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BRIEF REPORT

Remotely Delivering Real-Time Parent Training to the Home: An Initial Randomized Trial of Internet-Delivered Parent–Child Interaction Therapy (I-PCIT)

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Objective: Remote technologies are increasingly being leveraged to expand the reach of supported care, but applications to early child-behavior problems have been limited. This is the first controlled trial examining video-teleconferencing to remotely deliver behavioral parent training to the home setting with a live therapist. ***Method:*** Racially/ethnically diverse children ages 3–5 years with disruptive behavior disorders, and their caregiver(s), using webcams and parent-worn Bluetooth earpieces, participated in a randomized trial comparing Internet-delivered parent–child interaction therapy (I-PCIT) versus standard clinic-based PCIT ($N = 40$). Major assessments were conducted at baseline, midtreatment, posttreatment, and 6-month follow-up. Linear regressions and hierarchical linear modeling using maximum-likelihood estimation were used to analyze treatment satisfaction, diagnoses, symptoms, functioning, and burden to parents across conditions. ***Results:*** Intent-to-treat analyses found 70% and 55% of children treated with I-PCIT and clinic-based PCIT, respectively, showed "treatment response" after treatment, and 55% and 40% of children treated with I-PCIT and clinic-based PCIT, respectively, continued to show "treatment response" at 6-month follow-up. Both treatments had significant effects on children's symptoms and burden to parents, and many effects were very large in magnitude. Most outcomes were comparable

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across conditions, except that the rate of posttreatment "excellent response" was significantly higher in I-PCIT than in clinic-based PCIT, and I-PCIT was associated with significantly fewer parent-perceived barriers to treatment than clinic-based PCIT. Both treatments were associated with positive engagement, treatment retention, and very high treatment satisfaction. ***Conclusion:*** Findings build on the small but growing literature supporting the promising role of new technologies for expanding the delivery of behavioral parent training.

What is the public health significance of this article?
This study provides the first evidence from a controlled trial supporting the feasibility, acceptability, and preliminary efficacy of leveraging video-teleconferencing technology to remotely deliver live parent training to the home setting. With continued support, such a format may play an important role in improving the accessibility and scope of supported treatments for traditionally underserved populations by overcoming geographic barriers to quality mental health care and extending the reach of evidence-based treatment providers.

Keywords: telemental health, preschool, conduct problems, parent training, technology

Disruptive behavior disorders (DBDs) are among the most common disorders affecting young children (e.g., Egger & Angold, 2006), and when left untreated, are associated with complex and intractable trajectories over time (e.g., Lavigne et al., 2001). Guidelines suggest that psychosocial interventions, when available, should constitute first-line treatment (Comer et al., 2013; Eyberg et al., 2008). Behavioral parent training, in particular, has shown the strongest support (Comer et al., 2013; Eyberg et al., 2008; Kaminski et al., 2008). parent–child interaction therapy (PCIT; Eyberg & Funderburg, 2011) is one such supported parent-training program. Throughout treatment, parents practice positive attending and effective discipline while the therapist monitors family interactions from behind a one-way mirror and provides live coaching via a parent-worn bug-in-the-ear device.

Despite treatment advances, barriers interfere with proper service access. Regional professional workforce shortages in mental health care impinge on the availability of services (Comer & Barlow, 2014). Transportation barriers and stigma-related concerns about going to a mental health facility (Owens et al., 2002) further limit the accessibility and acceptability of clinic-based services. Remote technologies are increasingly being leveraged to expand the reach and scope of children's mental health care, given their potential to overcome traditional barriers to services and promote skill generalization by extending skill engagement beyond brick-and-mortar sessions (Comer & Barlow, 2014; Jones et al., 2013; Kazdin & Blase, 2011). However, applications to early child DBDs have been limited. To date, controlled evaluations in this area have only involved hybrid models that conduct most parent training in person, despite other treatment components being conducted remotely (Jones et al., 2014; Myers et al., 2015). Such programs are not fully liberated from the geographical obstacles that hinder service accessibility for many.

Comer and colleagues (2015) have suggested that PCIT may be particularly amenable to a videoteleconferencing (VTC) format, given that, by design, the PCIT therapist is not in the same room as the family for most of the treatment, but rather is remotely monitoring from another room and providing real-time feedback to parent(s) via a parent-worn bug-in-the-ear device. With VTC, therapists can remotely provide in-the-moment feedback during parent–child interactions in the home, regardless of a family's geographic proximity to a mental health clinic. Such Internet-delivered PCIT (I-PCIT) can afford a comparable quantity of therapist contact relative to standard, clinic-based PCIT. Moreover, treating families in homes may enhance the ecological validity of treatment by providing parent coaching in the very settings in which child behaviors are most problematic. VTC platforms are being increasingly used to remotely provide full courses of real-time treatment in the home for a number of clinical populations (e.g., Comer et al., 2017), although applications to early DBDs are limited.

This is the first randomized trial evaluating VTC to offer fully remote behavioral parent training with a live therapist. Three–five-year olds with DBDs were randomly assigned to receive either I-PCIT or standard clinic-based PCIT. We hypothesized that I-PCIT would: (a) be associated with productive engagement and high treatment satisfaction; and (b) yield significant improvements maintained across a 6-month follow-up period. We further predicted that I-PCIT and standard clinic-based PCIT would yield similar outcome trajectories and response rates across time.

Method

Participants

Racially/ethnically diverse participants were 40 children ages 3–5 with a DBD defined by the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV*; APA, 1994) and their caregiver(s). Table 1 presents eligibility criteria and sample characteristics.

Measures

Assessments included independent evaluator ratings and diagnoses, and parent reports on questionnaires evaluating (a) child diagnostic outcomes, (b) global severity, impairment and functioning, (c) disruptive behavior symptoms, (d) caregiver burden, (e) barriers to treatment, and (f) treatment satisfaction. Table 2 presents a summary and description of measures included.

Table 1
Demographic Characteristics of Study Participants

Eligibility criteria	
Inclusion	Exclusion
1. Child between ages of 3–5 years (inclusive)	1. Child has emotional or behavioral problems more impairing than *DSM-IV* DBD
2. Independent evaluator assigned a principal diagnosis of *DSM-IV* ODD, CD, and/or DBD-NOS, based on the *K-DBDS*	2. Child receiving medication or psychotherapy to manage emotional or behavioral problems
3. *Eyberg Child Behavior Inventory* (*ECBI*) in clinical range (i.e., >132)	3. Child behavior problems due to organic pathology or traumatic brain injury, as reported by parents (note: no families were excluded due to this criterion)
4. Child and participating caregiver(s) speak English	4. Child is a ward of the state
5. Family home equipped with a computing device (e.g., desktop computer, laptop)	5. Caregiver-reported history of severe physical or mental impairments (e.g., intellectual disability, deafness, blindness, developmental delay) in child or participating caregiver(s)

Sample demographic characteristics

Variable	Total sample (N = 40)	Internet-delivered PCIT (n = 20)	Clinic-based PCIT (n = 20)	Significance test
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	
Child age, years	3.95 (.9)	3.8 (.8)	4.1 (.9)	$t(38) = 1.11, p = .27$
Maternal Age, years	37.5 (5.5)	38.3 (4.3)	36.6 (6.6)	$t(38) = .97, p = .34$
	n (%)	*n* (%)	*n* (%)	
Sex				Fisher's exact test: $p = 1.0$
Male	33 (83.5)	16 (80.0)	17 (85.0)	
Female	7 (16.5)	4 (20.0)	3 (15.0)	
Race/ethnicity[a]				$\chi^2(1, N = 33) = .35, p = .55$
Non-Hispanic Caucasian	19 (57.6)	9 (56.2)	10 (58.8)	
Ethnic/racial minority[b]	14 (42.4)	7 (43.8)	7 (41.2)	
Annual household income[c]				Fisher's exact test: $p = .49$
<$50,000	8 (23.5)	4 (22.2)	4 (26.7)	
$50,000-$100,000	11 (32.4)	5 (27.8)	6 (40.0)	
$100,001-$150,000	6 (17.6)	5 (27.8)	1 (6.7)	
>$150,000	9 (26.4)	5 (27.8)	4 (26.7)	

Note. ODD = oppositional defiant disorder; CD = conduct disorder; DBD-NOS = disruptive behavior disorder (not otherwise specified); *K-DBDS* = *Kiddie-Disruptive Behavior Disorder Schedule.*
[a] Based on 33 participants providing such data. [b] Among those reporting racial/ethnic minority status, 64.3% were Hispanic/Latino, 21.4% were African American/Black, 7.2% were Asian American, and 7.2% were biracial/multiracial. [c] Based on 34 participants providing such data.

Treatments

PCIT (Eyberg & Funderburg, 2011) is a well-established, clinic-based, behavioral parent-training program for young children that places central emphasis on improving parent–child interaction patterns and the quality of parent–child relationships. PCIT draws on attachment and social learning theories to emphasize positive attention, consistency, problem-solving, and communication. Parents first learn to build a positive and rewarding parent–child relationship via positive attending skills and differential reinforcement, and then learn effective discipline strategies and time-out procedures. The precise length of PCIT for a given family is titrated to the quickness with which the family achieves mastery criteria. A distinguishing feature of PCIT is the use of in-session parent coaching. The therapist monitors the family from behind a one-way mirror and provides live and individualized coaching through a parent-worn bug-in-the-ear device.

I-PCIT (Comer et al., 2015) follows traditional clinic-based PCIT, but uses a VTC platform to enable therapists to remotely deliver treatment to families in their homes. Instead of interacting in front of a one-way mirror at a clinic, families use a webcam to broadcast home-based interactions to their therapists, who remotely provide live coaching through a parent-worn Bluetooth earpiece. Technological, administrative, security, and hardware considerations for telemental health care are considered elsewhere (Chou et al., 2016; Comer et al., 2015).

Procedure and Data Analysis

Procedures were approved by the Florida International University and Boston University institutional review boards and informed consent was obtained for all families. Participants were recruited from the flow of families seeking treatment for child-behavior problems at one of two university-affiliated clinics in [Miami, FL and Boston, MA]. Independent evaluators (IEs) masked to treatment condition conducted *Kiddie-Disruptive Behavior Disorder Schedule* (*K-DBDS;* Keenan, Wakschlag, & Danis, 2001) diagnostic interviews, and generated *Clinical Global Impressions* (*CGI*; Guy & Bonato, 1970) and Children's Global Assessment Scale (CGAS; Shaffer et al., 1983) scores, at baseline,

Table 2
Overview of Included Measures

Domain	Measure	Description	Study assessment point(s) administered
Diagnostic outcomes	*Kiddie-Disruptive Behavior Disorders Schedule* (*K-DBDS*; Keenan et al., 2001).	Semistructured parent-report diagnostic interview conducted by an IE that assesses *DSM-IV* ODD, CD, and ADHD in preschoolers	Baseline, Posttreatment, 6-month follow-up
Global severity, impairment, and functioning	Clinical Global Impression-Severity and Improvement Scales (CGI-S/I; Guy & Bonato, 1970)	Most widely used clinician-rated measure of treatment-related changes in functioning. The CGI-Severity score rates severity on a 7-point scale, ranging from 1 ("normal") to 7 ("among the most severely ill patients"). The CGI-Improvement rates improvement on a 7-point scale, ranging from 1 ("very much improved") to 7 ("very much worse"). CGI-Improvement scores of 1 ("very much improved") or 2 ("much improved") reflect "treatment response." CGI-Improvement scores of 1 ("very much improved") reflect "excellent response." Completed by IE in present study.	Baseline, Posttreatment, 6-month follow-up
	Children's Global Assessment Scale (CGAS; Shaffer et al., 1983)	Clinician-rated index of functioning. Scores range from 0–100; lower scores indicate greater impairment. Completed by IE in present study.	Baseline, Posttreatment, 6-month follow-up
Disruptive behavior symptoms and caregiver burden	*Eyberg Child Behavior Inventory (ECBI*; Eyberg & Pincus, 1999)	Parent-report of child behavior problems that yields an Intensity Score (indicating frequency of symptoms, scores > 132 reflect clinical range) and Problem Score (indicating how problematic symptoms are for caregivers). $\alpha = .93$ in present sample.	Baseline, Midtreatment, Posttreatment, 6-month follow-up
	Child Behavior Checklist (CBCL) 1.5–5 (Achenbach & Rescorla, 2000)	Standardized instrument for assessing psychopathology in youth below 6 (t scores < 65 reflect normative functioning). For this study, we included the Externalizing Problems scale ($\alpha = .87$ in present sample).	Baseline, midtreatment, posttreatment, 6-month follow-up
Barriers to treatment	*Barriers to Treatment Participation Scale (BTPS; Kazdin et al., 1997)*	44-item parent-report measure of perceived barriers to treatment participation. Items are rated along 5-point scales and assess stressors and obstacles that compete with treatment (e.g., transportation, scheduling), treatment demands issues (e.g., uncomfortable treatment setting), and attitudes about treatment and the therapist (e.g., treatment is not working). Tallying the items yields a total barriers score ($\alpha = .88$ in present sample).	Midtreatment
Treatment satisfaction	*Client Satisfaction Questionnaire* (CSQ-8; Larsen et al., 1979)	Assessment of consumer satisfaction with services. Used as a parent-report in present study ($\alpha = .85$ in present sample).	Posttreatment
	Therapy Attitude Inventory (TAI; Brestan et al., 1999)	Parent-report of satisfaction with parent training, specifically ($\alpha = .91$ in present sample).	Posttreatment

Note. ODD = oppositional defiant disorder; CD = conduct disorder; DBD-NOS = disruptive behavior disorder (not otherwise specified); IE = independent evaluator masked to treatment condition.

posttreatment, and 6-month follow-up. Diagnostic interviews were conducted in the clinic, regardless of treatment condition, to maintain the masked study design. Caregivers also completed parent-report forms at baseline, midtreatment, posttreatment, and 6-month follow-up online through a secure and encrypted Web-survey application. Families received $40 for each evaluation. Services were provided at no cost. To standardize care across I-PCIT participants, I-PCIT families were provided with a temporary equipment kit for the duration of their participation (~$150; see Comer et al., 2015). Therapists ($n = 9$; seven women, two men; 22.2% ethnic/racial minority status) were clinical psychology trainees who completed yearly intensive didactic training with a PCIT master trainer, followed by cotreatment roles on two cases. Therapists self-completed session-integrity checklists, and session recordings were reviewed during weekly supervision with a clinical psychologist. The same therapists delivered treatment across conditions, and supervision groups simultaneously provided supervision for Internet and clinic-based cases. The lead supervisor also selected 36 random sessions (5% of the total 719 sessions conducted across the study) and completed independent treatment-integrity checks; treatment integrity was high (88%). IEs met internal certification and reliability procedures, developed with the *K-DBDS* lead author. IEs presented interview results to supervision and diagnoses and *CGI*/CGAS scores were collaboratively generated.

Analyses were conducted on the intent-to-treat sample ($N = 40$). Baseline differences between groups were evaluated using t and χ^2 tests, and linear regressions controlling for site and therapist-evaluated differences in treatment satisfaction and treatment barriers across groups. Hierarchical linear modeling (HLM) was conducted to model the nonindependence of data due to nesting of repeated observations (Level 1) within children (Level 2), using maximum-likelihood estimation of parameters to account for missing data (0% of data were missing at baseline; 12.5% at posttreatment; 32.5% at follow-up). HLM mixed-effects models accounted for missing data and used the data from the full intent-to-treat sample. For each HLM, treatment group, study site, therapist, the natural log (ln) of time (weeks since baseline), and the Group ×

ln(Time) interaction were fixed-effect predictors, and the intercept (scaled to the baseline assessment; i.e., time = 0) was the single random effect (allowing individuals to vary in their mean-outcome values). The MIXED procedure in SPSS 21 was used for mixed model analyses. Fitted models were used to calculate estimated mean scores at each time point. Clinical significance was evaluated with between- and within-subjects effect sizes (*d*), as well as by examining rates of posttreatment and follow-up treatment response (*CGI*-Improvement = 1 or 2), excellent response (*CGI*-Improvement = 1), diagnostic response to baseline principal diagnosis, and diagnostic response to all DBDs. Intent-to-treat analyses on responder rates were based on an assumption that cases of posttreatment or follow-up missing data were not responders. For each responder type, binomial logistic regressions (controlling for site and therapist) examined whether condition predicted response rate.

Results

Figure 1 presents the participant flow throughout the study. There were no significant differences in age, sex, race/ethnicity, income, or baseline child-behavior problems between families who did and did not participate in post/follow-up assessments. Treatment retention was high, with 70% of families in each condition completing their full treatment course. Among families completing treatment, the mean number of sessions until achieving PCIT mastery criteria was 21.2 (*SD* = 7.4); number of sessions did not differ across conditions ($M_{\text{Internet}} = 21.7$ vs. $M_{\text{Clinic}} = 20.8$), $t(26) = 0.35$, $p = .73$. Treatment satisfaction was high across both conditions, as rated on the *Client Satisfaction Questionnaire* (CSQ-8; Larsen et al., 1979; $M_{\text{Internet}} = 30.1$ vs. $M_{\text{Clinic}} = 28.5$; highest possible score = 32) and the *Therapy Attitude Inventory* (TAI; Brestan et al., 1999; $M_{\text{Internet}} = 45.9$ vs. $M_{\text{Clinic}} = 45.1$; highest possible score = 50). Treatment condition did not predict posttreatment, CSQ-8 $F(3, 29) = .71$, $p = .50$; $\beta_{\text{Condition}} = -1.63$, $p = .25$, or TAI scores $F(3, 29) = 1.57$, $p = .23$; $\beta_{\text{Condition}} = -1.23$, $p = .48$. I-PCIT was associated with fewer barriers to treatment participation than clinic-based PCIT, $F(3, 29) = 7.62$, $p < .001$; $\beta_{\text{Condition}} = 8.40$, $p = .01$, $M_{\text{Internet}} = 50.1$ versus $M_{\text{Clinic}} = 58.5$.

Treatment Outcomes Across Time

Table 3 presents actual means and model-estimated means for outcomes across assessment points, by treatment condition, and Table 4 presents HLM results examining the effects (controlling for site and therapist) of time, condition, and their interactions on outcomes. For child-behavior problems and burden to caregivers, there was a significant effect of time (see Table 4). Specifically, across conditions, *Eyberg Child Behavior Inventory* (*ECBI*; Eyberg & Pincus, 1999) Intensity, *Child Behavior Checklist* (*CBCL*; Achenbach & Rescorla, 2000) Externalizing, and *ECBI* Problem scores significantly improved across time. Change leveled off somewhat between posttreatment and follow-up. Figure 2 presents the symptom trajectory, by treatment condition, for *ECBI* Intensity scores; the general trajectory shape depicted was also comparable across *CBCL* Externalizing and *ECBI* Problem scores. Across these three outcomes, there were no significant interaction effects of Time×Condition. In contrast, across conditions, global severity and functioning (*CGI*-Severity; Guy & Bonato, 1970 and CGAS; Shaffer et al., 1983, respectively) did not improve across time (see Table 4).

Clinical Significance

Table 5 (top) presents within-subjects effect sizes (*d*) across outcomes, by treatment condition. Effects for child-behavior problems and burden to caregivers from pre-to-post and from pre-to-follow-up were all "large" to "very large" (Cohen, 1988; Sawilowsky, 2009) for I-PCIT and "medium" to "very large" for clinic-based PCIT. Nonsignificant between-groups effects were

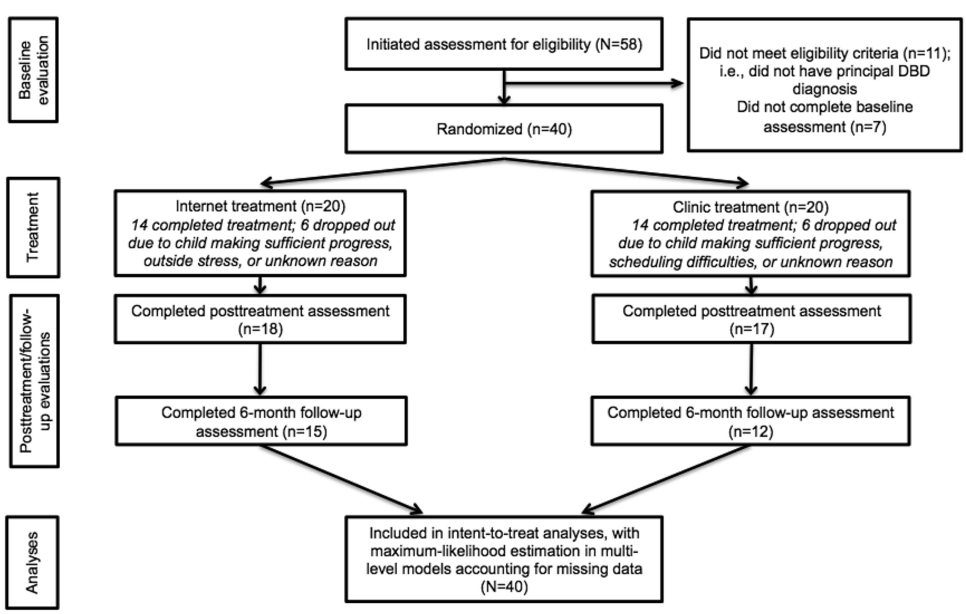

Figure 1. Flow of participants across study phases.

Table 3
Child Outcomes Across Assessment Points, by Condition

Variable	Internet-delivered PCIT Pre *M* (*SD*)	Internet-delivered PCIT Mid *M* (*SD*)	Internet-delivered PCIT Post *M* (*SD*)	Internet-delivered PCIT 6-month follow-up *M* (*SD*)	Clinic-based PCIT Pre *M* (*SD*)	Clinic-based PCIT Mid *M* (*SD*)	Clinic-based PCIT Post *M* (*SD*)	Clinic-based PCIT 6 month follow-up *M* (*SD*)
	Raw means[a]							
Child-behavior problems								
ECBI Intensity score	152.5 (35.9)	102.8 (51.0)	73.5 (28.8)	96.2 (34.8)	164.2 (39.6)	112.1 (45.4)	73.2 (15.3)	88.2 (30.3)
CBCL Externalizing	66.7 (10.3)	54.5 (9.3)	54.2 (11.0)	56.2 (9.9)	65.5 (10.3)	55.7 (10.7)	55.6 (11.4)	54.8 (13.1)
Child global severity and functioning								
CGI-Severity	5.0 (.7)	—	2.8 (1.2)	2.8 (1.1)	4.9 (.8)	—	3.3 (1.0)	3.0 (1.0)
CGAS	46.7 (7.4)	—	66.3 (13.9)	61.5 (19.7)	45.4 (7.4)	—	60.6 (10.0)	65.3 (8.2)
Burden to caregiver(s)								
ECBI Problem score	19.7 (9.7)	15.5 (8.3)	9.2 (7.3)	9.8 (9.3)	23.0 (8.3)	15.5 (9.9)	11.5 (9.6)	8.0 (8.8)
	Intent-to-Treat Model Means[b]							
Child-behavior problems								
ECBI Intensity score	157.6 (35.8)	103.2 (51.0)	90.4 (28.8)	81.6 (34.8)	160.0 (39.6)	100.8 (45.4)	86.8 (15.3)	77.1 (30.3)
CBCL Externalizing	67.3 (10.3)	58.0 (17.8)	55.7 (10.6)	54.2 (17.8)	64.3 (10.3)	57.2 (13.3)	55.5 (11.9)	54.3 (13.3)
Child global severity and functioning								
CGI-Severity	4.1 (.7)	—	3.6 (1.2)	3.5 (1.1)	3.7 (.8)	—	3.9 (1.0)	3.9 (1.0)
CGAS	55.3 (7.4)	—	54.1 (13.9)	53.9 (19.7)	57.3 (7.5)	—	55.7 (10.0)	55.5 (8.2)
Burden to caregiver(s)								
ECBI Problem score	21.1 (9.7)	13.5 (8.4)	11.7 (7.3)	10.5 (9.3)	22.2 (8.3)	13.3 (9.9)	11.2 (9.6)	9.7 (8.8)

Note. *ECBI* = *Eyberg Child Behavior Inventory*; *CBCL* = *Child Behavior Checklist*; *CGI*-S = Clinical Global Impressions-Severity; CGAS = Children's Global Assessment Scale; DBD = disruptive behavior disorder.
[a] Means reflect raw means (not model-estimated means). [b] Means for intent-to-treat sample reflect model-estimated means (not raw means).

relatively negligible in magnitude (see Table 5, middle). Among children who completed a full course of treatment ($n = 28$), 85.7% of I-PCIT children and 78.6% of clinic-based PCIT children were treatment responders (i.e., *CGI*-Improvement = 1 or 2) at posttreatment; 83.3% of I-PCIT treatment completers and 72.7% of clinic-based PCIT treatment completers were treatment responders at follow-up. Moreover, among children who completed a full course of treatment, 50% of I-PCIT children and 17.6% of clinic-based PCIT children were "excellent responders" (i.e., CGI-Improvement = 1) at posttreatment; 33.3% of I-PCIT treatment completers and 25.0% of clinic-based PCIT treatment completers were "excellent responders" at follow-up. Responder rates for intent-to-treat analyses found strong treatment response rates at posttreatment across conditions and somewhat lower response rates at follow-up (see Table 5, bottom). Diagnostic response rates are also presented in Table 5 (bottom). The rate of posttreatment excellent response (*CGI*-Improvement = 1) was significantly higher in I-PCIT than in clinic-based PCIT (see Table 5, bottom). Other response rates were equivalent across conditions.

Discussion

The present study provides the first evidence from a controlled trial supporting the use of real-time VTC to remotely deliver behavioral parent training to the home setting. After treatment, intent-to-treat analyses found that 70% of children treated with I-PCIT showed treatment response, and at 6-month follow-up, 55% continued to show treatment response. Further, roughly half of the children treated with I-PCIT no longer met criteria for a DBD at posttreatment or at 6-month follow-up. The effects of I-PCIT on children's symptoms

Table 4
Results of Mixed-Effects Models Examining the Effects of Condition, Time, and Their Interactions

Variable	Time *b* [95% CI]	Time *p*	Condition *b* [95% CI]	Condition *p*	Time × Condition interaction *b* [95% CI]	Time × Condition interaction *p*
Child-behavior problems						
ECBI Intensity score	−17.1 [−25.9, −8.2]	<.001	2.4 [−20.5, 25.3]	.83	−1.7 [−7.3, 3.9]	.55
CBCL Externalizing	−4.0 [−6.6, −1.5]	.002	−3.1 [−9.6, 3.4]	.35	.8 [−.8, 2.4]	.34
Child global severity and functioning						
CGI-Severity	−.4 [−.9, .2]	.17	−.5 [−1.5, .6]	.40	.2 [−.1, .5]	.21
CGAS	.2 [−5.3, 5.6]	.94	2.0 [−9.4, 13.5]	.72	−.1 [−3.7, 3.4]	.94
Burden to caregiver(s)						
ECBI Problem score	−2.2 [−4.3, −.1]	.03	1.1 [−5.1, 7.2]	.73	−.4 [−1.8, .9]	.51

Note. *ECBI* = *Eyberg Child Behavior Inventory*; *CBCL* = *Child Behavior Checklist*; *CGI* =*Clinical Global Impressions*; CGAS = Children's Global Assessment Scale; DBD = disruptive behavior disorder. Models also control for site and therapist.

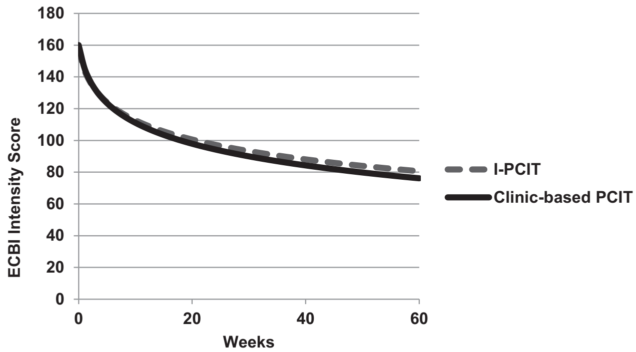

Figure 2. Trajectories of change across weeks, by treatment condition, for scores on the Eyberg Child Behavior Inventory (*ECBI*; Eyberg & Pincus, 1999). Average timing of the midtreatment evaluation = 17.2 weeks postbaseline; average timing of posttreatment evaluation = 35.2 weeks postbaseline; average timing of the follow-up evaluation = 56.9 weeks postbaseline. The general curvilinear shape of change depicted here for *ECBI* Intensity scores was comparable for *CBCL* (Achenbach, & Rescorla, 2000) Externalizing scores and *ECBI* Problem scores.

and burden to parents were large-to-very-large in magnitude, and important to note, these outcomes and symptom trajectories were comparable to those observed in children randomized to standard clinic-based PCIT. Of note, the rate of excellent response at posttreatment was significantly higher in youth treated with I-PCIT relative to those treated with clinic-based PCIT, and parents treated with I-PCIT perceived fewer barriers to their treatment participation than parents treated with clinic-based PCIT. These findings build on the small but growing literature supporting the promising role of remote technologies for expanding the delivery of behavioral parent training (Jones et al., 2014; Kirkman et al., 2016; Myers et al., 2015), and add to broader efforts leveraging new technologies to expand the reach and scope of indicated mental health care (Comer & Barlow, 2014; Kazdin & Blase, 2011).

Relative to other evaluated technology-based programs that incorporate real-time behavioral parent training, I-PCIT is novel in its use of VTC to remotely deliver all parent training components. Indeed, I-PCIT is fully liberated from the geographical constraints that limit the accessibility of hybrid models forming the basis of much of the behavioral parent training in the clinic. Important to note, in addition to positive child outcomes, we found I-PCIT to be associated with high engagement and treatment satisfaction, and reduced perceived barriers to participation relative to clinic-based PCIT. With continued support in geographically diverse populations, I-PCIT may play an important role in overcoming geographic barriers to care for those living in rural, remote, or otherwise underserved regions characterized by limited local treatment options. For those in regions with access to quality care, research is needed to examine the relative merits of emerging technology-based treatment options to identify for whom technology-enhanced treatments might best be suited (i.e., technology could be used to extend in-session content beyond the treatment hour (as Jones et al., 2014 suggested) versus telemental health formats like I-PCIT in which all of the treatment is conducted remotely in real time. Moreover, the present findings that, (a) the rate of posttreatment excellent response was significantly higher among youth treated with I-PCIT than clinic-based PCIT, and (b) I-PCIT was associated with fewer parent-perceived barriers to participation than clinic-based PCIT, underscore the important role I-PCIT can play, even in regions with access to quality clinic-based parent training.

Of note, although I-PCIT may address geographic disparities, the reliance on live sessions with a provider means that I-PCIT alone cannot solve broader mental health-care workforce-power problems (Kazdin & Blase, 2011). Even after addressing geographic workforce disparities, there is still an enormous discrepancy between the large numbers of individuals in need of care and the relatively small numbers of providers delivering care. Lower intensity, technology-based treatment options are needed to buttress real-time technology-based treatments. Self-administered e-health programs that have parents watch recorded parent-training modules have shown initial promise in open trials (Kirkman et al., 2016), sometimes with additional telephone-based support (Sourander et al., 2016). Such approaches will likely play an important role in stepped-care models that reserve higher intensity treatments requiring extensive provider time for more severe cases.

Study limitations merit comment. First, the sample size in this initial trial of VTC methods for remotely delivering parent training to the home may have been underpowered to detect between-groups differences, although within-subjects analyses did yield significant and sizable results and significant differences were found in rates of excellent response and barriers to treatment. Continued studies with larger samples incorporating noninferiority designs are needed to examine issues of comparability between treatments. Second, the comparison to standard clinic-based PCIT offered a conservative I-PCIT evaluation, benchmarking it against the same treatment delivered in person, but this comparison also required participants to live close enough to one of the two recruitment sites so they could feasibly participate in either of the treatment conditions as assigned. Accordingly, although I-PCIT itself was an entirely remote format, the present findings may not generalize to the more geographically remote and underserved populations for whom VTC formats may be particularly necessary (see Chou, Bry, & Comer, 2017). Research comparing I-PCIT to usual care in rural populations is needed, given that technology access may differ across regions. Third, we provided equipment kits to I-PCIT families so differences in treatment response could not be attributed to differences in household technology. Although many families already own sufficient equipment for I-PCIT, some participants who benefited from I-PCIT may not have independently owned proper equipment to participate in I-PCIT outside of this study. Fourth, we presently focused on the main outcomes of I-PCIT; examination of other outcomes and mediators, such as parent stress, parent–child interactions, and parenting practices, was beyond the scope of this analysis. Fifth, inclusion criteria focused on parent reports and IE assessments, and did not directly incorporate teacher/daycare-provider reports. Although the *K-DBDS* (Keenan et al., 2001) assesses symptoms across multiple settings, incorporating direct teacher/daycare-provider assessments might have yielded a more representative sample of DBD youth. Finally, families lacking Internet accessibility will not be able to benefit from I-PCIT. Almost half of participating families reported annual incomes over $100,000. Encouragingly, the overwhelming majority of U.S. families now have Internet access, and digital divides based on income, race, and age are steadily disappearing (Pew Research Center, 2015).

Table 5
Clinical Significance of Child Outcomes at Posttreatment and at 6-Month Follow-Up

Variable	Within-subjects effect sizes (*d*) across child outcomes, by treatment condition[a]			
	Internet-delivered PCIT		Clinic-based PCIT	
	Pre vs. post [95% CI]	Pre vs. follow−up [95% CI]	Pre vs. post [95% CI]	Pre vs. follow−up [95% CI]
Child-behavior problems				
ECBI Intensity score	−1.92 [−2.96, −.84]	−2.20 [−3.40, −.97]	−2.40 [−4.14, −.78]	−2.42 [−4.08, .77]
CBCL Externalizing	−1.10 [−2.13, −.11]	−.85 [−1.66, −.08]	−.59 [−2.11, .52]	−.59 [−2.07, .51]
Child global severity and functioning				
CGI-Severity	−.42 [−2.30, 1.33]	−.51 [−2.64, 1.53]	.18 [−2.43, 2.82]	.17 [−2.65, 3.07]
CGAS	−.09 [−1.57, 1.61]	−.07 [−1.17, 1.20]	−.14 [−2.64, 2.61]	−.15 [−2.79, 2.77]
Burden to caregiver(s)				
ECBI Problem score	−1.15 [−2.21, −.12]	−1.10 [−2.11, −.11]	−1.28 [−2.62, .09]	−1.44 [−2.92, .10]

	Between-subjects effect sizes (*d*) across child outcomes[a,b]	
	At post [95% CI]	At follow–up [95% CI]
Child-behavior problems		
ECBI Intensity score	−.15 [−.8, .5]	−.14 [−.8, .5]
CBCL Externalizing	−.02 [−.6, .6]	.01 [−.6, .6]
Child global severity and functioning		
CGI-Severity	.27 [−.4, .9]	.36 [−.3, 1.0]
CGAS	.13 [−.5, .8]	.10 [−.5, .7]
Burden to caregiver(s)		
ECBI Problem score	−.06 [−.7, .6]	−.08 [−.7, .5]

Variable	Responder statuses by treatment condition					
	Posttreatment			6–month follow–up		
	Internet %[c]	Clinic %[c]	Significance test[d]	Internet %[c]	Clinic %[c]	Significance test[d]
Treatment responder[e]	70.0	55.0	Wald test = .89, p = .34	55.0	40.0	Wald test = .82, p = .37
Excellent responder[f]	45.0	15.0	Wald test = 3.94, p = .04	25.0	15.0	Wald test = .60, p = .44
Diagnostic responder (principal diagnosis)[g]	65.0	50.0	Wald test = .86, p = .35	70.0	50.0	Wald test = 1.56, p = .21
Diagnostic responder (any DBD)[h]	55.0	45.0	Wald test = .08, p = .78	55.0	45.0	Wald test = .35, p = .55

Note. PCIT = parent–child interaction therapy; I-PCIT = Internet-delivered parent–child interaction therapy; ECBI = *Eyberg Child Behavior Inventory*; CBCL = *Child Behavior Checklist*; CGI =*Clinical Global Impressions*; CGAS = Children's Global Assessment Scale; DBD = disruptive behavior disorder. [a] For effect-size calculations, means were drawn from the mixed-effects models examining the effects of covariates (site and therapist), condition, time, and the Time × Condition interaction. Within-subjects effect-size calculations incorporated the correlation between means into pooled standard deviations to correct for the dependence among means. Confidence intervals for within-subjects effects were calculated using Monte Carlo simulation in R based on the mixed-model coefficients and their standard errors. [b] For between-subjects effects, negative values indicate I-PCIT scores are higher than clinic-based PCIT scores. Positive values indicate I-PCIT scores are lower than clinic-based PCIT scores. [c] Rates reflect intent-to-treat sample. [d] Results from binomial logistic regression models controlling for site and therapist. [e] *CGI*-Improvement = 1 or *CGI*-Improvement = 2. [f] *CGI*-Improvement = 1. [g] Diagnostic criteria of principal diagnosis at baseline no longer met. [h] Child does not meet diagnostic criteria for any *DSM-IV* DBD.

Despite limitations, this study offers the first controlled evaluation of VTC to offer fully remote behavioral parent training to the home setting with a live therapist, and provides support for the feasibility and preliminary efficacy of I-PCIT. Although behavioral parent-training programs are well-supported and recommended as first-line treatment for early onset DBDs, problems remain in the accessibility of quality care. Against a concerning backdrop of reduced availability of and reliance on psychosocial treatments in preschool-aged youth and increased pharmacological intervention for DBDs in the absence of relevant controlled evaluations (Comer et al., 2010; Olfson et al., 2010), the present findings underscore the urgency to overcome reimbursement challenges to telemental health and improve dissemination of technology-based care that can transform the reach of indicated care.

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