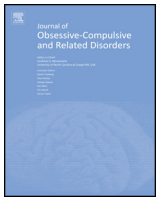
Journal of Obsessive-Compulsive and Related Disorders 25 (2020) 100528

Contents lists available at ScienceDirect

Journal of Obsessive-Compulsive and Related Disorders

journal homepage: www.elsevier.com/locate/jocrd



Towards a clinically valid mechanistic assessment of exposure and response prevention: Preliminary utility of an exposure learning tool for children with OCD

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ARTICLE INFO

Keywords:
Obsessive compulsive disorder
Children
Exposure and response prevention
Mechanisms
Inhibitory learning

ABSTRACT

Despite advances in understanding mechanisms underlying fear processes, there remains a significant gap between insights produced via laboratory assessment and concrete tools for harnessing these insights in clinical practice. In addressing this gap, researchers would ideally introduce tools that are feasible for patients in clinical practice, easily disseminated to practitioners, and clinically useful. We present pilot data on the Exposure Experience Questionnaire (EEQ), a brief measure designed to assess exposure learning mechanisms. Ten children (ages 8–15) with a primary diagnosis of obsessive-compulsive disorder (OCD) underwent exposure and response prevention in which they completed weekly exposures in clinic and at home. During each exposure, children completed an exposure practice form which included the EEQ. Results suggest the preliminary feasibility and internal consistency of this measure, with comparable utility in clinic and home settings. The EEQ was associated in the expected direction with slope of OCD symptoms, such that greater exposure learning in both clinic and homework exposures predicted improved outcome. Although limited by small sample size, these data support the continued research on the feasibility and utility of the EEQ and suggest that quantifying learning processes following exposure may be a useful addition to mechanistic research in OCD.

Obsessive compulsive disorder (OCD) in youth produces significant functional impairment (Piacentini, Bergman, Keller, & Mccracken, 2003) and approximately 50% of cases onset during childhood or adolescence (Kessler et al., 2005). Left untreated, obsessive compulsive symptoms are often chronic throughout childhood and into adulthood (Krebs, Waszczuk, Zavos, Bolton, & Eley, 2015; Micali et al., 2010). Efficacious treatments exist and can provide significant relief for children with OCD, most notably cognitive behavior therapy (CBT) with an emphasis on exposure and response prevention (ERP) (Öst, Riise, Wergeland, Hansen, & Kvale, 2016).

Despite its status as the treatment of choice for children with OCD (AACAP, 2012), ERP-based treatments are associated with a number of limitations that attenuate its potential impact. A recent meta-analysis of 25 randomized controlled trials demonstrated that only 53% of children with OCD achieved remission following CBT (Öst et al., 2016). Moreover, the majority of such studies represent optimal scenarios in which children have access to a full course of recommended treatment (e.g., 12–14 CBT sessions) and clinicians have expertise and/or close supervision in the treatment of childhood OCD (Peris & Piacentini, 2013; POTS, 2004; Storch et al., 2013). Unfortunately, the majority of youths receiving mental health services for anxiety-related disorders receive fewer than six sessions of any form of therapy (Merikangas et al., 2011; Whiteside et al., 2016) and limited clinician training in exposure therapy represents a significant barrier among community providers (Reid et al., 2017).

To address issues of clinical effectiveness and efficiency, there has been a growing emphasis on the identification of mechanisms underlying psychological interventions. The National Institute of Mental Health (NIMH) introduced the “experimental therapeutics” and Research Domain Criteria (RDoC) approaches (Gordon, 2017; Insel et al., 2010; Insel & Gogtay, 2014) that call for measurement of biological target mechanisms (e.g., genes, molecules, cells, circuits, physiology) underlying psychological phenomena. Research informed by these initiatives has yielded insights into behavioral and biological processes that may be implicated in negative valence disorders, such as OCD, as well as interventions such as exposure therapy (Dougherty

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https://doi.org/10.1016/j.jocrd.2020.100528
Received 7 November 2019; Received in revised form 12 March 2020; Accepted 17 March 2020
Available online 23 March 2020

et al., 2018; Hamm et al., 2016; Lang, McTeague, & Bradley, 2016; McKay & Tolin, 2017).

In parallel with the development of RDoC, researchers have been updating theoretical models of exposure therapy. Traditional models of exposure emphasize the importance of initial activation of a fear network followed by within- and between-session habituation of anxiety (Foa & Kozak, 1986). Recognizing mixed findings regarding the role of habituation, more recent inhibitory learning models of exposure emphasize the importance of targeting fear learning and fear tolerance over fear expression, which may be best measured after rather than during completion of the actual exposure task (Craske et al., 2008). Constructs such as self-efficacy (Bandura & Adams, 1977) may be closely related to fear learning, i.e., the ability to tolerate anxiety or to perform a given task despite the presence of anxiety (Craske et al., 2008; Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014).

Laboratory-based research on fear processes has primarily emphasized the relevance of neurobiological phenomena in the context of fear conditioning paradigms (Boeke, Moscarello, LeDoux, Phelps, & Hartley, 2017; Craske et al., 2008; Sotres-Bayon, Cain, & LeDoux, 2006). Similarly, RDoC encourages quantification of biological mechanisms of psychopathology (Insel et al., 2010). Although anxiety and OCD researchers have generally expressed cautious optimism about the potential for RDoC and other neurobiological-focused research to eventually facilitate an improved understanding of psychopathology (Garnaat, Conelea, McLaughlin, & Benito, 2018; Zoellner & Foa, 2016), some have expressed concern about how such approaches will translate into improved clinical care for patients who present to treatment in the community (Goldfried, 2016; Paris & Kirmayer, 2016; Weinberger, Glick, & Klein, 2015; Zoellner & Foa, 2016).

Such concerns underscore the need to translate laboratory-based research into feasible clinical tools for provider usage in the delivery of targeted, mechanism-focused treatment. The overwhelming majority of practitioners lack access to equipment to study biological indicators and do not routinely administer fear conditioning paradigms or behavioral approach tests to assess for mechanistic change. While a number of excellent and specific suggestions for implementation of exposure therapy within an inhibitory learning framework have been proposed (Craske et al., 2014), there remains little guidance in terms of assessment of how successfully exposures are actually changing fear learning from session to session.

How then can clinicians assess mechanisms within a clinical setting, in which sessions and resources may be limited? Two common components of CBT protocols for anxiety and OCD include written worksheets and assignment of homework between sessions (Hope, Heimberg, & Turk, 2010; Kazantzis, Whittington, & Dattilio, 2010; Piacentini, Langley, & Roblek, 2007). While worksheets may be related to the assessment and modification of target mechanisms, their utility is typically studied at the level of the overall protocol rather than for each individual worksheet. Moreover, in the context of CBT and ERP there are few tools to quantify the degree to which target mechanisms are being modified, and to make clinical decisions about how best to deliver the intervention. Such mechanism-focused assessment and decision-making tools have been successfully developed and utilized within-session in the context of other community-based behavioral interventions for children, a notable example being the Dyadic Parent-Child Interaction Coding System (Eyberg & Robinson, 1981) for parent-child interaction therapy (Cooley, Veldorale-Griffin, Petren, & Mullis, 2014; Eyberg, 1988). Similarly, while assignment of homework has shown beneficial to CBT outcome in general (Kazantzis et al., 2010), it may be helpful for exposure therapists to be able to quantify the extent to which fear learning occurred following specific homework exposures. For example, Abramowitz, Franklin, Zoellner, and DiBernardo (2002) studied the relationship between exposure homework compliance and treatment outcome for adults with OCD, but compliance was rated by a therapist at the end of treatment based on consideration of all exposure homework forms and homework discussions with the patient.

Below we describe the use of a clinical tool to assess mechanisms of exposure therapy with a small sample of 10 children with OCD and their parents. This tool is expanded from standard and previously published questions and/or forms from exposure exercises (Craske et al., 2014; Kozak, Foa, & Steketee, 1988; Kuckertz, Najmi, Baer, & Amir, 2019; Piacentini et al., 2007) and includes the Exposure Experience Questionnaire (EEQ), which we designed to both a) facilitate post-exposure processing based on exposure learning constructs (Craske et al., 2008, 2014) and b) provide clinicians, children, and their parents with an assessment of post-session learning. Because mechanistic research by its nature requires assessment across multiple timepoints (Maric, Wiers, & Prins, 2012) and because we were interested in using this measure as a session-by-session clinical tool, children (typically with a parent and/or clinician present) were instructed to complete this form for every in-clinic and at-home exposure. We provide brief feasibility data regarding this process and outcome data for the overall intervention. We also tracked OCD symptoms weekly so as to provide preliminary data on the relationship between our mechanistic measure and treatment change. Finally, we present further preliminary evidence of construct validity by examining relationships between our mechanistic measure with symptoms that we hypothesize should be less strongly affected (anxiety and depression) and another candidate exposure mechanism (within-session habituation).

1. Method

1.1. Participants

Participants were 10 children (5 females, 5 males) ages 8 to 15 (M = 11.80, SD = 2.39) with a primary diagnosis of OCD. All children identified as white, two of whom identified as Hispanic/Latino and eight of whom identified as non-Hispanic/Latino. Primary parents for the purposes of the study (i.e., attended all appointments) included nine mothers and one father, who were on average 42.30 years old (SD = 6.77) and had 15.10 years of education (SD = 2.69). Six parents were currently married, one was living with a partner, and three were divorced or separated. In five families, a second caregiver attended assessment and/or treatment sessions. Children had on average 2.60 clinical diagnoses (SD = 0.97, range = 1 to 4). OCD symptoms fell within the severe range on the Children's Yale-Brown Obsessive Compulsive Scale scores (clinician: M = 26.50, SD = 5.13; child: M = 25.60, SD = 4.27; parent: M = 25.55, SD = 2.65) (Scahill et al., 1997).

Families were recruited through community referrals, online searches, and study flyers, as part of a larger NIMH-funded study awarded to the first author (F31MH107176) examining behavioral and neurobiological mechanisms of ERP response. Inclusion criteria were children ages 8 to 17; OCD as primary diagnosis; clinician-rated CYBOCS $\geq$16 (Piacentini et al., 2011; Storch et al., 2007; Thomsen et al., 2013); and English proficiency. Exclusion criteria were active suicidality; prior psychotic, bipolar, or substance use disorder; diagnosis of intellectual disability and/or grade equivalency below the minimum threshold for study participation (e.g., second grade); developmental disorder; change in psychotropic medication within the past 6 weeks; concurrent psychotherapy; and serious medical conditions that would interfere with study participation.

1.2. Clinical measures

Children's Yale-Brown Obsessive Compulsive Scale (CYBOCS) Clinician-Rated Version. The CYBOCS (Scahill et al., 1997) is a clinician-rated measure of obsessive-compulsive symptom severity. The total score is comprised of 10 items, including subscales for obsessions and compulsions. The CYBOCS total score demonstrates excellent internal consistency (α = 0.90), test-retest reliability (ICC = 0.79), and

convergent/divergent validity (Storch et al., 2004). Internal consistency for the CYBOCS was excellent at baseline (α = 0.91) and post-treatment (α = 0.96).

CYBOCS Child- and Parent-Rated Versions. The child- and parent-rated CYBOCS (Scahill et al., 1997) parallel the clinician-rated CYBOCS. The child- and clinician-rated CYBOCS correlate highly (*r* = 0.77; Conelea, Schmidt, Leonard, Riemann, & Cahill, 2012). Internal consistency for the child-rated CYBOCS was somewhat low at baseline (α = 0.69) but in the acceptable to excellent range for all subsequent timepoints (α = 0.78 to 0.95). Similarly, internal consistency for the parent-rated CYBOCS was poor at baseline (α = 0.49) but in the acceptable to excellent range for all subsequent timepoints (α = 0.71 to 0.95).

Screen for Child Anxiety Related Emotional Disorders (SCARED). The SCARED (Birmaher et al., 1999) is a 41-item questionnaire designed to assess a variety of anxiety symptoms in youth populations with both child-rated (SCARED-C) and parent-rated versions (SCARED-P). This measure has good psychometric properties (Birmaher et al., 1999; Hale, Raaijmakers, Muris, & Meeus, 2005). Across timepoints, internal consistency was excellent for SCARED-P (α = 0.92 to 0.95) and good to excellent for SCARED-C (α = 0.86 to 0.95).

Mood and Feelings Questionnaire (MFQ). The MFQ (Wood, Kroll, Moore, & Harrington, 1995) measures depressive symptomatology in children and adolescents with sound psychometric properties and good sensitivity to symptomatic change over time. This measure has separate child- and parent-rated versions (MFQ-C and MFQ-P). Across timepoints, internal consistency was acceptable to excellent for MFQ-C (α = 0.71 to 0.91) but ranged from poor to excellent for MFQ-P (α = 0.47 to 0.95).

Anxiety Disorders Interview Schedule for DSM-IV-Child and Parent versions (ADIS-IV-C/P). The ADIS-IV-C/P (Silverman & Albano, 1996) is a semi-structured interview administered to youth and their parents to obtain diagnostic information based on the Diagnostic and Statistical Manual-IV (DSM-IV; American Psychiatric Association, 1994), including mood, anxiety, and externalizing disorders. The ADIS-IV-C/P has strong evidence for concurrent validity (Wood, Piacentini, Lindsey Bergman, McCracken, & Barrios, 2002) and excellent inter-rater agreement for principal diagnosis (k = 0.92; Lyneham, Abbott, & Rapee, 2007) and test-retest reliability (k = 0.80-0.92; Silverman, Saavedera, & Pina, 2001).

1.3. Treatment

Participants completed an 8-week ERP program as well as one pre-treatment session of hierarchy development and psychoeducation regarding the rationale for ERP. The authors developed the treatment manual for the current study (Appendix A, copyright authors and published with permission), with included constructs influenced by manuals used in previous studies on the treatment of children with OCD (Lebowitz & Omer, 2013; Storch et al., 2016; Piacentini et al., 2007). This protocol had been iteratively adapted and utilized successfully by the authors with four pilot participants prior to the current study. Per session structure utilized by Storch et al. (2007) parents were present during each 60 min ERP session unless otherwise clinically indicated.

Prior to each exposure while children were completing a computerized task relevant to separate study aims,[1] the therapist met briefly with parents to (a) review homework, (b) introduce psychoeducation module (weeks 1–3: what to expect from treatment, rewarding your child for exposure effort, gradual reductions in family accommodation) or reviewing questions related to previous psychoeducation components (weeks 4–8), and (c) planning for in-session exposure. At the beginning of each ERP session, the therapist, child, and parent reviewed homework exposure(s) completed prior to the session and discussed the upcoming in-clinic exposure. During exposure, the child completed an exposure practice form. While the child always provided all answers to questions on the exposure practice form, we allowed for the parent to actually read the questions aloud to the child and circle answers for them when developmentally appropriate and/or to promote generalization to at-home exposure completion. For in-clinic sessions, the clinician provided prompts and answered questions related to completion of the form as needed. Across exposures, we encouraged verbalization of the EEQ items and responses, as verbal processing and affect labeling have been posited to enhance exposure learning (Craske et al., 2014; Weisman & Rodebaugh, 2018). Consistent with previous research (Amir, Kuckertz, Najmi, & Conley, 2015; Kuckertz et al., 2019), families were instructed to stay in the exposure until the child's initial subjective units of discomfort (SUDS) dropped by half, or when 40 min passed, whichever occurred first. We selected these criteria so as to maximize the likelihood that exposure learning occurred, although we hypothesized that such learning could occur either via habituation and/or other inhibitory learning processes (e.g., distress tolerance, self efficacy). At the end of each session, families were reminded to complete and record at least one homework exposure prior to the next visit, although they were encouraged to complete more than one exposure if possible.

1.4. Exposure practice form and Exposure Experience Questionnaire (EEQ)

Completed exposures were recorded on an exposure practice form. SUDS were recorded at 5 min intervals (Kozak et al., 1988; Kuckertz et al., 2019) and graphed so as to help children better visualize patterns in their anxiety (Piacentini et al., 2007). Several developmentally adapted questions from Craske et al. (2014) were included pre-exposure ("OCD thought – what do you think will happen?" and "Right before exposure – how bad do you think your anxiety will be? [0-10]) and post-exposure ("After exposure – did the thing you thought would happen actually happen? [circle yes/no] and "What did you learn?").

After each exposure, children completed the EEQ (Table 1) at the bottom of the exposure practice form. The EEQ comprises six items with five response options per item coded 0–4 (scale range: 0 to 24), with higher ratings indicating greater agreement (see Table 2 for descriptive statistics). EEQ items were iteratively narrowed and refined from a pool of candidate items through discussions between the first author with the second and third authors (both licensed clinical psychologists with extensive experience treating OCD with ERP in children and adults). Items were designed to capture concepts relevant to exposure learning, including self-efficacy ("I think I could do this exposure again"), violation of expectancies ("What happened during this exposure was …" and "If I did this exposure again it would be …"), and future willingness to tolerate anxiety ("I think I could do a harder exposure next time"). We also included two questions ("I think this exposure helped me" and "I am glad I did this exposure") that we hypothesized may relate to the aforementioned learning constructs using straightforward language (i.e., child may be more likely to say that they are glad they did the exposure if they learned something and/or feel they are more capable of tolerating anxiety). Furthermore, we felt that these items they may be clinically useful for subsequent exposure planning. Reliability analyses suggested that these two items fit well with the other items on the

[1] As part of the broader project participants completed an assessment and training version of an approach-avoidance task (Amir et al., 2013. In this task, participants saw ideographically-selected threat and neutral pictures and were asked to pull a joystick towards or away from themselves. All participants completed the same version of this task, albeit with different pictures. Related study aims including examining the extent to which automatic action tendencies may be modified through building contingencies between the type of picture and push vs. pull motion.

Table 1
Exposure Experience Questionnaire (EEQ).

YOUTH: Please answer these questions after you finish the exposure (circle one answer):					
1. I think I could do this exposure again	Definitely not	Probably not	Not sure	Probably yes	Definitely yes
2. What happened during this exposure was	Much worse than I thought	A little worse than I thought	About the same as I thought	A little better than I thought	Much better than I thought
3. If I did this exposure again it would be	Much worse than this time	A little worse than this time	About the same as this time	A little better than this time	Much better than this time
4. I think this exposure helped me	Definitely not	Probably not	Not sure	Probably yes	Definitely yes
5. I am glad I did this exposure	Definitely not	Not really	Not sure	Kind of yes	Definitely yes
6. I think I could do a harder exposure next time	Definitely not	Probably not	Not sure	Probably yes	Definitely yes

Table 2
Descriptive statistics for Exposure Experience Questionnaire (EEQ).

Location		Week							
		1	2	3	4	5	6	7	8
Clinic	Item 1	3.4 (0.70)	2.9 (0.99)	3.1 (1.27)	3.0 (1.00)	3.7 (0.50)	2.9 (1.36)	2.9 (1.20)	3.1 (0.78)
	Item 2	3.0 (0.47)	2.7 (1.12)	2.9 (1.05)	2.8 (1.39)	3.2 (0.67)	2.9 (1.27)	2.6 (1.50)	2.9 (1.17)
	Item 3	2.8 (0.79)	2.4 (0.84)	2.8 (0.97)	2.8 (0.83)	2.8 (0.83)	2.9 (1.17)	2.7 (1.10)	3.4 (0.53)
	Item 4	3.1 (0.74)	2.9 (0.99)	3.0 (1.00)	3.3 (0.87)	3.3 (0.71)	3.3 (0.71)	3.4 (1.10)	3.6 (0.73)
	Item 5	3.2 (0.92)	2.5 (1.35)	2.7 (1.22)	2.8 (1.30)	3.1 (0.93)	2.8 (1.30)	3.1 (1.10)	3.1 (1.05)
	Item 6	2.7 (1.06)	2.6 (1.07)	2.6 (1.33)	2.9 (0.93)	3.3 (1.00)	3.0 (1.00)	2.9 (1.20)	2.9 (1.27)
	Total	18.2 (3.12)	15.7 (5.12)	17.0 (5.59)	17.6 (4.50)	19.4 (3.00)	17.8 (5.07)	17.6 (6.23)	19.00 (4.47)
Home	Item 1	3.6 (0.52)	3.0 (0.76)	3.4 (0.74)	3.0 (0.93)	3.6 (0.52)	3.5 (1.20)	3.3 (1.21)	3.7 (0.95)
	Item 2	2.9 (1.13)	3.1 (0.64)	2.8 (1.16)	2.9 (1.13)	3.8 (0.46)	3.1 (0.99)	3.0 (1.22)	3.1 (1.46)
	Item 3	2.6 (0.74)	2.8 (0.71)	2.9 (0.83)	3.0 (0.76)	3.0 (0.93)	2.9 (0.99)	3.0 (1.10)	3.1 (1.46)
	Item 4	3.2 (0.71)	3.6 (0.52)	3.2 (1.16)	3.1 (0.83)	3.9 (0.35)	3.1 (0.99)	3.3 (1.21)	3.4 (1.13)
	Item 5	3.1 (0.83)	3.1 (0.64)	3.1 (1.13)	3.1 (0.83)	3.6 (0.52)	3.4 (0.74)	3.6 (0.55)	3.4 (1.13)
	Item 6	3.2 (0.89)	2.9 (1.13)	3.1 (0.83)	2.5 (0.76)	3.5 (0.53)	3.2 (1.16)	2.8 (1.47)	3.3 (1.70)
	Total	18.8 (2.87)	18.5 (2.56)	18.5 (4.07)	17.6 (3.46)	21.4 (2.07)	19.3 (4.20)	21.5 (1.91)	20.14 (6.82)

Notes. Standard deviations are presented in parentheses along with means. Descriptive statistics for home-based EEQ were based on only the first exposure completed at home within a given week. Descriptive statistics were calculated based on all complete data; mean substitution was not used.

scale and thus were included in further analyses. Children were instructed that there were no good or bad answers and that the clinician wanted to know what the child really thought in order to plan for future exposures.

1.5. Procedure

Families attended two assessment visits prior to initiating treatment. Families completed an initial eligibility/pre-treatment appointment including the CYBOCS, SCARED, MFQ, and ADIS administration. Eligible families who chose to enroll were subsequently provided psychoeducation about OCD/ERP and a copy of the treatment manual (Appendix A) with homework instructions to a) read sections on exposure therapy and fear hierarchy, and b) brainstorm an initial exposure hierarchy. In the second assessment appointment, families completed a battery of child- and parent-rated measures and met with the clinician to review and/or create a fear hierarchy.[2] The eight treatment sessions ranged from 60 to 90 min. During each session, parents and children completed weekly self-report measures including the CYBOCS, SCARED, and MFQ, following which the parent meeting occurred with the clinician. Afterwards, children completed the exposure with the clinician, with parent present unless clinically indicated otherwise. Children received a $5 gift card following each in-clinic session and a $10 cash bonus at the end of the study as an incentive for having turned in at least one homework exposure practice form each week. During a post-treatment session, the clinician re-administered the CYBOCS and families completed another battery of questionnaires, including the child- and parent-rated CYBOCS, SCARED, and MFQ. All assessment and treatment sessions were conducted by the first author, a masters-level clinical psychology doctoral student with prior experience treating children with OCD; and supervised by the last author, a licensed clinical psychologist with extensive experience treating children and adults with OCD. Appropriate consent was obtained from parents and assent from children; and all study procedures were approved by the San Diego State University Institutional Review Board.

1.6. Analytic plan

Feasibility of the EEQ. We present feasibility indicators on drop out rate as well as compliance with exposure practice form completion for a) clinic sessions, and b) homework sessions. Specifically, we also describe compliance with the study expectation that families complete at least one exposure practice form for homework each week. Finally, we report the total number of exposures completed a) across the entire study, and b) at home.

Reliability of the EEQ. We examined Cronbach's alpha at each time point for in-clinic as well as homework exposures. Because families completed varying numbers of homework exposures each week, we only examined reliability for the first homework exposure completed during that week. For each item, we also examined Cronbach's alpha if deleted.

Clinical outcomes. We used mixed models to estimate fixed and random effects (per-participant slopes) of symptom reduction across treatment using all available data (up to two clinician-rated timepoints and up to 10 child- and parent-rated timepoints). We opted to utilize

[2] As part of a broader project, children attended a third session prior to treatment in which they were assessed via EEG while completing computerized assessment tasks.

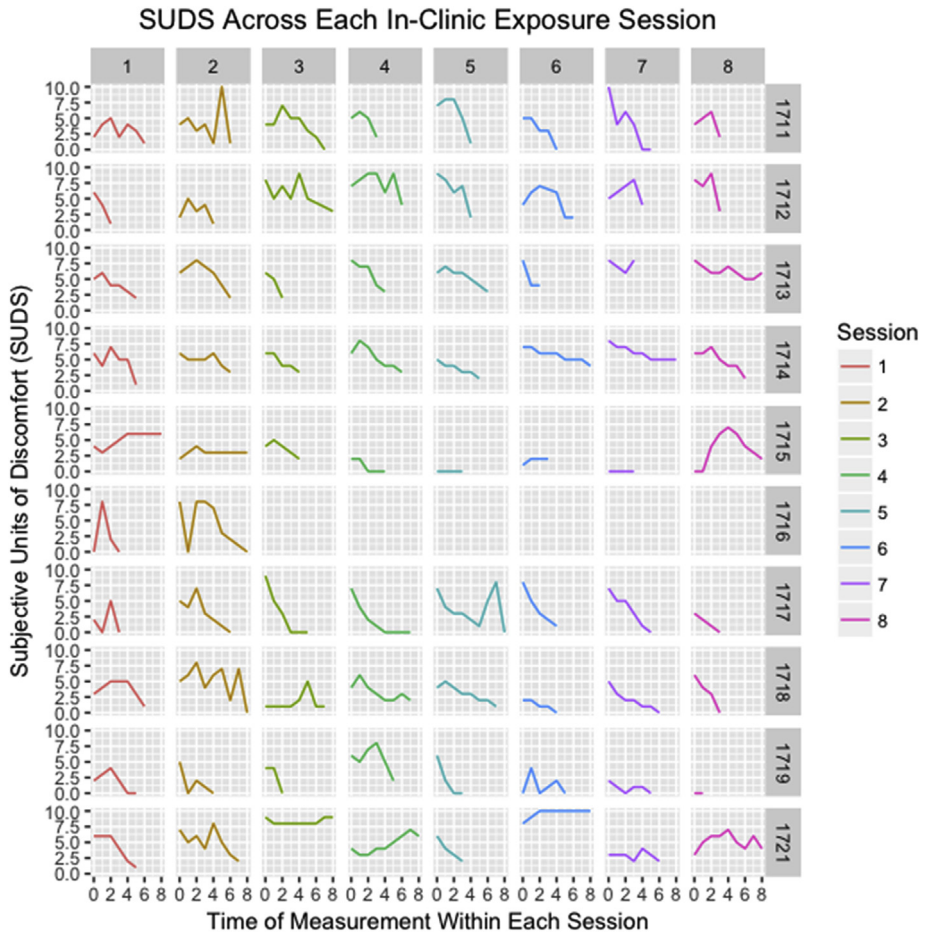

Fig. 1. Subjective units of distress (SUDS) across each in-clinic exposure session.

mixed models because of their noted advantages for small, longitudinal datasets (Muth et al., 2016). Specifically, mixed models maximize power in small datasets when many repeated measurements are included from the same individual. Unlike traditional repeated measures analysis of variance approaches, mixed models allow for analysis of all available data rather than applying listwise deletion or using imputation methods such as last observation carried forward, which reduce power and introduce bias – both of which are particularly problematic in small samples.

Compliance and relationship to clinical outcomes. To examine the extent to which clinical outcome is a function merely of exposure completion, we correlated the number of completed homework exposures and per-participant slopes of CYBOCS. We did not examine the relationship between number of completed clinic exposures and symptoms because this number was constant, except for one family who terminated treatment early.

Comparisons of clinic and homework exposures. To examine comparability between learning that occurred in clinic versus homework exposures, we compared mean EEQ scores for each participant based on all available a) clinic, and b) homework exposures using a paired samples *t*-test.

EEQ and relationship to clinical outcomes. We used mixed models with both fixed and random effects of treatment week to determine the presence of a linear slope for the EEQ over time. Due to small sample size, we examined statistical significance of the linear effect of week as well as visually inspected the EEQ plotted over time using participant-level data. If the pattern indicated a linear fixed effect, per-participant slopes of EEQ were subsequently correlated with per-participant slopes of CYBOCS, SCARED, and MFQ. If the pattern did not suggest a linear fixed effect, a per-participant mean EEQ score was calculated using all exposures and then correlated with per-participant slopes of CYBOCS, SCARED, and MFQ.

Within-session habituation. We used mixed models with both fixed and random effects of time (i.e., each 5 min interval within session) to determine the presence of a linear slope for time. We correlated this slope with EEQ means and/or slopes for clinic and homework exposures.

Data were analyzed using SPSS Version 26 (IBM, 2018) and R version 3.6.1 (R Core Team, 2019). Mixed models were estimated using the R package *nlme* (Pinheiro, Bates, DebRoy, Sarkar, & R Core Team, 2019).

2. Results

2.1. Feasibility

Of the 10 families enrolled in the study, one dropped out prematurely during the third treatment session. Dropout reasons included the child, aged 8, being unwilling to continue completing study tasks, and the parents stating that they felt the child's symptoms had become more manageable. This family did not turn in any homework exposure practice forms but did report practicing exposure at home and reducing accommodations.

Families successfully completed the exposure practice form (inclusive of the EEQ) during all exposure sessions completed in clinic across the course of the study (76 total sessions across 10 participants). Homework compliance was high among study completers: four families did not miss any weeks and five families missed 1–4 weeks, defined as not turning in at least one exposure practice form for a given week. However, each of the nine families who completed the study turned in

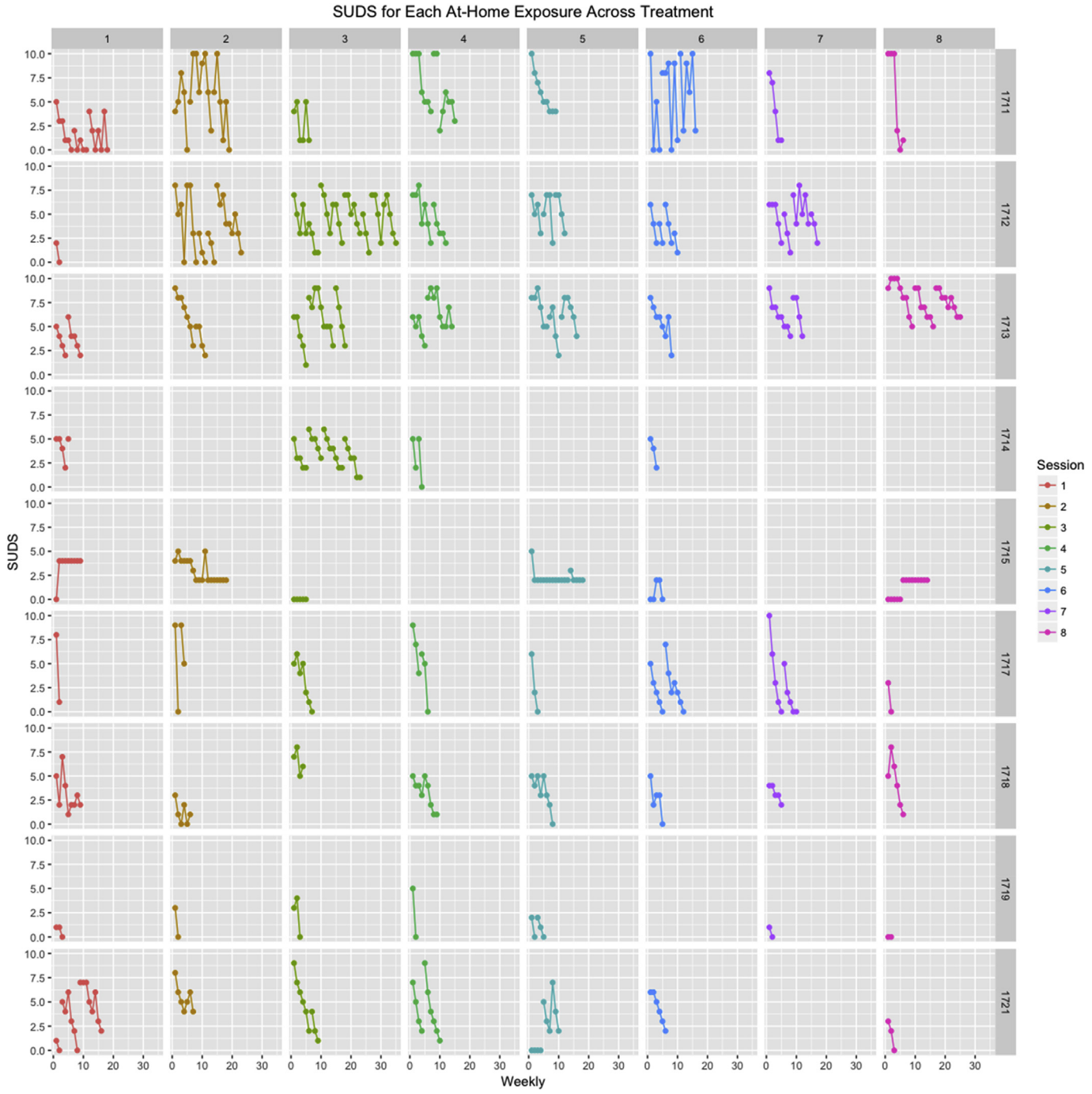

Fig. 2. Subjective units of distress (SUDS) across each at-home exposure session within a given week.

more than one exposure practice form during a given week at some point during the study.

Mean total number of exposures completed across treatment, including both clinic and at-home exposures, was 19.30 (*SD* = 7.79). On average, participants completed 11.90 exposures at home across the course of treatment (*SD* = 6.42).

We present the patient-level exposure data for each/all exposure(s) completed within a given week for both clinic (Fig. 1) and homework (Fig. 2) exposures. These figures provide a visual summary of the number of exposures completed per participant, per week, and also depict patterns of SUDS ratings within each exposure.

2.2. Internal consistency of the EEQ

Regarding deletion of specific items on Cronbach's alpha, no consistent patterns emerged and therefore we included all items for subsequent analyses. Internal consistency for the EEQ ranged from acceptable to excellent for clinic exposures (α = 0.70 to 0.94). Internal consistency was acceptable to excellent for most at-home timepoints, although two of the eight timepoints had alphas < .70 (α = 0.61 to 0.93). See Table 3 for alphas and sample size at each timepoint.

2.3. Clinical outcomes

OCD symptoms significantly decreased from pre-to post-treatment,

Table 3
Cronbach's Alpha for Exposure Experience Questionnaire (EEQ).

Location		Week							
		1	2	3	4	5	6	7	8
Clinic	α	.73	.87	.89	.79	.73	.85	.94	.87
	n	10	10	9	9	9	9	9	9
	Items	6	3	2/3[a]	3, 2	–	3	–	–
	Max α	.77	.90	.90	.84	–	.93	–	–
Home[b]	α	.63	.61	.76	.73	.76	.79	.85	.93
	n	8	8	8	8	8	8	6	7
	Items	3	3, 1, 2	6	5, 4	3	3	5,3	4
	Max α	.68	.69	.87	.78	.86	.81	.94	.94

Notes. Items = items that would improve alpha if deleted, ranked in order of most to least improvement. Max α = alpha if item with largest impact was deleted.

[a] Items 2 and 3 had equal impact on alpha if removed.

[b] Reliability for EEQ based on first exposure completed at home within a given week.

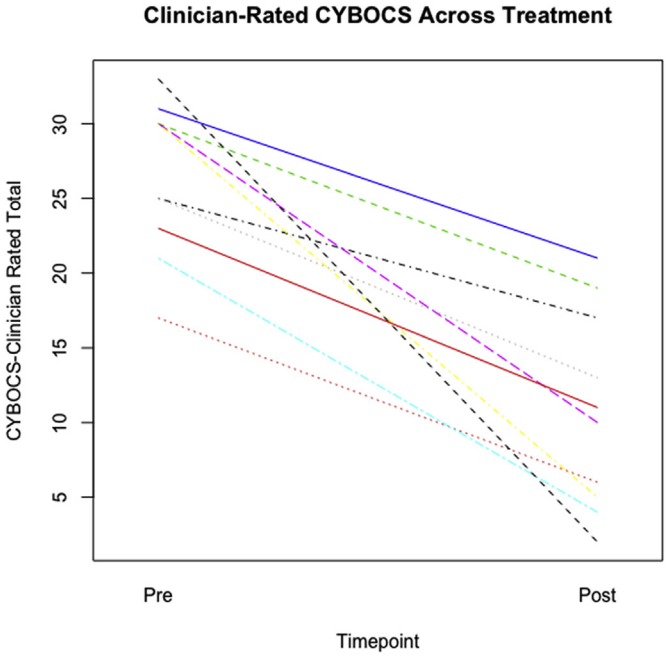

Fig. 3. Clinician-rated CYBOCS across treatment.

as assessed via the clinician-rated CYBOCS [$B = -15.70$, $t(9) = -6.63$, $p < .001$] (Fig. 3). On average, clinician-rated CYBOCS scores decreased by 15.70 points across the course of treatment ($SD = 7.48$). Both children and parents similarly reported steady and significant decreases in symptoms as assessed weekly via child-rated [$B = -1.44$, $t(83) = -7.31$, $p < .001$] and parent-rated CYBOCS [$B = -1.16$, $t(82) = -4.85$, $p < .001$] (Figs. 4 and 5).

2.4. Compliance and relationship to clinical outcomes

Number of completed at-home exposures was moderately and nonsignificantly correlated with slope of clinician-rated CYBOCS ($r = .47$, $p = .166$) such that more completed at-home exposures was associated with lesser symptom reduction, and weakly and non-significantly correlated in the same direction with child-rated ($r = 0.25$, $p = .493$) and parent-rated CYBOCS ($r = 0.10$, $p = .781$).

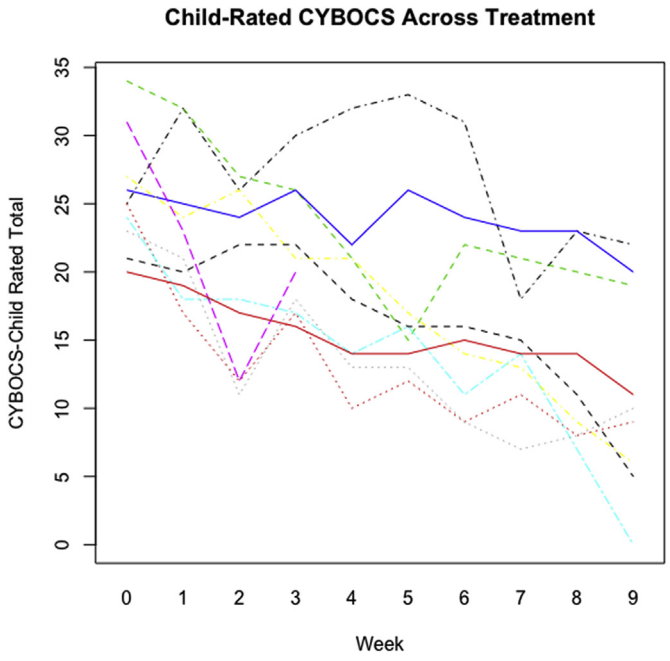

Fig. 4. Child-rated CYBOCS across treatment.

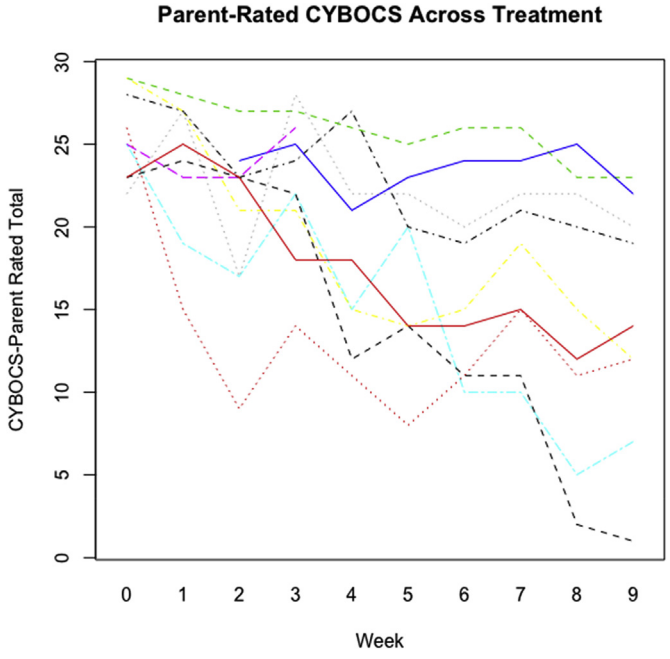

Fig. 5. Parent-rated CYBOCS across treatment.

2.5. Comparisons of clinic and homework exposures

Mean EEQ scores not significantly different across treatment for exposures completed in clinic ($M = 17.31$, $SD = 3.99$) versus at home ($M = 18.67$, $SD = 3.33$) [$t(8) = -0.79$, $p = .454$].

2.6. EEQ and relationship to clinical outcomes

Clinic exposures. The slope of the EEQ across time was not significant for clinic exposures [$B = 0.12$, $t(62) = 0.62$, $p = .538$] and visual inspection of the EEQ plotted over time did not suggest linear change (Fig. 6). Therefore, we calculated a mean EEQ score from all clinic exposures. For clinic exposures, mean EEQ was strongly but nonsignificantly correlated with slope of parent-rated CYBOCS

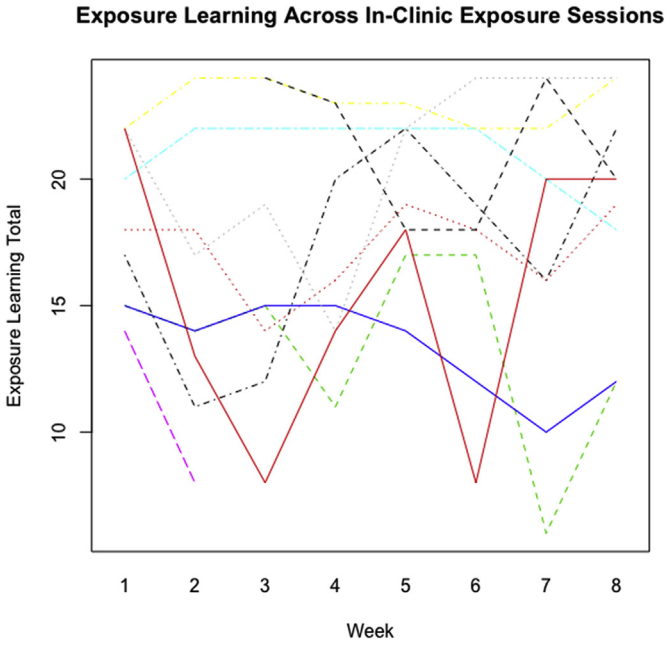

Fig. 6. Exposure learning (EEQ) across in-clinic exposure sessions.

($r = -0.52$, $p = .122$) such that greater exposure learning was associated with steeper reductions in symptoms, and similarly, moderately but nonsignificantly correlated with slopes of child-rated ($r = -0.47$ $p = .172$) and clinician-rated CYBOCS ($r = -0.43$, $p = .214$).

Homework exposures. The slope of the EEQ across time was significant for homework exposures [$B = 0.33$, t (102) $= 2.22$, $p = .029$].[3] Slope of EEQ was strongly and significantly correlated with slope of clinician-rated ($r = -0.71$, $p = .032$), child-rated ($r = -0.67$, $p = .047$), and parent-rated CYBOCS ($r = -0.74$, $p = .022$) such that greater exposure learning was associated with steeper reductions in symptoms. For consistency with the analyses using clinic data, we calculated a mean EEQ score from all homework exposures. Consistent with the clinic data, mean EEQ for homework exposures was strongly and significantly associated with slope of clinician-rated ($r = -0.72$, $p = .028$), child-rated CYBOCS ($r = -0.83$, $p = .005$), and parent-rated CYBOCS ($r = -0.78$, $p = .014$).

2.7. Other preliminary evidence of EEQ validity

The EEQ was not significantly correlated with slopes of child- or parent-rated anxiety (SCARED) or depressive symptoms (MFQ) in either the clinic or home setting. The slope of SUDS within-session was significant for both clinic [$B = -0.29$, t (442) $= -2.80$, $p = .005$] and homework exposures [$B = -0.44$, t (590) $= -4.01$, $p < .001$], indicating that within-session habituation did occur.[4] However, the EEQ was not significantly associated with the slope of within-session SUDS across either setting. Mean EEQ scores for clinic and home exposures were significantly and strongly correlated ($r = 0.73$, $p = .026$). See Table 4 for details.

[3] This model included week as both a fixed and random factor but did not account for the order in which participants completed at-home exposures within a given week. We examined more complex models that accounted for order within a given week as a fixed and/or random factor, however these more complex models were not a significantly better fit to the data than the parsimonious model per model comparison using ANOVA.

[4] These models included time (i.e., SUDS measurement within each exposure) as a fixed and random factor. We examined a more complex model that included week as a fixed factor, however this model was not a significantly better fit to the data for either clinic or homework exposures.

Table 4
Correlations between EEQ with Symptoms and Habituation Across Timepoints.

	EEQ (Mean)-Clinic	EEQ (Mean)-Homework	EEQ (Slope)-Homework
CYBOCS-Clinician	−0.43	−0.72*	−0.71*
CYBOCS-Child	−0.47	−0.83*	−0.67*
CYBOCS-Parent	−0.52	−0.78*	−0.74*
SCARED-Child	−0.36	−0.47	−0.40
SCARED-Parent	−0.07	−0.38	−0.34
MFQ-Child	−0.17	0.04	0.13
MFQ-Parent	−0.33	−0.33	−0.22
Slope of SUDS (WSH)-Clinic	0.07	0.34	0.35
Slope of SUDS (WSH)-Homework	−0.17	0.16	0.11
EEQ (Mean)-Clinic	–	0.73*	0.65†
EEQ (Mean)-Homework		–	0.53
EEQ (Slope)- Homework			–

†$p < .10$, *$p < .05$.
Notes. CYBOCS = Children's Yale Brown Obsessive Compulsive Scale; SCARED = Screen for Child Anxiety and Related Emotional Disorders; MFQ = Mood and Feelings Questionnaire; SUDS = Subjective Units of Distress; WSH = Within Session Habituation; EEQ = Exposure Experience Questionnaire.

3. Discussion

Despite advances in our understanding of mechanisms underlying fear processes (Dougherty et al., 2018; Lang et al., 2016; McKay & Tolin, 2017), there is currently a gap between the insights produced via laboratory assessment and concrete tools for harnessing these insights in clinical practice. Relatedly, a recent special issue published in the *Journal of Obsessive Compulsive and Related Disorders* highlighted the need for further direction on what clinicians are supposed to do during and following exposures so as to maximize exposure gains and promote dissemination of this intervention (Conelea & Freeman, 2015). In addressing such gaps, researchers would ideally introduce tools that are feasible for the typical family in clinical practice, easily disseminated to practitioners, and clinically useful for a given patient's treatment. In the current study, we describe and present initial data on the Exposure Experience Questionnaire (EEQ), a brief and novel measure based on fear learning mechanisms of exposure success.

Feasibility indicators suggested that families were capable and willing to complete the EEQ in the clinic as well as generally to meet or exceed the study therapist's expectations that they complete at least one exposure practice form per week as homework. Psychometric indicators were also promising. The EEQ demonstrated acceptable to excellent internal consistency across most timepoints in clinic and home settings. In particular, internal consistency estimates for homework exposures suggest that participants were independently completing this measure in a meaningful way that replicated the process of completing the measure in the clinic. As such, the EEQ items can be viewed as measuring a single, reliable construct. At the same time, certain individual questions may offer a useful launchpad from which families and clinicians can process the exposure using plain language (e.g., “I am glad I did this exposure”).

Our preliminary results suggest that exposure learning as assessed via the EEQ was associated in the expected direction with OCD outcomes. Perhaps more promising, this pattern of associations was present for homework exposures, thus supporting the potential utility of the EEQ to capture activation of exposure learning mechanisms in real world settings outside of the therapy office. Correlations between EEQ were weaker and nonsignificant with symptoms less directly targeted via exposure, including anxiety broadly and depression. Within-session habituation was not significantly associated with the EEQ across either setting. Collectively these data suggest that 1) the EEQ is not merely measuring the same learning processes as this form of habituation, and 2) quantifying learning processes following exposure may be a useful

addition to research that has to date focused largely on patient anxiety ratings during exposures (Chu et al., 2015; Kircanski et al., 2012; Sripada & Rauch, 2015).

Given that exposure and response prevention is typically seen as a critical procedure in CBT interventions for OCD and researchers have critiqued CBT protocols that do not maximize time spent completing exposure (Storch, 2014), one might question to what extent simply maximizing dosage rather than manipulating mechanisms is critical to improving outcomes. Our data did not suggest a pattern whereby increasing exposure dosage (i.e., increasing number of completed homework exposures) resulted in improved outcomes. One caveat is that compliance was high for the study requirement to complete a minimum of one exposure per week and therefore the range included families who did more homework exposures than required but generally not less. These data suggest that clinicians and families in outpatient settings may be best served by spending their time designing and processing exposures that are likely to maximize exposure *learning* rather than simply maximizing the *number* of exposures completed beyond a certain level (e.g., weekly). These findings are consistent with previous research suggesting that perceived helpfulness but not frequency of homework exposure affects outcomes (Bluett, Zoellner, & Feeny, 2014).

The purpose of the current study was to examine whether the EEQ demonstrated initial feasibility and clinical utility in a small sample of children with OCD, and to support future research on its use. A limitation of our study is that we did not validate our constructs with external measures of inhibitory learning (e.g., fear conditioning paradigms, psychophysiological indicators), which are generally not feasible in typical clinical settings. Future research will be important to better validate and characterize which aspects of exposure learning are reflected by the EEQ. We also did not set out to examine the comparative contributions of inhibitory learning mechanisms versus more traditional habituation-driven mechanisms. Continued research that examines how inhibitory learning and habituation may interact (e.g., Kuckertz et al., 2019) to affect outcome represents a critical area for future research. Given this small initial sample, we attempted to leverage the richness of the exposure dataset by analyzing all exposures and all symptom assessments completed over the course of treatment within a mixed models approach that is advantageous for small samples (Muth et al., 2016), and by examining symptom-related findings across three sources of information (parent, child, clinician). Nonetheless, even with optimizing analytic approaches for small samples, findings should be interpreted with caution until replicated in larger samples. Thus while the findings based on this sample are not robust enough to support the inclusion of the EEQ in clinical practice at this time, they do support the continued investigation of the reliability, validity, and clinical utility of this measure among larger samples.

We wish to note that while children provided all responses to EEQ questions, there was some variability in whether the child or parent actually recorded responses. This was by design, because 1) it would encourage verbal processing and affect labeling, which may enhance exposure learning (Craske et al., 2014; Weisman & Rodebaugh, 2018), 2) in some cases, it helped parents be involved in the exposure in a clinically appropriate way, 3) we assumed that having the option for parents to record responses might improve child's compliance with completing the exposure practice form, and 4) this would simulate real-world clinical settings in which the extent that parents assist in the completion of therapy homework is based on individual clinical and feasibility concerns. Anecdotally, the majority of participants verbally articulated responses to the EEQ with their parent(s) present and recording of data was fairly split between child and parent. While we would not necessarily expect differential demand characteristics based on who recorded verbally articulated responses, it is possible that differences in the child's attention or effort may have affected responding. In our future research utilizing the EEQ, we plan to more systematically track how the form was completed. Similarly, we did not systemically collect feedback on child and/or parents' attitudes towards this measure, which represents an important area for our future work.

Moreover in subsequent research, it will be critical to examine such questions in racially and ethnically diverse samples. If similar patterns and effect sizes are demonstrated in follow up studies, the EEQ and exposure practice form accompanying it could potentially allow for comparison between exposures and facilitate discussions about the selection of future exposures. It could guide homework exposures and provide clinicians with a more detailed picture of how mechanisms were invoked outside of the clinic. In the era of RDoC and an increasing emphasis on mechanisms ranging from the level of genes to behavior (National Institute of Mental Health, 2019), this study brings research suggestions from the laboratory into practice, and provides some framework for using clinical measures of mechanism in order to increase efficiency of treatment.

Role of funding sources

This research was supported by a grant from the National Institute of Mental Health (NIMH) (F31MH107176) awarded to Jennie Kuckertz. Additionally, Nader Amir received funding from the NIMH (R01MH106477) during the time this research was conducted and prepared for publication.

Contributors

Jennie Kuckertz: designed the study, wrote the treatment protocol, administered study visits, Formal analysis, completed statistical analyses, Writing - original draft, and wrote the first draft of the manuscript. John Piacentini: provided feedback during the development of the EEQ measure, was a collaborator on the larger project (F31MH107176), provided clinical training and consultation to the first author in support of this study, and was involved in the revision process for this manuscript. Nader Amir: advised the study design and writing of the protocol, Supervision, supervised all assessment and treatment visits, and contributed to the final manuscript. All authors approved the final manuscript

Declaration of competing interest

Jennie Kuckertz has no conflicts of interest to declare.

John Piacentini receives research support from NIMH, the TLC Foundation for BFRBs, and Pfizer Pharmaceuticals for a noninterventional safety surveillance study; publication royalties from Guilford Press and Oxford University Press; and travel/speaking honoraria from the Tourette Association of America, International OCD Foundation, and the TLC Foundation for BFRBs.

Nader Amir was formerly a part owner of Cognitive Retraining Technologies, LLC (“CRT”), a company that marketed anxiety relief products. Dr. Amir's ownership interest in CRT was extinguished on January 29, 2016, when CRT was acquired by another entity. Dr. Amir has an interest in royalty income generated by the marketing of anxiety relief products by this entity.

Acknowledgements

The authors wish to thank Emily Reikes, Miguel Montero, Shaan McGhie, and Ieshia Brown for their assistance in data collection for this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jocrd.2020.100528.

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