothesize that augmenting inhibitory learning-based exposures with DCS or other cognitive enhancers may lead to even more robust effects in improved extinction learning and extinction recall, thereby leading to better clinical outcomes.

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