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Exposure and Response Prevention Process Predicts Treatment Outcome in Youth with OCD

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Abstract Recent research on the treatment of adults with anxiety disorders suggests that aspects of the in-session exposure therapy process are relevant to clinical outcomes. However, few comprehensive studies have been conducted with children and adolescents. In the present study, 35 youth diagnosed with primary obsessive-compulsive disorder (OCD; *M* age = 12.9 years, 49 % male, 63 % Caucasian) completed 12 sessions of exposure and response prevention (ERP) in one of two treatment conditions as part of a pilot randomized controlled testing of a family focused intervention for OCD. Key exposure process variables, including youth self-reported distress during ERP and the quantity and quality of ERP completed, were computed. These variables were examined as predictors of treatment outcomes assessed at mid-treatment, post-treatment, and three-month follow-up, partialing treatment condition. In general, greater variability of distress during ERP and completing a greater proportion of combined exposures (i.e., exposures targeting more than one OC symptom at once) were predictive of better outcomes. Conversely, greater distress at the end of treatment was generally predictive of poorer outcomes. Finally, several variables, including within- and between-session decreases in distress during ERP, were not consistently predictive of outcomes. Findings signal potentially important facets of exposure for youth with OCD and have implications for treatment. A number of results also parallel recent findings in the adult literature, suggesting that there may be some continuity in exposure processes from child to adult development. Future work should examine additional measures of exposure process, such as psychophysiological arousal during exposure, in youth.

Keywords Obsessive-compulsive disorder (OCD) · Youth · Exposure therapy · Exposure and response prevention (ERP) · Subjective distress

Obsessive-compulsive disorder (OCD) is a common and highly impairing psychiatric condition in children and adolescents (Moore, Mariaskin, March, and Franklin 2007; Piacentini, Bergman, Keller, and McCracken 2003; Valleni-Basile et al. 1994). OCD is defined by the presence of obsessions and/or compulsions: obsessions are repetitive and intrusive thoughts, images, or impulses, and compulsions are repetitive behaviors or mental acts that are performed in order to reduce distress or perceived harm (American Psychiatric Association 2013). Cognitive-behavioral therapy (CBT) currently is considered the front-line treatment for pediatric OCD (Freeman et al. 2014; Geller and March 2012), and importantly, research supports the efficacy of its core behavioral component, exposure and response prevention (ERP) (Abramowitz 1996; Kendall et al. 2005; Stanley and Turner 1995). During a typical exposure session, ERP entails repeatedly triggering a client's obsessions (exposure) and helping the client to resist the associated compulsions (response prevention) over a series of exposure tasks or trials (Meyer 1966). Indeed, ERP is utilized extensively in manualized CBTs for OCD in youth (e.g., Kendall and Hedtke 2006; Piacentini, Langley, and Roblek 2007; see Freeman et al. 2014 for review). This approach is similar to exposure-based interventions for other anxiety disorders, which involve the process of repeatedly exposing clients to feared stimuli and situations.

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Traditionally, ERP for OCD, and exposure therapy in general, is postulated to facilitate corrective learning and clinical improvement through a process of initial activation of the client's fear during the first exposure task (initial fear activation; IFA) (Foa and Kozak 1986; Foa and McNally 1996) followed by habituation, or the gradual reduction in distress or arousal that results from repeated and sustained exposures to a feared stimulus (Foa and Kozak 1986; Foa and McNally 1996; Groves and Thompson 1970). In addition, response prevention is theorized to disrupt the negative reinforcement cycle of compulsion-related distress reduction (Foa, Steketee, Grayson, Turner, and Latimer 1984). Several investigations with adult clinical and analogue anxiety samples have examined initial levels of, and within- and between-session decreases in, self-reported distress and/or physiological arousal throughout exposure and their relations to treatment outcomes. A recent review of this research found mixed evidence that initial level of distress during exposure therapy predicts clinical outcomes, no consistent evidence that the amount of distress reduction within exposure sessions predicts outcomes, and limited evidence that the amount of distress reduction between exposure sessions predicts outcomes (Craske et al. 2008). More recent work has generally supported this perspective (Baker et al. 2010; Culver, Stoyanova, and Craske 2012; Hayes et al. 2008; Kircanski et al. 2012; Norton, Hayes-Skelton, and Klenck 2011). Importantly, however, while the term "habituation" has been used frequently to characterize distress reduction in the literature, this obscures the distinction between habituation per se (an internal process) and distress reduction more generally (which may encompass the influences of external events, such as avoidance behavior).

Relative to the work in adult samples, very little research has investigated the relation of exposure process variables to treatment outcomes in youth. This is an important issue to consider, as exposure practices with youth are widespread and as there may be important continuities or discontinuities from child to adult development in the relation of exposure processes to treatment outcomes. For example, it is possible that differences between youth and adults in level of cognitive and emotional development may change the relation of exposure-based distress to outcomes. An early examination of self-reported distress in four youth with OCD undergoing ERP indicated that the degree of between-session reduction in distress did not predict post-treatment fear ratings (Knox, Albano, and Barlow 1996). Likewise, in a sample of youth with non-OCD anxiety disorders, Hedtke et al. (2009) found that peak anxiety ratings averaged across exposure sessions did not predict post-treatment outcomes. Kircanski et al. (2014) examined youths' average level of distress rated across all OC symptoms during CBT, and demonstrated that greater decreases in distress were associated with improved clinical outcomes. However, this study did not examine between-session changes in distress specifically during ERP. To our knowledge, no other studies have been conducted with youth with OCD or other anxiety disorders. Furthermore, in both youth and adult samples, a considerable proportion of clients fail to exhibit significant distress reduction during exposure therapy, and very few attain complete elimination of distress (Craske 1999; Craske et al. 2008; Stanley and Turner 1995). Therefore, it is critical to investigate these and additional aspects of the exposure process that may predict treatment outcomes, especially in youth.

Emerging research on other facets of the exposure process suggest several important variables to consider. First, the adult literature has examined other indices of distress and/or arousal during treatment, including the expected versus actual level of distress during exposure tasks, the amount of variability in distress during an exposure session, and the final level of distress at the end of treatment. For instance, it has long been argued that individuals with anxiety disorders tend to over-predict the level of distress that they will experience when confronting a feared stimulus (Rachman 1994; Rachman and Bichard 1988), and during exposure therapy with adults, this over-prediction, relative to correct prediction or under-prediction of distress, has been associated with subsequent increases in self-efficacy (Van Hout and Emmelkamp 1994). In addition, greater variability of distress, a measure that indexes both greater increases and greater decreases in distress throughout exposure, has been associated with improved outcomes in two studies. Several mechanisms may account for this relation, such as periodic increases in distress providing more opportunities for corrective learning to occur. In contrast, findings regarding the final level of distress at the end of treatment have been mixed (Culver, Stoyanova, and Craske 2012; Kircanski et al. 2012). Second, studies with youth and adults have examined quantitative characteristics of exposure, such as the number of exposures completed per session and the amount of session time spent on conducting exposures, and findings for youth have been inconsistent. Hedtke et al. (2009) found in their sample with non-OCD anxiety disorders that completing fewer exposure tasks predicted improved outcomes, whereas Benito et al. (2012) found in a sample of young children with OCD that the duration of exposures was unrelated to outcomes. Thus, further research is needed regarding the association between quantitative exposure characteristics and treatment outcomes. Finally, the review of the adult exposure therapy literature (Craske et al. 2008) explored qualitative characteristics of exposure that may help to improve clinical outcomes. Among several key findings, the review indicated that an approach involving separate exposure to two different feared stimuli followed by exposure to both stimuli simultaneously (Rescorla 2006), is a potentially fruitful avenue for further research. Relative to exposures to only single stimuli, compound exposure may help to maximize the

amount of corrective learning that can be achieved (Craske et al. 2008).

In the present study, we utilized data from a recent open trial and a pilot randomized controlled trial (RCT) of a family focused intervention for OCD in children and adolescents (Peris and Piacentini 2013) in order investigate the relations of key exposure process variables to clinical outcomes. Both treatment conditions in the study involved 12 sessions of individual ERP, throughout which data were collected regarding youth self-reported distress and quantitative and qualitative characteristics of exposure. This research design allowed us to examine whether aspects of the exposure process predict treatment outcomes after partialing the unique effects of treatment condition. In order to advance the very limited research to date on exposure process and treatment outcomes in youth, we derived and examined indices of initial level of distress at the start of ERP, reduction in distress across ERP tasks within session, reduction in distress between sessions, expected versus actual distress, variability in distress, final level of distress at the end of ERP, the number of exposures completed per session, the amount of session time spent on exposures, and the proportion of combined exposures (i.e., single exposure tasks that targeted more than one symptom or stimulus simultaneously). We then examined these exposure process variables in relation to primary outcomes at mid-treatment, post-treatment, and three-month follow-up, as assessed using well-validated and widely-used measures of clinician-rated OCD severity, OCD improvement, and overall functioning.

Based on the extant literature, we hypothesized that the measures of initial level of distress, reductions in distress across ERP tasks within sessions, reductions in distress between sessions, and the final level of distress during ERP would not consistently predict treatment outcomes. Conversely, we hypothesized that higher expected distress than actual distress and greater variability of distress during ERP would predict better outcomes. Given the mixed findings for quantitative aspects of exposure, we hypothesized that the number of ERP tasks completed and the amount of time spent on ERP tasks per session would not consistently predict outcomes. Finally, given the potential promise of compound exposure, we hypothesized that completing a greater proportion of ERP tasks targeting more than one OC symptom at once would predict better outcomes.

Method

Participants

Participants were 35 treatment-seeking youth ages 8–17 years (*M* age = 12.86 years, 49 % male) and their families. Youth were drawn from a larger treatment development project that included both open (n=5) and randomized controlled testing (RCT; n=30) of a family focused intervention for OCD. To be included in either the open trial or pilot RCT, youth were required to have: (a) a primary diagnosis of OCD as determined by DSM-IV-TR criteria (American Psychiatric Association 2000); (b) a score of 15 or higher on the Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS; Scahill et al. 1997); (c) high levels of family distress as demonstrated by elevations on at least two out of three measures of family functioning (Peris et al. 2012); (d) no failed CBT trials for anxiety or OCD within the last 2 years; (e) sufficient English proficiency to participate in family therapy; and (f) no comorbid psychiatric illness for which exposure-based CBT was contraindicated (e.g., schizophrenia, conduct disorder). Youth with other co-occurring secondary diagnoses were allowed to participate. Children and adolescents on a stable dose of psychotropic medication were also eligible to participate, and 14 % of participants were taking a serotonin reuptake inhibitor medication at intake. Overall, 63 % of youth self-identified as Caucasian, 17 % Latino, 9 % Persian, 6 % African American, and 5 % other. For information on the pilot feasibility RCT sample, see (Peris and Piacentini 2013).

Measures

Baseline and Treatment Outcome Measures

Anxiety Disorders Interview Schedule: Child and Parent Versions (ADIS-C/P; Silverman and Albano 1996). Eligibility for the study was determined using the ADIS-IV, a semi-structured psychiatric diagnostic interview that assesses for a range of mental health conditions affecting children and adolescents. The interview produces clinician severity ratings ranging from 0 to 8 for each diagnosis, with higher scores reflecting greater levels of severity. A clinical severity rating (CSR) of 4 or higher on a 0–8 scale is indicative of clinically significant disorder and was required for a diagnosis of OCD. The ADIS has demonstrated sound psychometric properties (Silverman, Saavedra, and Pina 2001), and interviewers were trained according to the procedures set forth by instrument developers. Although we did not conduct a formal reliability assessment, studies from this program utilizing similar training and supervision procedures as the present study have demonstrated excellent agreement on OCD diagnosis (k=0.89) between diagnosticians and a best-estimate derived from a consensus case conference procedure (Piacentini et al. 2011).

Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS; Scahill et al. 1997). The CY-BOCS is a widely-used measure of OCD symptom severity. The semi-structured

clinician-rated interview produces separate scores for obsessions and compulsions, and a total severity score is determined by summing 10 items on 5-point Likert scales. The CY-BOCS possesses adequate internal consistency and convergent and discriminant validity (Storch et al. 2004) and inter-rater reliability for a subsample of cases within the pilot RCT produced *ICC* = 0.98 (Peris and Piacentini 2013).

Clinical Global Impression-Severity Scale (CGI-S; NIMH 1985). CGI-S is a clinician-rated global measure of the client's overall severity of illness, with scores ranging from 1 (normal) to 7 (extremely ill).

Clinical Global Impression-Improvement Scale (CGI-I; NIMH 1985). CGI-I is a clinician-rated global measure of clinical improvement from baseline, with scores ranging from 1 (very much improved) to 7 (very much worse), with youth rated as 1 (very much improved) or 2 (much improved) considered treatment responders. Independent review of 20 % (n=7) of cases revealed excellent agreement (r=0.95) on post-treatment CGI-I ratings.

Children's Global Assessment Scale (CGAS; Shaffer et al. 1983). CGAS is a single-item clinician-rated scale of a child's overall functioning over the past month, with scores ranging from 1 (lowest functioning) to 100 (highest functioning). As adapted from the adult Global Assessment Scale, the CGAS includes behavioral anchors to aid in clinician ratings. The CGAS has been shown to possess good construct validity and test-retest reliability (e.g., Green, Shirk, Hanze, and Wanstrath 1994).

Exposure Process Measures

Subjective Units of Distress Scale (SUDS; Wolpe 1973). Youth self-reported subjective distress level using a "fear thermometer" scale ranging from 0 (least distressed) to 10 (most distressed). Therapists asked youth to rate their expected SUDS level for each ERP task immediately prior to its onset, and to rate their actual SUDS level immediately after its onset.

Session Summary Sheet Following each treatment session, therapists completed a standardized summary sheet that delineated the quantitative and qualitative aspects of ERP during the session. Specifically, therapists documented the number of ERP tasks that were completed, the number of minutes of the 60-minute session spent on ERP tasks, and, for up to the first three ERP tasks, the expected and actual SUDS level for each ERP task, and whether each ERP task targeted a single symptom or more than one symptom or stimulus simultaneously (i.e., combined exposure). Finally, the form requested open-ended narrative information about the ERP tasks that were completed (e.g., a brief verbal description of each ERP task). Session summary sheets were reviewed as part of weekly supervision and were also checked in real time by research coordinators for completeness in an effort to minimize missing data.[1] A blind coder trained to criterion rated a randomly-selected 10 % (n=35) of videotaped treatment sessions on several exposure process variables, including the number of ERP tasks completed, number of minutes spent on ERP, expected SUDS for the first ERP task, and actual SUDS for the first ERP task. In some instances and primarily for subsequent ERP tasks, tasks were completed outside of the session room in order to enhance their real-world generalizability, thus potentially contributing to inter-rater disagreement. Inter-rater reliability was excellent for these variables, producing *ICC* range = 0.81–0.97.

Procedure

This study was conducted in compliance with the University of California, Los Angeles Institutional Review Board (IRB). Interested families participated in a brief telephone screen to ascertain eligibility and those that were prospective participants went on to complete the informed consent/assent process and a baseline evaluation with an independent evaluator (IE). IEs were trained to criterion on the ADIS-IV, CY-BOCS, CGI-S, CGI-I, and CGAS using procedures established by the instrument developers, and they administered these interviews jointly to parents and children. Additional self-report measures were also completed as part of the baseline evaluation. IEs remained blind to treatment condition and completed additional standardized assessments at mid-treatment, post-treatment, and three-month follow-up.

In order to use all available ERP data for the current study, data were taken from youngsters participating in either the open testing or RCT phase of the treatment. Regardless of treatment phase or condition, all youth received 12 weekly 60-minute sessions of individual child ERP. Individual child ERP was completed according an existing CBT manual

[1] Due to therapists not fully completing the Session Summary Sheet, there were missing values for initial distress (1 participant), decrease in distress across tasks within session through mid-treatment (1 participant), between-session decrease in distress through mid-treatment (4 participants) and post-treatment (2 participants), variability in distress through post-treatment (1 participant), and final distress through mid-treatment (6 participants) and post-treatment (3 participants). In addition, across the full sample a total of 39 sessions did not include ERP or associated therapist ratings. Twenty-two of these cases occurred in Sessions 3–11, and the majority were isolated sessions in which treatment focused on mastering associated skills (e.g., cognitive restructuring). The other 17 cases occurred in Session 12, in which treatment focused instead on relapse prevention.

for pediatric OCD (Piacentini, Langley, and Roblek 2007), in which Session 1 involved psychoeducation to the child and parent on OCD and the rationale for exposure, Session 2 involved creation of the child's OCD symptom hierarchy that would guide exposure for the remainder of treatment, and Sessions 3 through 12 involved completing in-session ERP tasks.

In the open trial, individual child ERP was followed by positive family interaction therapy (PFIT) aimed at helping families to manage OCD symptoms more effectively. The PFIT protocol was conducted every-other-week for 60 min (6 h total) after individual child ERP, and it involved an intensive family therapy module designed specifically to address familial responses of conflict and blame and to enhance cohesion. In the RCT, families were assigned to either this PFIT protocol (n=15) or to standard treatment (ST; n=15). The parent component of ST was also based on the existing CBT manual for pediatric OCD (Piacentini, Langley, and Roblek 2007); time was spent with parents every week for 30 min (6 h total) following individual child ERP, and it entailed discussion of the treatment session, an opportunity to ask questions, and a standardized psychoeducation module for parents. Regardless of treatment phase or condition, the amount and duration of ERP and of total treatment were equal. Although the format and focus of the family intervention differed across conditions, the amount of parental contact was the same.

Data Reduction and Statistical Analysis

A series of exposure process variables were computed. With respect to self-reported distress variables, initial distress was operationalized as the SUDS level for the first ERP task during the first ERP session, decrease in distress across tasks within session was operationalized as the average difference between the maximum SUDS level obtained for an ERP task and the SUDS level obtained for the last ERP task at each session (such that more positive scores indicate greater decreases), and decrease in distress between sessions was operationalized as the average difference in the maximum SUDS level from each ERP session to the next (such that more positive scores indicate greater decreases). Final distress was operationalized as the SUDS level for the last ERP task during the last ERP session, variability in distress was operationalized as the average difference between the maximum SUDS level and the minimum SUDS level for each ERP session (such that higher scores indicated greater variability), and expected minus actual distress was operationalized as the average difference between the expected SUDS level and actual SUDS level for each ERP session (such that more positive scores indicate higher expected than actual SUDS). Because decrease in distress within session and variability in distress were calculated across multiple ERP tasks within sessions, when a participant completed only one ERP task per session in all sessions, thus providing no operationalization of these two variables, these variables were coded as missing.[2] Variables corresponding to the quantity and quality of ERP were also computed, including the average number of ERP tasks completed per session, the average number of minutes spent on ERP per session, and the average proportion of ERP tasks per session that were combined exposures. In order to examine exposure process variables in relation to mid-treatment outcomes, a series of variables corresponding to all of those listed above were computed using only data through Session 6.

Treatment outcome measures were computed as change scores for the CY-BOCS, CGI-S, and CGAS from baseline to mid-treatment, post-treatment, and three-month follow-up. Raw CGI-I scores at mid-treatment, post-treatment, and three-month follow-up were retained as measures of change from baseline.

In order to examine the nature of self-reported distress during ERP over the course of treatment and to provide a comparison to previous findings, a series of t-tests were conducted with these variables. In order to test the study hypotheses regarding exposure process variables predicting treatment outcomes, a series of hierarchical regression analyses were conducted in which, for each treatment outcome measure, treatment condition (PFIT or ST) was entered in Model 1, and each exposure process variable was entered in Model 2. The significance of each exposure process variable was evaluated by examining the R^2 change statistic when the variable was added to the model. In order to capture potentially important variables for further research in youth samples, marginally significant results (p<0.10) are also presented.

Results

Descriptive Statistics

Descriptive statistics for the exposure process variables through mid-treatment and post-treatment are presented in Table 1. With respect to the SUDS variables, t-tests (test values = 0) indicated that initial distress, decrease in distress across tasks within session, variability in distress, and final distress through mid-treatment and through post-treatment were all significantly greater than 0, all ps<0.001, indicating that participants experienced significant initial activation of

[2] Due to participants who completed one ERP task per session in all sessions, decrease in distress across tasks within session and variability in distress values were coded as missing through mid-treatment (4 participants) and post-treatment (3 participants).

Table 1 Raw values for exposure process variables

Variable	Through mid-treatment *M* (*SD*)	Through post-treatment *M* (*SD*)
Initial distress[a]	3.41 (2.50)	3.41 (2.50)
Decrease in distress across ERP tasks within session[a]	0.93 (0.79)	1.02 (0.56)
Between-session decrease in distress[a]	−0.39 (1.08)	−0.24 (0.78)
Variability in distress[a]	1.98 (0.84)	2.02 (0.72)
Final distress[a]	4.48 (1.74)	4.58 (2.96)
Expected minus actual distress	0.23 (1.00)	0.39 (0.91)
Number of ERP tasks per session	2.31 (1.00)	2.29 (0.88)
Minutes spent on ERP per session	38.02 (6.75)	43.53 (7.37)
Proportion of combined exposures per session	0.13 (0.23)	0.16 (0.19)

ERP exposure and response prevention [a] Variable has missing data

fear, decreases in distress within sessions, variability in distress during exposure therapy, and final distress at the end of exposure therapy. Between-session decrease in distress through mid-treatment was marginally less than 0, $t(30) = -2.03$, $p=0.05$, and between-session decrease in distress through post-treatment was marginally less than 0, $t(32) = -1.78$, $p = 0.09$, indicating that maximum SUDS level slightly increased, rather than decreased, over the course of treatment. Expected minus actual distress through mid-treatment was not significantly different from 0, $t(34) = 1.38$, *ns*, and expected minus actual distress through post-treatment was significantly greater than 0, $t(34) = 2.57$, $p<0.05$, indicating that expected SUDS level was higher than actual SUDS level over the full course of treatment. With respect to quantitative and qualitative characteristics of exposure, *t*-tests (test values = 0) indicated that the number of exposures per session, the time spent on exposures per session, and the proportion of combined exposure targets were all significantly greater than 0, all *p*s<0.001.

Exposure Process Variables in Relation to Treatment Outcomes

Mid-Treatment

Results of the hierarchical regression analyses indicated that greater between-session decrease in distress (i.e., greater decrease in maximum SUDS level from one ERP session to the next) predicted greater improvement through mid-treatment on the CGI-I, R^2 change = 0.17, standardized $\beta=-0.41$, $p<0.05$, and CY-BOCS, R^2 change = 0.15, standardized $\beta=-0.39$, $p<0.05$. In addition, a greater proportion of ERP tasks per session that were combined exposures predicted greater improvement through mid-treatment on the CY-BOCS, R^2 change = 0.12, standardized $\beta=-0.35$, $p<0.05$, and CGAS, R^2 change = 0.12, standardized $\beta=0.34$, $p<0.05$. Conversely, greater expected minus actual distress predicted marginally lesser improvement through mid-treatment on the CGI-I, R^2 change = 0.10, standardized $\beta=0.32$, $p=0.06$. In addition, higher final distress predicted lesser improvement through mid-treatment on the CGI-I, R^2 change = 0.12, standardized $\beta=0.36$, $p<0.05$. No other exposure process variables were significant predictors of mid-treatment outcomes.

Post-Treatment

A greater proportion of ERP tasks per session that were combined exposures predicted greater improvement through post-treatment on the CGI-I, R^2 change = 0.12, standardized $\beta=-0.35$, $p<0.05$, and marginally on the CGAS, R^2 change = 0.09, standardized $\beta=0.30$, $p=0.07$. Conversely, higher final distress predicted lesser improvement through post-treatment on the CGI-I, R^2 change = 0.13, standardized $\beta=0.36$, $p<0.05$. No other exposure process variables were significant predictors of post-treatment outcomes.

Three-Month Follow-Up

Greater decrease in distress across tasks within session predicted marginally greater improvement through three-month follow-up on the CGI-S, R^2 change = 0.10, standardized $\beta=-0.32$, $p=0.08$. Greater variability in distress predicted greater improvement through three-month follow-up on the CY-BOCS, R^2 change = 0.18, standardized $\beta=-0.45$, $p<0.05$, and CGI-S, R^2 change = 0.18, standardized $\beta=-0.46$, $p=0.01$, and marginally on the CGAS, R^2 change = 0.10, standardized $\beta=0.34$, $p=0.09$. No other exposure process variables were significant predictors of three-month follow-up outcomes.

Statistical Power

Finally, we conducted a power analysis (G*Power 3.1; Faul, Erdfelder, Lang, and Buchner 2007) focusing on our hypothesized and obtained significant predictors of improved treatment outcomes, based on the reviewed previous findings and using desired power = 0.80. The present sample size was within the range of the lowest estimated required sample size for between-session decrease in distress ($n=24$), variability in distress ($n=36$), and expected versus actual distress ($n=20$). Estimated required sample size for combined exposures could not be computed due to the limited previous work in human samples. We also computed the achieved statistical power of our analyses, focusing on our significant findings, for which power ranged from 56 to 79 % likelihood of rejecting the null hypothesis.

Discussion

The aim of the present study was to advance the relatively scant extant research on exposure process and treatment outcomes in youth. In this sample of children and adolescents diagnosed with OCD, the results were generally supportive of the hypotheses, with some notable exceptions. First, as hypothesized, measures of initial distress and decrease in distress across tasks within session did not consistently predict outcomes. Specifically, initial distress did not predict any outcome measure at any time point, and greater decrease in distress across tasks within session marginally predicted greater improvement on the CGI-S at three-month follow-up. Findings for between-session decrease in distress and final distress were only slightly more consistent; greater between-session decrease in distress predicted greater improvement on the CGI-I and CY-BOCS at mid-treatment, and higher final distress predicted less improvement on the CGI-I at mid-treatment and post-treatment. Second, as hypothesized, greater variability in distress predicted greater improvement; this pattern was observed broadly across the CY-BOCS and CGI-S, and marginally on the CGAS, although only at three-month follow-up. Third, contrary to expectations, greater expected than actual distress marginally predicted lesser improvement on the CGI-I at mid-treatment. Fourth, as hypothesized with respect to quantitative aspects of exposure, the number of exposures completed and the amount of time spent on exposures per session did not consistently predict outcomes. In fact, neither variable predicted any outcome measures. Finally, as expected, a greater proportion of ERP tasks that were combined exposures predicted greater improvement; this was observed across the CY-BOCS and CGAS at mid-treatment and across the CGI-I and marginally on the CGAS at post-treatment.

Similar to what has been observed in the adult exposure therapy literature (reviewed in Craske et al. 2008), although on average youth did experience initial activation of their distress and reduction of distress across tasks within sessions, these indices were not reliably related to treatment outcomes. Recent work with adults has suggested that between-session decrease in distress may be slightly more predictive of outcomes (Baker et al. 2010; Kircanski et al. 2012), and this was also shown in the current study, although on average youth in this study did not experience decreases in distress between sessions. This lack of decrease in distress between sessions in the current study may be related to the fact that exposures frequently increase in level of difficulty over the course of treatment. Taken together with the results of a study in which youth with OCD and their parents reported decreases in the average level of distress across all symptoms during CBT (Kircanski et al. 2014), these findings suggest that the overall decrease in symptom-based distress during CBT is a much stronger predictor of outcomes than is between-session decrease in distress specifically during ERP.

By contrast, these data are more consistent with emerging research emphasizing the role of variability in distress in predicting outcomes of exposure therapy (Culver et al. 2012; Kircanski et al. 2012). Indeed, basic science work in learning and memory has demonstrated that random and variable practice of non-emotional information can improve its long-term retention (Bjork and Bjork 2006). Building on this work, two previous studies of the treatment of adults with anxiety disorders found that exposures to random and variable feared stimuli resulted in better outcomes than did exposures to constant stimuli (Lang and Craske 2000; Rowe and Craske 1998). Variability in distress during ERP may help youth to learn that they can tolerate a range of emotional states when confronting stimuli or situations, which may facilitate youth's ability to generalize their experiences in therapy to their experiences of symptoms in the real world, which are likely to involve variable emotional states as well. Interestingly, though decrease and variability in distress across ERP tasks within session were computed using some of the same SUDS values, the relative lack of findings for decrease in distress and the significant findings for variability in distress suggest that both increases and decreases in distress are important during ERP, but their temporal sequencing within sessions (i.e., increases followed by decreases) is not critical. In fact, an important clinical implication of this finding is that, when youth do experience periodic increases in distress throughout exposure, therapists may find it useful to describe that this is not a failure of the child or of the exposure process and to highlight its potential benefits for longer-term outcomes.

Theory from adult research regarding the over-prediction of distress (Rachman 1994; Rachman and Bichard 1988) was not supported by these data. Instead, when actual distress during ERP was higher than expected, this predicted marginally greater clinician-rated OCD improvement at mid-treatment. This finding may relate to the aforementioned benefits of youth learning to tolerate a variety of distress levels during ERP. That is, experiencing a higher level of distress than was expected may lead to new learning that one can handle even stronger emotional states than one thought possible. It is also possible that, due to differences in cognitive development, youth and adults differ in the ways in which they forecast future distress or in their ability to accurately do so during exposure. Further research across development is needed to substantiate this notion.

With respect to quantitative and qualitative aspects of exposure, it may be counterintuitive that the number of ERP tasks and the amount of time spent on ERP in session did not predict any outcomes, as it might be assumed that more exposure is better. Conversely, as proposed by Hedtke et al. (2009), completing fewer ERP tasks per session may allow more time for the therapist and client to prepare for and

subsequently process each task, such as discussing what the child learned. It is possible that these two competing influences may cancel out one another, thus leading to the lack of significant findings. As all therapists were following the same ERP manual, it is also possible that a restricted range of values contributed to the null findings. In addition, qualitative components of ERP likely play a role. As was evidenced in the current study, completing a greater proportion of ERP tasks that were combined exposures predicted greater improvement on multiple measures across two different time points. Although this study was not designed to evaluate the effects of compound exposure per se, or conducting separate exposures to two different feared stimuli followed by exposure to both stimuli simultaneously (Rescorla 2006; reviewed in Craske et al. 2008), we were able to approximate this concept by assessing the proportion of exposures that targeted more than one symptom at once. Theoretically, it is argued that compound exposure results in deepened extinction, in which greater inhibitory learning is achieved when an aversive stimulus (i.e., a feared outcome) does not occur in the presence of multiple conditioned stimuli versus in the presence of one conditioned stimulus. This is because the presence of multiple stimuli is associated with a greater baseline likelihood of the feared outcome occurring, thus the fact that the outcome does not occur is more "surprising" (Rescorla and Wagner 1972). The present findings suggest that clinical practice with children and adolescents may benefit from the incorporation of combined exposures when possible. As clinical research on this topic is limited, future exposure-based studies should more closely evaluate this argument in both youth and adults with OCD and other anxiety disorders.

Several limitations of the present study warrant discussion. First, the exposure process variables were operationalized for this study in order to best approximate their use in previous research with youth and adults. However, prior studies have been inconsistent in their collection and computation of exposure process measures, and the current study also had limitations, including the amount and types of data that were collected during ERP sessions. In particular, future studies should employ more continuous measurement procedures for SUDS, so that within-task changes and other more nuanced fluctuations in distress may be examined. Future studies should also integrate the examination of SUDS changes during ERP with the occurrence of external events (e.g., avoidance behavior) in order to construct a more complete model of exposure processes in youth. For example, Benito et al. (2012) reported a set of coding variables including child, therapist, and parent statements and behaviors that may be fruitful to examine in relation to distress ratings during ERP. Second, this study used multiple therapist-report measures of exposure processes, which as subjective measures are susceptible to various biases. This concern is alleviated to some degree by strong agreement with an independent rater on key exposure process variables. Nevertheless, this study did not employ more objective measures such as observational coding or assessment of psychophysiological arousal, which hold promise in further elucidating ERP processes. Third, the present study included a fairly small sample of youth with OCD, and analyses of achieved statistical power indicated a range of power from fair to desirable. Although the sample was carefully assessed, well characterized, and ethnically diverse, replication with larger samples is in order.

The present findings suggest additional important directions for future research. First, there are several intriguing alternative explanations for these findings that may be examined in future studies. It is possible that some of the exposure process variables for which no significant effects were found are in fact relevant to treatment outcomes, but the manner in which these constructs traditionally have been indexed is not optimal. For example, initial fear activation indexes youth subjective affect associated with the triggering of obsessions and/or resisting of compulsions at the start of ERP, and it may be useful to more directly assess the subjective intensity of symptoms, which may not correspond precisely to level of subjective distress. It is also likely that therapists' actions are influenced by youths' subjective distress ratings during the course of treatment; for instance, upon observing that distress has been decreasing, therapists may choose to increase the intensity of subsequent ERP tasks, potentially contributing both to greater variability in distress and to more effective treatment overall. Similarly, while therapists in the present study were encouraged to include combined exposures when feasible, this type of clinical decision-making may reflect specific perceptions of patients, such as youths' ability to tolerate high levels of distress and engage in more powerful exposures. Further studies should attempt to better capture therapist decision-making during treatment as a function of youth process variables. Moreover, future studies with clinical and analogue youth samples may experimentally manipulate potential emerging mechanisms of learning in exposure, such as comparing conditions that attempt to enhance versus minimize distress variability through the ordering of exposure tasks, or comparing conditions that involve compound versus single exposure targets. Insights from such work will guide theory and will inform the refinement and optimization of empirically-supported treatment approaches. As another future direction, to our knowledge, no studies with children and adolescents have investigated the relations of psychophysiological arousal during exposure therapy to treatment outcomes, which will be critical in more comprehensively understanding youth's affective experiences. Finally, it will be important to extend this investigation to the study of children and adolescents with non-OCD anxiety disorders in an attempt to develop more generalized principles of exposure process.

In summary, this was the first study to investigate both self-reported distress and structural components throughout ERP

and their relations to immediate- and longer-term outcomes in youth with OCD, building significantly on previous studies of exposure processes in youth. Key aspects of exposure process were derived and tested across a range of pertinent outcome measures. Intriguingly, several results paralleled those in recent adult literature, suggesting that there may be some continuity in the models and methods of exposure therapy from child to adult development. However, exposure-based research on youth with OCD and other anxiety disorders lags significantly behind the work with adults. Further rigorous research will enable us to fully test the mechanisms that may help to drive exposure efficacy for children and adolescents.

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