Evaluating a Companion Homework App for Parent-Child Interaction Therapy

by

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Abstract

The present study constituted a pilot evaluation of the Special Time Homework App, a smartphone application designed to serve as a companion tool for Parent-Child Interaction Therapy (PCIT) by facilitating the completion of daily at-home practice of the skills learned by parents in treatment. Specifically, the app provides push notification reminders to complete daily homework, times each practice session, conducts rudimentary Dyadic Parent-Child Interaction Coding System (DPICS) coding of the homework session, and allows PCIT therapists to remotely track their clients' homework completion. Fourteen parents receiving services from an outpatient clinic were randomly assigned to receive standard PCIT or PCIT with the app. No significant differences in key treatment outcomes emerged between the app and no app conditions. Both parents and therapists noted that the app was easy to use, but expressed frustration related to technological limitations associated with the app. DPICS coding conducted by the app was largely inconsistent with that conducted by trained human coders. Exploratory analyses examining possible associations between pretreatment readiness, study condition, homework completion, and key treatment outcome variables did not yield significant results. Future research should draw upon lessons learned from the present study to refine and improve later iterations of the app.

Keywords: PCIT, PMT, app, homework

Dedication

This dissertation is dedicated in memory of my grandfathers, Richard F. Davis and James E. Hoffman.

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Table of Contents

List of Tables

List of Figures

Evaluating a Companion Homework App for Parent-Child Interaction Therapy

Externalizing behavior problems are among the most common reasons parents seek mental health services for their children (Shanley, Reid, & Evans, 2008), with prevalence estimates for externalizing conditions such as oppositional defiant disorder and conduct disorder ranging from 1 to 11% (American Psychiatric Association [APA], 2013). Parent management training (PMT), or behavioral parent training (BPT), is a family of interventions for child behavior problems with a strong evidence base supporting its use as a standard treatment to address child externalizing behavior (Kaehler, Jacobs, & Jones, 2016; Shaffer, Kotchick, Dorsey, & Forehand, 2001).

Many prominent PMT programs in use today are derived from the work of Constance Hanf and were developed by individuals who worked with Hanf in some capacity at the University of Oregon (Kaehler et al., 2016). Hanf's approach to PMT was originally intended for use with children between the ages of two and seven but has since been extended to older populations (Barkley & Robin, 2014; Kaehler et al., 2016). Common characteristics of Hanf-model PMT programs include the implementation of quality one-on-one time between parent and child, teaching parents to use positive attention as differential reinforcement for appropriate child behavior, training parents to give effective commands, and guiding parents through implementing a time out procedure for situations in which discipline is needed. Parents are trained in these skills through therapist modeling, at-home practice and, in some formats, through in-session practice and therapist coaching (Eyberg & Funderburk, 2011; Kaehler et al., 2016). Examples of current PMT interventions include Parent-Child Interaction Therapy (PCIT; Eyberg & Funderburk, 2011), the Barkley model programs (Barkley, 2013; Barkley & Robin, 2014), Incredible Years (Webster-Stratton, 2011), Helping the Noncompliant Child (McMahon &

Forehand, 2003), and the Triple P: Positive Parenting Program (Eyberg, Nelson, & Boggs, 2008; Kaehler et al., 2016; Kotchick et al., 2001; Sanders, 2012;).

Although PMT interventions are a well-supported approach for the treatment of child behavior problems, numerous barriers may prevent families from accessing these services. Potential barriers include low socioeconomic status, distrust of mental health services or an awareness of the stigma associated with seeking mental health services, insufficient availability of culturally-informed services, and a lack of trained PMT therapists in one's community, especially in rural areas (Comer et al., 2015; Jameson & Blank, 2007; McGoron & Ondersma, 2015; Parra-Cardona et al., 2017; Shaffer et al., 2001). To overcome these barriers and increase access to PMT, technological adaptations such as Internet-based PMT, telehealth, and companion software have been applied to the treatment of a wide range of parenting concerns (Baumel, Pawar, Kane, & Correll, 2016; Corralejo & Domenech Rodriguez, 2018; Hall & Bierman, 2015; Jones et al., 2013; Jones, Forehand, McKee, Cuellar, & Kincaid, 2010; McGoron & Ondersma, 2015). In addition to increasing access, companion software specifically may offer unique opportunities to increase parent adherence to treatment by facilitating their completion of at-home skills practice assignments, which are a hallmark of PMT programs (Jones et al., 2014). The present review considers existing research examining these adaptations and their implication for treatment adherence and introduces a pilot study designed to build upon this line of work by evaluating a recently developed companion homework app for PCIT.

Definitions and Measures of Child Behavior and Parenting

A wide variety of technological adaptations to PMT have been studied and described in the literature using many different terms. For the purposes of the present review, Internet-based PMT is considered to be a PMT intervention, typically self-directed, that is provided in a format

accessible online. In contrast, telehealth or telemedicine refers to a PMT intervention delivered remotely by a therapist using telephone or, more commonly, videoconferencing technology (Chi & Dennis, 2015). Finally, companion software includes apps or other technology that supplement a PMT intervention. Notably, some overlap exists between these categories, as some Internet-based PMT programs may include phone check-ins with a therapist.

When studying changes in child externalizing problems and parenting behavior, both parent-report measures, such as the Eyberg Child Behavior Inventory (ECBI; Eyberg & Pincus, 1999), and structured observations, such as the Dyadic Parent-Child Interaction Coding System (DPICS; Eyberg, Nelson, Ginn, Bhuiyan, & Boggs, 2014), that allow for live coding of parent-child interactions may be used. In the present review the majority of the results described were based on parent-report measures, although notable instances of the use of observational techniques are discussed when relevant.

Internet-Based PMT

Internet-based PMT is the most well-researched area of technological adaptations for PMT. Common elements of online PMT interventions generally include the use of videos to present content and opportunities for parents to assess their learning (Baumel & Faber, 2017; Enebrink, Hogstrom, Forster, & Ghaderi, 2012; Gordon, 2000; Irvine, Gelatt, Hammond, & Seeley, 2015). Many online PMT programs are self-directed, although some include regular contact with a therapist either through phone calls or via an online platform (Love et al., 2016; Sourander et al., 2016). These programs are easily accessible to parents who have Internet access and have the potential to be tailored to unique parenting challenges (Hinton, Sheffield, Sanders, & Sofronoff, 2017).

Parenting Wisely

The Parenting Wisely intervention developed by Gordon (2000) constitutes an early example of efforts to create self-directed PMT programs that would ultimately be available to parents through the Internet. Parenting Wisely was originally available as a CD-ROM that presented videos of parenting scenarios, allowed parents to choose how they would respond to a given situation, and played additional videos demonstrating the consequences of the chosen response. If a better response was available, parents were prompted to choose again. The program also included built-in quizzes to assess parent learning of the skills presented. Initially the Parenting Wisely program was intended primarily for parents of adolescents (Gordon, 2000).

Early research evaluating the Parenting Wisely program observed significant parent-reported improvements in child behavior and in parent knowledge of program content among both a sample of mothers of 12 to 18-year-olds from Appalachia and a sample of Irish parents of 9 to 18-year-olds (Kacir & Gordon, 1999; O'Neill & Woodward, 2002). The CD format of the program was easy to disseminate and was in use by more that 300 organizations in the early 2000s (Gordon & Stanar, 2003). Subsequent research compared results obtained by completing the CD individually or in a group format among an Australian sample of 119 parents of 9 to 16-year-olds. Although significant improvements in parent-reported child behavior problems were associated with both the individual and group format, a larger reduction in parent-reported behavior problems was observed for children of parents who completed the program individually (Cefai, Smith, & Pushak, 2010).

Ultimately Parenting Wisely moved to an online format, and research evaluating the Internet-based version described significant decreases in child externalizing problems as reported by parents of 11 to 15-year-olds (Cotter, Bacallao, Smokowski, & Robertson, 2015; Stalker,

11

Rose, Bacallao, & Smokowski, 2018). Furthermore, a modified version of the Parenting Wisely program known as the Parenting Toolkit was developed by Irvine and colleagues (2015) for parents of 11 to 14-year-olds. In addition to presenting videos depicting parent-child conflict and guiding parents through understanding the appropriate way to respond to the situations depicted, the Parenting Toolkit also encourages participants to select skills to practice at home and to create a plan to practice those skills. One study of this program demonstrated that child behavior problems, parental laxness, and parental overreactivity all significantly decreased based on reports obtained from 155 parents who completed the intervention (Irvine et al., 2015).

Triple P Online

The Triple P: Positive Parenting Program is a multilevel system of intervention designed to promote effective parenting practices (Sanders, 2012). One component of the program is parent training, and Triple P Online (TPOL) packages this training in a self-directed online format consisting of eight video modules covering topics such as addressing problem behavior in children, increasing appropriate child behavior, and managing children in public (Baumel & Faber, 2017; Sanders, 2012). Early research evaluating TPOL in a randomized controlled trial (RCT) involving parents of 2 to 9-year-olds detected significant decreases in parent-reported child behavior problems among the TPOL group, and also noted that child behavior problem scores were significantly lower among this group than among the control group at the post assessment (Sanders, Baker, & Turner, 2012). Sanders, Dittman, Farrugia, and Keown (2014) also demonstrated that TPOL was comparable to a workbook version of the program among parents of 3 to 8-year-olds.

Following this initial research, additional studies continued to examine predictors of TPOL outcomes as well as outcomes associated with different formats of the intervention.

Among parents of 3 to 8-year-olds, predictors of continuing behavior problems following completion of the intervention identified by Dittman, Farrugugia, Palmer, Sanders, and Keown (2014) included parenting challenges before completing the intervention, the extent of child behavior problems before the intervention, mothers' perceptions of their level of enjoyment when spending time with the target child before the intervention, and the number of completed sessions. Moving beyond the 3 to 8-year-old age range, Ehrensaft, Knous-Westfall, and Alonso (2016) evaluated TPOL in a sample of mothers under the age of 25 who were experiencing stress associated with parenting a child between the ages of two and six. Although self-reported levels of ineffective parenting decreased following the intervention, parenting stress did not. Interestingly, later research suggested that supplementing the self-directed TPOL with therapist phone contact may improve outcomes for highly stressed families (Day & Sanders, 2017).

Later work has attempted to further refine the TPOL program and develop alternative versions. Love et al. (2016) explored outcomes associated with adding an online community overseen by a trained Triple P facilitator to the standard TPOL intervention. The online community functioned similarly to a social media platform and allowed for communication with other parents and access to social reinforcement for work completed as part of the intervention. Importantly, the online community was also accessible from mobile devices such as tablets and phones. When studied within a sample of 155 parents of a 2 to 12-year-old, the TPOL program supplemented with the online community was associated with significant decreases in both ineffective parenting and child externalizing behavior as reported by parents (Love et al., 2016). Efforts to explore adaptations to TPOL continued with the recent work of Baker, Sanders, Turner, and Morawska (2017), who conducted a randomized controlled trial of Triple P Online Brief, a shorter five-module version of the full length TPOL program. Among a sample of

parents of 2 to 9-year-olds, parent-reported child behavior problems decreased at a nine-month follow-up following completion of TPOL Brief, whereas self-reported ineffective parenting decreased at post-treatment and was still low at the nine-month follow-up. Additional research identified several predictors of outcomes associated with TPOL Brief. Specifically, higher intensity parenting disagreements, greater child behavior severity at pre-treatment, and higher parent age predicted better outcomes after program completion (Baker & Sanders, 2017). In addition to TPOL Brief, a version of TPOL has also been developed for parents of children with a physical, developmental, or intellectual disability (Hinton et al., 2017). When evaluated in a sample of 51 parents of a 2 to 12-year-old with a disability, the TPOL-D program was associated with a significant increase in effective parenting. Although parent-reported child behavior problems did not significantly decrease at the post assessment following completion of TPOL-D, a significant decrease in parent-reported behavior problems was observed at a three-month follow-up (Hinton et al., 2017).

Comet

Enebrink and colleagues conducted an evaluation of an Internet-based version of a Swedish parent-management intervention called Comet (Enebrink et al., 2012; Hogstrom, Enebrink, & Ghaderi, 2013; Hogstrom, Enebrink, Melin, & Ghaderi, 2015). The online version of Comet included seven one and a half-hour sessions incorporating videos, illustrations, and text to teach effective parenting strategies. One key difference between Comet and other programs such as TPOL or Parenting Wisely was the availability of a research assistant to provide additional support and guidance to parents. As with other Internet-based PMT programs, a significant increase in positive parenting and a significant decrease in child behavior problems occurred among 46 parents who completed the program to obtain assistance for their children

between three and 12 years old (Enebrink et al., 2012). Although child externalizing problems continued to decrease at an 18-month follow-up (Hogstrom et al., 2015), a moderating effect of callous-unemotional traits was also observed such that parent-reported child behavior problems did not significantly decrease among children with high levels of callous-unemotional traits, but only decreased among children low in callous-unemotional traits (Hogstrom et al., 2013).

Strongest Families Smart Website

The Strongest Families Smart Website (SFSW) is an online PMT program developed by Sourander and colleagues that includes 11 modules supplemented with weekly 45-minute phone conversations with a healthcare provider trained in delivering the intervention (Sourander et al., 2016). A randomized controlled trial evaluated the program among a sample of 464 parents of 4-year-old children. Families were randomly assigned to receive the online intervention or to receive one 45-minute call with a healthcare provider and access to a website other than the SFSW presenting information about parenting. Following completion of the program, the intervention and control conditions were compared at six-and twelve-month follow-ups and significantly better improvement in child behavior problems was reported among the intervention group as compared to the control group at each time point (Sourander et al., 2016). Additional research examining the SFSW program indicated that less maternal education and less serious child behavior problems were predictors of nonparticipation (Fossum et al., 2016), and that parent psychopathology did not moderate outcomes associated with the intervention (Fossum et al., 2018).

Other Internet-Based PMT Interventions

In addition to the Internet-based programs discussed thus far for which multiple studies have been conducted, several less-studied online PMT programs also exist. As one example of

such a program, Porzig-Drummond and colleagues developed a video-based version of the 1-2-3 Magic program consisting of two video modules that could be viewed online or via DVD. Parents who viewed the videos subsequently reported significant decreases in their use of ineffective parenting and decreased child externalizing behavior among their 2-to 10-year-old children (Porzig-Drummond, Stevenson, & Stevenson, 2015). Second, a preliminary evaluation of an online version of the Incredible Years program was conducted by Taylor et al. (2008) among a sample of 45 parents of a four-year-old participating in Head Start. Parents completed online viewing of 250 videos covering nine topics, and also interacted with trained coaches through home visits, phone contact, and coach monitoring of client progress online. Although participants generally reported satisfaction with the program and achievement of some of their goals, no results regarding changes in child behavior were reported (Taylor et al., 2008).

As seen in the literature reviewed thus far, some Internet-based PMT programs include therapist contact, whereas others are entirely self-directed. Research by Rabbitt et al. (2016) examined the extent to which parents prefer varying amounts of therapist contact in an online PMT intervention. Rabbitt and colleagues compared two Internet-based PMT interventions that differed in the amount of therapist contact participants received. The reduced contact condition included eight sessions in which parents viewed a pre-recorded video presentation from the therapist via the Internet and received 10 minutes per week of therapist contact through phone. In contrast, the full contact condition was a telehealth intervention and involved eight 50-minute sessions in which parents communicated with a therapist through videoconferencing. Although child antisocial behavior significantly decreased in both the full and reduced contact conditions among parents of a child between 6 and 13 years old, the full contact version of the intervention was more acceptable to parents than the reduced contact version (Rabbitt et al., 2016).

Taken together, existing research exploring Internet-based PMT interventions has consistently demonstrated improvements in both self-reported parenting and child behavior within the families of parents who use these programs. Notably, although self-directed online PMT programs are associated with significant outcomes, some evidence suggests that parents may also benefit from, or in some instances prefer, some degree of contact with a therapist, even when completing an intervention online. PMT delivered via telehealth offers parents the option of working directly with a therapist while maintaining the convenience of accessing an intervention using the Internet.

PMT Companion Software

The development of companion software such as apps, e-books, and other software programs that can be used alongside standard or Internet-based formats of PMT constitutes an important emerging area in technological adaptations for PMT interventions. In light of results from a meta-analysis by Lindhiem, Bennett, Rosen, and Silk (2015) demonstrating a consistent relationship between integrating mobile technology with treatment and improved treatment results, researchers and software developers should continue working together to create useful tools for families receiving PMT services. Although relatively little research exists in this area to date, PMT programs such as Triple P, PCIT, Helping the Noncompliant Child, and others have begun to explore the development of companion software and the integration of this software with PMT treatments (Costa, 2017; Jent, Weinstein, & Dandes, 2017; Jent, Weinstein, Simpson, Gisbert, & Simmons, 2014; Jones et al., 2014; Morawska, Tometski, & Sanders, 2014; Self-Brown et al., 2015, 2017).

The Triple P program has explored companion software through the development of a series of podcasts presenting key material from the intervention (Morawska et al., 2014). In one

study, parents of a child between 2 and 10 reported significantly greater improvement in child behavior following access to the podcasts presenting Triple P material than did a group of control parents who did not listen to the podcasts (Morawska et al., 2014). These results are promising given the accessibility of podcasts and the potential for parents to use the podcasts as a standalone intervention or as a supplement to Triple P services received in a different format.

Researchers and clinicians have also examined possible companion software programs for PCIT, including an e-book and a specialized app to facilitate coding of parent skills either in-session or at home (Costa, 2017; Jent et al., 2017; Jent et al., 2014). *Pocket PCIT* is an e-book created by Jent and colleagues to supplement the information learned and coaching received in PCIT. The book is available free of charge from iBooks and includes information presented via text and video, as well as an interactive labeled praise generator to aid parents in practicing one of the key skills taught in PCIT (Eyberg & Funderburk, 2011; Jent et al., 2017; Jent et al., 2014). Unpublished research examining *Pocket PCIT* revealed that families using the e-book completed the first phase of treatment more quickly than families who did not use *Pocket PCIT* (Jent, Brown, & Weinstein, 2018; Jent et al., 2017). The creation of apps to assist in coding parent skills is also a recent development within PCIT. Treatment progress in PCIT is tracked using the DPICS (Eyberg et al., 2014), a behavioral observation system developed specifically for use with PCIT. Costa (2017) is developing an app that allows PCIT therapists to record DPICS codes on an iPad and generate graphs depicting parent demonstration of targeted skills over time. Although no published research has yet evaluated the efficacy or effectiveness of *Pocket PCIT* or the PCIT coding app, initial findings suggest that these adaptations should be useful tools for both parents and therapists due to their ease of access and potential to streamline or enhance the treatment process.

One exception to the lack of research examining PMT companion software is work by Self-Brown et al. (2015, 2017) evaluating software associated with SafeCare, a PMT program designed to reduce child maltreatment. Within the standard version of SafeCare, the intervention is typically delivered through a series of home visits conducted by therapists. In contrast, the Dad to Kids (Dad2K) program is a modified version of SafeCare that is designed specifically for fathers and includes the use of companion software. Within the Dad2K framework, therapists still conduct home visits, but fathers learn the skill taught by the program through interactive software accessed through a tablet computer before practicing the skills learned with the therapist (Self-Brown et al., 2015, 2017). In a pilot study of this program, four fathers of a child between 18 months and five years of age demonstrated improvement on the parenting skills targeted by the program, such as providing praise for appropriate behavior, implementing consequences for inappropriate behavior, and planning ahead for parent-child activities (Self-Brown et al., 2015). Furthermore, later research also observed significant skill improvement and general satisfaction with the program among a sample of 50 fathers of a child between two and five. Notably, this research did not examine changes in child behavior problems, as the goal of the program was to change parent behavior in order to prevent child maltreatment (Self-Brown et al., 2017).

In addition to the work of Self-Brown and colleagues, Jones et al. (2014) contributed to the study of companion software for PMT by pilot-testing a technology-enhanced version of the Helping the Noncompliant Child program. This intervention is similar to PCIT in that it teaches both relationship-building and discipline strategies in two distinct phases of treatment. Jones and colleagues compared the standard version of the program with a technology-enhanced version among a sample of low-income families including a child between the ages of 3 and 8. Seven

families were randomly assigned to receive the technology-enhanced version, and eight families received the standard Helping the Noncompliant Child protocol. The technology-enhanced version of the intervention included a smartphone app that allowed parents to record practice sessions to be sent to the therapist and included videos illustrating the skills taught in the program, text messages with reminders about upcoming sessions, surveys allowing parents to indicate if they completed at-home practice sessions each day, and regular videoconferencing with the therapist. Although significant decreases in child behavior problems occurred in both conditions, a larger decrease was observed in the technology-enhanced condition, a result attributed by Jones et al. to increased parental engagement in the intervention by those who received the companion software. Specifically, families utilizing the app demonstrated higher levels of both homework completion and session attendance (Jones et al., 2014).

Available research related to PMT companion software suggests that this is a promising area for promoting parent skill development and potentially enhancing intervention outcomes. At the same time, additional research is needed both to increase the number of interventions for which companion software is available and to further evaluate emerging technology such as the coding apps designed for use with PCIT. As mobile technology continues to advance, companion software will likely play an increasingly critical role in maintaining parent engagement in PMT interventions. When developing and implementing technological adaptations to PMT, an understanding of the components and indicators of parent engagement is therefore especially important.

Parent Engagement, Homework Completion, and Technology

Parent engagement in PMT interventions is an important component of the treatment process that could be strengthened and maintained through the use of companion technology.

Specifically, treatment engagement includes cognitions related to therapy, adherence to treatment recommendations, and attendance of treatment sessions (Becker et al., 2015; Chacko et al., 2016; Staudt, 2007). Adherence in particular has been identified as a key component of positive treatment outcomes (Nock & Ferriter, 2005), with completion of therapist-assigned homework assignments constituting an important aspect of adherence (Becker et al., 2015; Chacko et al., 2016). Homework completion is especially important for PMT interventions, which are often designed to teach parents specific skills to be implemented in the home environment (Barkley, 2013; Barkley & Robin, 2014; Eyberg & Funderburk, 2011).

Research suggests that completion of PMT homework assignments offers numerous benefits. Danko, Brown, Van Schoick, and Budd (2015) reported that homework completion in PCIT was associated with greater satisfaction with treatment, and that higher levels of homework completion during Child-Directed Interaction (CDI), the first phase of PCIT, were predictive of a higher likelihood of completing treatment. Furthermore, Ros, Hernandez, Graciano, and Bagner (2016) demonstrated that PCIT homework completion among parents of a young child exhibiting symptoms of a developmental delay was associated with reduced parent-reported externalizing behavior and increased parental use of positive parenting techniques as measured by a structured behavioral observation. Finally, Stokes et al. (2016) noted that higher levels of homework completion in PCIT were associated with a faster rate of treatment completion.

Despite the documented benefits of homework completion, many parents participating in PMT complete homework inconsistently, with one review of eight studies tracking homework completion reporting a 48% average rate of completion (Chacko et al., 2016). In a study of a group PMT intervention, Chacko, Anderson, Wymbs, and Wymbs (2013) identified commonly cited reasons provided by parents for not completing homework. These included parent

perceptions that the homework was difficult to implement, a lack of time to complete homework, and simply forgetting to complete at-home practice assignments. Interestingly, a survey of cognitive-behavioral therapists conducted by Helbig and Fehm (2004) suggests that clients are more likely to complete homework if they are participating in more advanced phases of therapy, if they report higher levels of motivation to complete homework, and if they are provided with a written reminder or homework sheet to complement the assigned task. In light of this research, tools such as the homework sheet provided to clients in PCIT to facilitate the recording of at-home practice sessions are especially important in maintaining homework completion.

Parent readiness for and dedication to treatment before beginning services may also function as important predictors of homework completion (Proctor, Brestan-Knight, Fan, & Zlomke, 2018; Sutton & Dixon, 1986). Sutton and Dixon (1986) noted that parent commitment to playing a role in changing their child's behavior at pretreatment as well as parent-reported perceived need for their child to change each predicted higher rates of homework completion in a parent training intervention. These results are consistent with more recent work examining the construct of parent readiness to change demonstrating that higher levels of readiness were predictive of attendance of a parent education group (Proctor et al., 2018). Still, little existing research has examined the relationship between parent readiness to engage in treatment and treatment adherence, and this potential association remains an important area for future exploration.

In light of the previously discussed work by Jones et al. (2014) evaluating a companion app for the Helping the Noncompliant Child program, companion software such as apps can potentially increase homework completion in PMT interventions. Jones and colleagues argue that the ability for parents to produce video recordings of their practice sessions, receive text message

reminders to complete at-home practice of the skills learned in therapy, and access electronic resources available through the app contributed to the higher levels of homework completion observed among parents who received the technology-enhanced version of the intervention (Jones et al., 2014).

Interestingly, recent trends in the health psychology literature suggest that companion software such as the app described by Jones and colleagues may improve treatment adherence via homework completion by increasing client accountability to the therapist through monitoring the frequency with which at-home practice occurs (Mohr, Cuijpers, and Lehman, 2011). Health psychologists have begun to explore and implement the use of electronic reminders and monitoring to improve adherence to medical treatment regimens (Wu & Hommel, 2014), with one case study illustrating the benefits of these techniques by demonstrating that electronic monitoring of when medication was taken improved medication adherence in a 17-year-old patient (Hilliard, Ramey, Rohan, Drotar, & Cortina, 2011). Additional work has also explored the role of monitoring in maintaining adherence to treatment regimens for asthma (Bartlett, Lukk, Butz, Lampros-Klein, & Rand, 2002; Otsuki et al., 2009; Wu & Hommel, 2014).

A theoretical framework developed by Mohr and colleagues (2011) to inform research examining the role of human service providers in electronic healthcare interventions suggests that monitoring such as that used to improve medication adherence or the daily reports of homework completion sent by parents to therapists in the Jones et al. (2014) study can play an important role in improving adherence to an intervention if it is described in positive terms and is not aversive to the patient. According to this conceptualization, monitoring is an important component of accountability to the service provider along with other key variables such as goal setting and provider expectations (Mohr et al., 2011). The role of monitoring in improving parent

homework completion remains an important question as new PMT companion software

continues to emerge.

The Present Study

To expand upon the work of Jones et al. (2014) in developing companion apps for PMT

interventions, the present study evaluated a companion app for PCIT. Specifically, an app

designed to allow parents enrolled in therapy to track their daily PCIT homework completion and

transmit this information to their PCIT therapist while receiving general automated feedback

related to the quality of their practice sessions was pilot tested in an outpatient therapy clinic.

Services were provided by Master's level therapists treating a combined total of approximately

20 families with PCIT per week. Parents were randomly assigned to receive standard PCIT or to

receive PCIT supplemented with access to the companion app.

Given that the present study constituted a pilot investigation of a companion app for PCIT

and utilized a small sample, study aims included the collection of summary data related to parent

use of the app, homework completion rate between the app and no app conditions, skill use by

parents during at-home practice sessions, and client and therapist satisfaction with the app.

Additionally, exploratory analyses were conducted examining the effect of the app on homework

completion, CDI treatment outcomes, and the rate of treatment completion during CDI, the first

phase of PCIT. In light of research suggesting that parent readiness for treatment may also relate

to homework completion (Proctor et al., 2018; Sutton & Dixon, 1986), the role of readiness as a

predictor of homework completion, CDI treatment outcomes, and the rate of treatment

completion during CDI was also assessed. Specifically, the following primary and exploratory

hypotheses were proposed:

Primary Hypotheses

1. Parents receiving the PCIT companion app will demonstrate a higher level of homework completion, will require fewer sessions to complete CDI, and will demonstrate a greater reduction in parent-reported child externalizing behavior problems at the conclusion of CDI compared to parents who receive standard PCIT.

2. Among parents assigned to the app condition, use of CDI skills during homework sessions, as measured by the app, will significantly and positively correlate with their use of the skills in session as measured by their PCIT therapist.

3. Both therapists and parents assigned to the app condition will express a high level of satisfaction with the app.

Exploratory Hypotheses

4. Across study conditions, parent readiness at pretreatment will be significantly and positively associated with parent homework completion and the magnitude of the reduction in parent-reported child externalizing problems at the conclusion of CDI, and significantly negatively associated with the number of sessions required to complete CDI.

5. Parent readiness at pretreatment and the assigned treatment condition (app vs. standard PCIT) will significantly interact such that the effects of treatment readiness at pretreatment described in hypothesis 4 will be stronger among parents who receive the PCIT homework app.

6. The percentage of homework completed will partially mediate the relationship between assigned treatment condition (app vs. standard PCIT) and the number of sessions required to complete CDI as well as the relationship between assigned treatment condition and the

magnitude of the reduction in parent-reported child externalizing behavior problems (see Figure 3).

7. The percentage of homework completed will partially mediate the relationship between pretreatment readiness and the number of sessions required to complete CDI as well as the relationship between pretreatment readiness and the magnitude of the reduction in parent-reported child externalizing behavior problems (see Figure 3).

Method

Participants

English-speaking parents aged 19 or older with a child between the ages of 2 and 9 and receiving PCIT at an outpatient therapy clinic in Maryland were invited to participate in the study by their PCIT therapist, who also obtained informed consent from participating parents. For cases in which more than one parent or caregiver from the same family was participating in treatment, both parents were invited to participate, although only data collected from the first parent to meet CDI mastery criteria were utilized for the purposes of the present study. Additionally, at least one participating caregiver per family was required to have custody of the participating child. As illustrated in Figure 2, utilizing these selection criteria resulted in an initial sample of 22 parents, four of whom ultimately withdrew from treatment (Participating families who did not contact their therapist or schedule a future session for two weeks since their last contact with the therapist via session attendance, phone, or email were considered to have withdrawn.) and four of whom were excluded from subsequent analyses due to not being the target parent for analyses (target parents were either the first parent in a two-parent family to achieve CDI mastery or, in cases in which both parents met mastery at the same session, the parent selected by a coin flip). Of note, the 18.1% attrition rate observed in the present study is slightly lower than the 21% attrition rate observed by Jones et al. (2014) when conducting an evaluation of similar technology for a different PMT program, and comparable to the lower end of the range of attrition rates observed in a meta-analysis of 13 studies examining PCIT in which reported attrition rates were between 18 and 35 percent (Thomas & Zimmer-Gembeck, 2007). Reasons given by families for withdrawal from treatment included scheduling conflicts,

preference for individual services in a format other than PCIT, and, in one case, psychosocial stressors related to homelessness.

The final sample considered in the present study therefore included 14 parents (4 male, 10 female, M_{Age}=33.86, SD=5.65, median annual household income=$106,500) of a child (8 male, 6 female) between the ages of 3 and 7 (M_{Age}=4.30, SD=1.16). Of the participating parents retained for the duration of the study, eight were randomly assigned to receive PCIT with the app, and six were randomly assigned to receive standard PCIT without the app. In addition to parents, five therapists providing PCIT (5 female, M_{Age}=38.54, SD=9.10) also acted as participants by completing a satisfaction survey at the conclusion of the study. As such, informed consent was also obtained from the therapists by the author before their participation in the study began. Additional demographic information regarding participating parents and therapists is displayed in Tables 1 and 2.

Materials

Measures

Therapist Demographics Form. Therapists were asked to provide basic demographic information about themselves including age, gender, and ethnicity. Additionally, therapists provided information about their professional background including their most advanced academic degree, theoretical orientation, PCIT certification status, average number of PCIT cases seen per week, and years of experience working with children and families.

Parent Demographics Form. Parents provided basic demographic information about themselves and their child participating in PCIT, including child and parent age, gender and ethnicity, caregiver relationship to the child, parent educational background, income, and

occupation, the number of children in the home, the presenting problem, and current discipline strategies used by the parent.

Readiness, Efficacy, Attributions, Defensiveness and Importance-Short Form (READI-SF). The READI-SF (Proctor et al., 2018) is a 17-item parent-report measure of treatment readiness. Sample items include "I'm ready to start working on my parenting," "I'd like to learn what will work to change my child's behavior," and "I'm eager to learn any skills the therapist can teach me." Possible responses range from 1=*Strongly Disagree* to 5=*Strongly Agree.* Two items are reverse scored. A Total score is computed by summing responses to all items after completing reverse-scoring where necessary, and higher scores indicate higher levels of parental readiness for treatment (Proctor et al., 2018; *READI scoring manual*, 2016). Previous research indicates that the READI-SF demonstrates convergent and predictive validity as well as good internal consistency (α=.94; Proctor et al., 2018). In light of previous research suggesting that the two reverse-scored items do not load onto the same construct as the other items comprising the READI-SF (Proctor et al., 2018), the present study excluded these items and utilized a 15-item version of the measure. Cronbach's alpha was .75.

Eyberg Child Behavior Inventory (ECBI). The Eyberg Child Behavior Inventory (Eyberg & Pincus, 1999) is a 36-item parent report measure of child externalizing behavior problems designed for use among parents of a child between 2 and 16-years-old. Each item includes a common child behavior concern (e.g., "Whines," "Teases or provokes other children," "Is easily distracted"). For each item, parents indicate how frequently a given behavior currently occurs by selecting a number between 1 (Never) and 7 (Always). Next, parents circle "YES" or "NO" for each item to indicate if they consider the behavior described in that item to be a problem. An Intensity score is computed by summing the frequency ratings for each item, and a

Problem score is computed by summing the number of "YES" responses provided across items. Higher Intensity scores are indicative of a higher level of externalizing problems demonstrated by the child, whereas higher Problem scores are indicative of a higher number of behaviors the parent considers to be problematic. Several studies have supported the internal consistency of both the Intensity (α=.95) and Problem (α=.93) scales as well as the inter-rater and test-retest reliability, discriminative and convergent validity, and treatment sensitivity of the measure (Eyberg & Pincus, 1999). Cronbach's alpha was .92 for the Intensity scale and .88 for the Problem scale in the present study.

Dyadic Parent-Child Interaction Coding System, Fourth Edition (DPICS-IV). The DPICS-IV (Eyberg et al., 2014) is a structured behavioral coding system designed to facilitate in-clinic observations of parent-child interactions during play. It is used in PCIT to track parent mastery of the verbal skills taught in treatment (Eyberg & Funderburk, 2011). A standard DPICS observation consists of three five-minute segments (Child-Led Play, Parent-Led Play, and Clean-Up) and is conducted at pre-treatment as part of PCIT. Parents are subsequently coded using the DPICS during a five-minute coding period occurring at the beginning of most PCIT sessions. (Eyberg & Funderburk, 2011). The parent verbalizations coded using the DPICS may be broadly categorized into positive parenting skills consisting of Labeled Praise (i.e., praising a child's specific behavior), Reflection (i.e., repeating what a child just said), and Behavior Description (i.e., describing what a child is doing), and negative parenting skills consisting of Negative Talk (i.e., criticism), Questions, and Commands (Eyberg & Funderburk, 2011; Eyberg et al., 2014). Numerous studies have examined the various iterations of the DPICS and have demonstrated the treatment sensitivity of this coding system (Eyberg et al., 2014). During the present study, DPICS coding was conducted by the therapists and occurred in real time during a designated

portion of each treatment session. Given that each therapist worked individually with their clients instead of in co-therapy teams, inter-rater reliability data for DPICS coding is not available. However, each therapist previously demonstrated 80% inter-rater reliability with a trained DPICS coder during PCIT training.

PCIT App Satisfaction Survey (PASS). The PASS is a seven-item measure developed for use in the present study to measure parent satisfaction with the Special Time Homework App (See Appendix A). Sample items include "The Special Time app was easy to use," "The accountability to my therapist provided by the app was helpful," and "Overall, I was satisfied with the Special Time app". Possible responses range from 1=*Strongly Disagree* to 5=*Strongly Agree*. A total score is computed by summing the responses to each item. In addition to the seven items incorporating a Likert-type scale, an additional item allows parents to provide open-ended feedback regarding their experience using the app. Cronbach's alpha was .78 in the present study.

Therapist Satisfaction Survey (TSS). The TSS is a five-item measure developed for use in the present study to measure therapist satisfaction with the Special Time Homework App (See Appendix B). Sample items include "The Special Time app was easy for this client to use," "The ability to track this client's homework completion remotely was helpful," and "Overall, I was satisfied with the Special Time app as a tool for working with this client". Possible responses range from 1=*Strongly Disagree* to 5=*Strongly Agree*. A total score is computed by summing the responses to each item. In addition to the five items incorporating a Likert-type scale, an additional item allows therapists to provide open-ended feedback regarding their experience using the app. Cronbach's alpha was .88 in the present study.

Therapy Attitude Inventory (TAI). The TAI is a 10-item measure designed to assess parent satisfaction with parent management training programs (Brestan, Jacobs, Rayfield, & Eyberg, 1999; Eyberg & Johnson, 1974). Sample items include "Regarding techniques of disciplining, I feel I have learned:", and "I feel the type of program that was used to help me improve the behaviors of my child was:". Possible responses range from 1=*Most negative response* to 5=*Most positive response*. Items scores are summed to compute the total score, with higher scores indicating higher levels of parent satisfaction with treatment. Previous research has observed that the TAI exhibits strong internal consistency (α=.91; Brestan et al., 1999). Cronbach's alpha for the present study was .69.

Parent-Child Interaction Therapy (PCIT). PCIT is an evidence-based manualized Hanf-model PMT program developed by Dr. Sheila Eyberg for parents of a child between 2 and 7 with externalizing behavior problems (Eyberg & Funderburk, 2011; Eyberg et al., 2008; Kaehler et al., 2016). Treatment consists of two phases presented in a play context, Child Directed Interaction (CDI) and Parent Directed Interaction (PDI; Eyberg & Funderburk, 2011). During CDI, parents learn to provide positive attention for appropriate behavior while ignoring minor problem behavior. During PDI, parents learn a structured discipline procedure (time out) to be used when children do not comply with direct commands. Parents must demonstrate mastery of the skills taught in CDI before transitioning to PDI, and must demonstrate mastery of both the CDI and PDI skills before ending treatment (Eyberg & Funderburk, 2011). The present study focuses exclusively on the CDI phase of treatment given that the Special Time Homework App (see below) was designed specifically to facilitate practice of the skills learned in CDI. To demonstrate mastery of the CDI phase, parents must provide 10 labeled praises, 10 behavior descriptions, and 10 reflections within a five-minute coding interval while avoiding questions,

commands, and negative talk. Throughout PCIT, parents are encouraged to complete daily five-minute homework sessions called Special Time during which they play with their child while practicing CDI skills in order to assist them in meeting CDI mastery criteria (Eyberg & Funderburk, 2011).

  The Special Time Homework App. The Special Time Homework App was developed as a companion app for PCIT by a computer science researcher at Harvard University working in collaboration with clinical child psychology researchers at Auburn University with the goal of creating an app capable of reliably coding parent verbalizations in real time using the DPICS in order to provide parents with immediate feedback during at-home practice sessions. Through an iterative process, several versions of the app were developed over a three-year period.

  To refine the computer program algorithm associated with the app, coded examples from the DPICS manual (Eyberg et al., 2014) and coded examples generated from an IRB-approved survey of 193 PCIT therapists were entered into a machine learning program. Following the creation of the database of DPICS codes to be used by the app, initial testing indicated that the app demonstrated 79% inter-rater reliability with trained DPICS coders when coding written examples of parent verbalizations presented individually with accompanying child verbalizations for context. Similarly, the app achieved 73.5% inter-rater reliability when coding written transcripts of parent-child interactions (Brestan-Knight, Huber, Davis, Junkin, & Cotter, 2018).

  Despite the promising results of using the computer program to code written examples of parent-verbalizations, subsequent pilot testing using both scripted live-action role-plays and parent-child interactions occurring during clinic-based PCIT CDI sessions revealed that the app averaged approximately 40% inter-rater reliability when coding live verbalizations (Brestan-Knight et al., 2018). Qualitative data collected from an IRB-approved initial pilot study sample

of six parents completing initial testing of the app at a PCIT clinic in Maryland indicated that several parents perceived that the app's live coding was inaccurate or believed that the app did not work effectively. Based on these preliminary findings, it was concluded that current technological limitations impede the app's ability to accurately assign DPICS codes in real time, although early pilot testing did suggest that the app accurately measured parent trends toward improvement in the use of the CDI skills across multiple homework sessions (Huber et al., 2019).

In light of the results of initial pilot testing, the app was redesigned to function primarily as a homework tracker with the ability to send push notification reminders to study-issued phones prompting parents enrolled in PCIT to complete Special Time each day and to track parent homework completion and produce a report of this completion that is remotely accessible by the parent's PCIT therapist. Additionally, the version of the app used in this study included an integrated timer and retained the ability to code parent verbalizations using the DPICS, although the app only provided general guidance following each at-home Special Time session instead of skill-specific feedback for this study (e.g., "Next time, try to use fewer COMMANDS and more LABELED PRAISES"; see Figure 1) in order to avoid providing parents with potentially inaccurate information regarding their use of each CDI skill during Special Time practice sessions at home. However, comprehensive DPICS data for each homework session were still collected using the app. For this study, the app was only compatible with the Android operating system, and participating parents who did not own an Android phone received an Android phone featuring the app to use for the duration of the study.

Procedure

Ethical approval for the proposed study was obtained from the Auburn University Institutional Review Board (IRB). As discussed above, data collection occurred at an outpatient therapy clinic in Maryland, with PCIT services provided by Master's level therapists trained in the intervention and supervised by a PCIT Level I Trainer certified to train therapists within her agency in PCIT. These therapists also completed CITI ethics training and were trained by the author to be primarily responsible for data collection. The Level I Trainer additionally served as the primary on-site coordinator of data collection from the Maryland clinic and led biweekly meetings with study therapists in which questions and comments about the study were discussed and study procedures were clarified. Each therapist was assigned a unique ID number for data collection purposes, provided informed consent to participate in the study by reporting demographic information about themselves and completing satisfaction surveys, and completed a demographics form at the initiation of the study so that therapist variables such as degree and years of experience could be controlled for in study analyses. Once a family was identified as being eligible for the study, informed consent was obtained during one of two PCIT intake sessions prior to CDI Teach (the first PCIT treatment session) and a participant ID number was assigned. At these initial sessions, parents completed the demographics form, the READI-SF, and a baseline ECBI and DPICS observation. After completing these measures, parents were randomly assigned to receive PCIT with the Special Time Homework App or to receive standard PCIT in which homework is tracked using a paper version of the homework form completed by the parent each week. Parents assigned to the app condition received an Android phone featuring the app from their therapist or were directed to install the app on their own Android phone during the CDI Teach session or, in two cases, at the beginning of the first CDI coaching session.

Participants were also instructed in how to operate the app, provided information regarding the app's specific features, and received a handout containing basic information about the use of the app. Of note, following the initial five months of data collection during which eight participants were enrolled, study therapists requested further guidance regarding how to best explain the app to participants to supplement the initial training they received before the study began. As such, additional written materials were created and provided to the therapists to structure their discussions about the app with the participants for the remaining six enrollments. Independent samples t-tests comparing study outcome variables (i.e., ECBI change score [$t(6)$=-.65, p=.543, 95% CI{-65.23, 38.03}] percentage of CDI homework completed [$t(6)$=1.05, p=.336, 95%CI{-7.03, 17.54}], number of sessions required to complete CDI [$t(6)$=-.259, p=.804, 95%CI{-3.49, 2.82}], and PASS [$t(6)$=.337, p=.748, 95%CI{-7.10, 9.37}] and TSS [$t(6)$=-.71, p=.504, 95%CI{-10.96, 6.02}] scores) between participants whose intake occurred before and after the creation of these materials indicated that no significant differences were associated with this adjustment to the study procedures.

The parent demographics form, baseline ECBI, and READI-SF completed by parents were deidentified and scanned by the therapist and uploaded to a secure, HIPAA-compliant cloud storage platform accessible by both the therapist and by the research team at Auburn University. Therapist demographics forms were also uploaded to the cloud storage platform. Baseline DPICS codes were entered by the therapist into a spreadsheet stored on the same cloud storage platform. During subsequent CDI sessions, parents completed the ECBI and a five-minute DPICS observation, and provided information to their therapist regarding the number of times they completed Special Time during the previous week. This information was then entered by the therapist into the shared spreadsheet following each session, with therapists receiving

email reminders from the Auburn University research team if data were not uploaded by the Friday of a given week. Trained undergraduate research assistants were responsible for transferring data entered into the spreadsheet into an SPSS file stored on a password-protected university shared drive on a weekly basis, with the author conducting data entry spot checks and sending the email reminders to the therapists regarding uploading data.

After a parent demonstrated mastery of the skills taught in CDI (i.e., the parent produced 10 labeled praises, 10 behavior descriptions, and 10 reflections while producing no more than three questions, commands, or negative talks during a five-minute DPICS coding interval), the therapist scanned and upload a copy of the ECBI completed during the session in which mastery was achieved, and completed the usual weekly data entry in the shared spreadsheet. The therapist also sent an email notification to the author stating that the participant completed CDI. At the subsequent session (PDI Teach), parents who received the app completed the PASS, which was scanned and uploaded to the cloud storage platform by the therapist. Therapists also completed and uploaded a therapist satisfaction survey for each participating family assigned to the app condition that completed CDI. Additionally, study families who completed PDI were administered the PASS a second time and completed the TAI for the purposes of exploratory data collection. Completed TAI forms were also deidentified and uploaded to the cloud storage platform by study therapists. Data collection proceeded in this manner for approximately nine months.

Deviations from Study Procedures

Although study therapists were largely adherent to the procedures described above, at times minor deviations from the study procedure occurred due to technical difficulties or unforeseen clinical circumstances. One family assigned to the app condition was unable to use

the app due to a malfunctioning home WiFi connection. A faulty update to the app resulted in the app failing to code at-home Special Time sessions for four participants for a period of several weeks. One participant did not complete a post-CDI ECBI during the session in which CDI mastery was reached, and as such the ECBI completed at the previous session was used as post-CDI data for this participant. Another participant moved to PDI without first completing CDI due to a spouse who was not participating in the study but was involved in treatment meeting CDI mastery criteria before the parent who was participating in the study, although the participating parent achieved CDI mastery during the first PDI coaching session. Lastly, a misunderstanding regarding study procedures resulted in participants from four families completing the READI-SF at the first CDI coaching session after treatment began. As such, data from the READI-SF for these families were unusable and treated as missing during subsequent analyses incorporating the READI-SF.

PCIT Treatment Outcomes

All analyses were conducted using SPSS unless otherwise noted. A series of paired

samples *t*-tests were conducted examining changes in ECBI Intensity scores, total use of positive

parenting skills (i.e., Behavior Description, Reflection, and Labeled Praise), and total use of

negative parenting skills (i.e., Negative Talk, Questions, and Commands) from pretreatment to

the conclusion of CDI. Positive parenting skills and negative parenting skills were measured by

study therapists using the DPICS (Eyberg et al., 2014). Paired samples *t*-tests revealed that the

mean ECBI Intensity score significantly decreased from pretreatment (*M*=146.21, *SD*=30.70) to

the conclusion of CDI at the .05 level (*M*=128.57, *SD*=45.26), *t*(13)=2.38, *p*=.033. Furthermore,

the use of positive parenting skills significantly increased from pretreatment (*M*=3.86, *SD*=3.44)

to the conclusion of CDI (*M*=38.00, *SD*=4.88), *t*(13)= -20.36, *p*<.001, whereas the use of

negative parenting skills significantly decreased from pretreatment (*M*=17.36, *SD*=6.57) to the

conclusion of CDI (*M*=1.21, *SD*=1.19), *t*(13)=8.91, *p*<.001.

Descriptive Statistics and Zero-Order Correlations

Means and standard deviations for pretreatment readiness (READI-SF score), ECBI

change score (the change in ECBI Intensity score from pre-CDI to post-CDI), CDI completion

time (the number of sessions required to complete CDI), CDI homework completion (the

percentage of homework completed during CDI), and client and therapist satisfaction scores are

presented in Table 3. Independent samples *t*-tests revealed no significant differences in

pretreatment readiness, ECBI change scores, CDI completion time, and homework completion

associated with parent gender (t_{range}= -1.34 to 1.59, nonsignificant [ns]), child gender (t_{range}= -

1.41 to .80, ns), or parent marital status (married vs. unmarried; t_{range}= -1.19 to 2.28, ns). To

reduce the possibility of Type I error given the large number of tests conducted, a more conservative *p*-value of .01 was used when determining significance.

Table 4 displays the results of statistical comparison of means across conditions for several key study variables. Zero-order correlations (see Table 5) between parent income, parent years of education, pretreatment readiness, therapist years of experience with children and families, ECBI change scores, CDI completion time, and CDI homework completion were examined to determine if parent income, education, or therapist experience should be controlled for in subsequent analyses. As seen in Table 5, none of the variables examined were significantly correlated with ECBI change scores, CDI completion time, or CDI homework completion.

Primary Hypotheses

Hypothesis 1

In order to broadly test the hypothesis that parents receiving the PCIT companion app would demonstrate a higher level of homework completion, would require fewer sessions to complete CDI, and would demonstrate a greater reduction in parent-reported child externalizing behavior problems at the conclusion of CDI compared to parents who receive standard PCIT, a series of independent samples *t*-tests were conducted comparing CDI homework completion, CDI completion time, and ECBI change scores between parents in the app and no app conditions. Independent samples *t*-tests revealed that parents in the app condition (*M*=6.13, *SD*=1.64) did not complete CDI significantly more quickly than parents in the no app condition (*M*=5.33, *SD*=1.37), *t*(12)= -.96, *p*=.358. Similarly, parents in the app condition (*M*=40.73, *SD*=6.92) did not complete a significantly higher percentage of the assigned CDI homework than parents in the no app condition (*M*=35.66, *SD*=20.13), *t*(5.89)= -.59, *p*=.576. Finally, parents in the app condition (*M*=11.50, *SD*=27.66) did not exhibit a significantly greater reduction in parent

reported child behavior problems during CDI than parents in the no app condition (*M*=25.83, *SD*=28.02), *t*(12)=.95, *p*=.359.

Hypothesis 2

To test the hypothesis that parent use of the skills taught in CDI during homework sessions as measured by the app will significantly and positively correlate with their use of the skills in session as measured by their PCIT therapist, zero-order correlations between the average score the app assigned for a given DPICS code (Behavior Descriptions, Reflections, Labeled Praise, Questions, Commands, and Negative Talk) on the date closest to but not following the date of the CDI Coach 1 and CDI Mastery sessions and the average score assigned by the therapist for a given DPICS code at these sessions were computed. Additionally, graphs were created for each code (see Figures 4-9) depicting changes in parent skill use averaged across participants as measured by the app and as measured by the therapist over the course of CDI.

As reported in Figures 4 through 9, none of the correlations comparing average app and therapist codes at CDI Coach 1 and CDI Mastery were significant. Visual inspection of the graphs presented in Figures 4 through 9 revealed that both the app and the therapists broadly captured increases in the number of Behavior Descriptions (see Figure 4) and Reflections (see Figure 5) over time. In contrast, less correspondence between the app and therapists in trends over time was observed for Labeled Praise (see Figure 6), Questions (see Figure 7), Commands (see Figure 8), and Negative Talk (see Figure 9).

Hypothesis 3

To assess therapist and client satisfaction with the app, mean client (*M*=18.38, *SD*=4.31, highest possible score=35) and therapist (*M*=13.13, *SD*=4.58, highest possible score=25) satisfaction scores were calculated for the app condition. Additionally, the percentage of

favorable and unfavorable responses to each item on the satisfaction surveys was computed and is presented in Table 6. As seen in Table 6, parents assigned to the app condition largely reported that the app was easy to use (87.5% Agreed or Strongly Agreed), but were somewhat ambivalent as to whether the app made homework time more enjoyable (75% Neutral) or provided helpful accountability to their therapist (62.5% Neutral). Notably, parents largely disagreed that the in-app homework tracking (25% Neutral, 50% Somewhat or Strongly Disagreed), push notification reminders (75% Somewhat or Strongly Disagreed), and qualitative feedback regarding parent skill use (62.5% Somewhat or Strongly Disagreed) was helpful. Furthermore, 62.5% of parents provided a neutral response when reporting overall satisfaction with the app. Common themes emerging from the open-ended item of the parent satisfaction measure included observations that the qualitative feedback from the app was too generic or inaccurate, that the app sometimes failed to log completed homework sessions, that using the app on a phone different from the parent's personal cell phone was challenging, and that parents either forgot to charge the study-issued phone with the app installed or simply did not use the phone.

As seen in Table 6, therapists largely agreed with parents that the app was easy to use (62.5% Agreed or Strongly Agreed). In contrast, therapists endorsed neutral to negative responses regarding whether parents enjoyed using the app (50% Neutral, 50% Somewhat or Strongly Disagreed). Notably, therapists largely did not agree that the ability for them to remotely track client homework completion using the app was helpful (62.5% Somewhat or Strongly Disagreed). Similarly, many therapists did not view the daily push notification reminders from the app as helpful for their clients or expressed ambivalence toward the reminders (25% Neutral, 50% Somewhat or Strongly Disagreed that reminders were helpful). Regarding overall satisfaction with the app, most therapists provided a neutral (37.5%) or

42

negative (37.5%) response. The generic and inaccurate nature of the qualitative feedback provided by the app emerged as the most common theme from the open-ended item of the therapist satisfaction measure. Other notable therapist comments included that one client became frustrated with the app and did not use it consistently and that one client frequently forgot to use the app. Additionally, one therapist reported that she found the remote tracking of the client's homework completion afforded by the app to be helpful.

Exploratory Hypotheses

Hypotheses 4 and 5

To test the hypotheses concerning the role of pretreatment readiness and assigned treatment condition in relation to CDI homework completion, CDI completion time, and ECBI change scores, a series of hierarchical regression analyses was conducted for each outcome variable (CDI homework completion, CDI completion time, and ECBI change scores; see Table 7). Predictor variables were mean-centered for each regression analysis when appropriate. Pretreatment readiness was entered in Step 1. Step 2 incorporated assigned treatment condition, and Step 3 included a product term capturing the possible interaction between pretreatment readiness and assigned treatment condition. To correct for the large number of tests, a more conservative p-value of .01 was used when determining significance.

As presented in Table 7, neither pretreatment readiness nor assigned treatment condition significantly predicted CDI homework completion, CDI completion time, or ECBI change score. Similarly, the interaction between pretreatment readiness and assigned treatment condition was not significant for CDI homework completion, CDI completion time, or ECBI change score.

Hypotheses 6 and 7

To evaluate the role of CDI homework completion as a potential mediator of the relationships between pretreatment readiness and the outcome variables (CDI completion time, ECBI change score) and assigned treatment condition and the outcome variables, a series of mediational models (see Figure 3) were tested using Mplus (Muthen & Muthen, 2017). To test for partial mediation in each model, the direct effect of the predictor variable on the mediator were tested before examining the effect of the mediator on the outcome variable while controlling for the predictor variable. The significance of the indirect effects was evaluated using bootstrapping.

As seen in Figures 10 and 11, CDI homework completion did not significantly partially mediate the relationship between treatment condition and CDI completion time, β= -.09, *SE*=.26, *p*=.731, nor did it significantly mediate the relationship between treatment condition and ECBI change score, β= .08, *SE*=.23, *p*=.737. Similarly, as illustrated in Figures 12 and 13, homework completion did not significantly partially mediate the relationship between pretreatment readiness and CDI completion time, β= .08, *SE*=.25, *p*=.746, nor did it significantly partially mediate the relationship between pretreatment readiness and ECBI change score, β= -.06, *SE*=.22, *p*=.789.

Discussion

The present study was designed to expand upon prior research examining companion software such as smartphone apps created to complement PCIT (Costa, 2017; Jent et al., 2014; Jent et al., 2017) as well as similar PMT programs (Jones et al., 2014) while hopefully contributing to efforts to increase the accessibility of PCIT for underserved groups (Comer et al., 2015; Corralejo & Domenech-Rodriguez, 2018; Jameson & Blank, 2007; McGoron & Ondersma, 2015; Parra-Cardona et al., 2017; Shaffer et al., 2001). Specifically, a randomized controlled pilot evaluation focusing on CDI was conducted of the Special Time Homework App, a smartphone application intended to facilitate adherence to the at-home practice of skills learned in session that constitutes an essential component of PCIT (Eyberg & Funderburk, 2011). The app included several features designed to improve adherence to at-home practice, including integrated push notification reminders, a timer, the ability to track homework completion both within the app and in a format accessible remotely by the therapist, and the capacity to perform rudimentary DPICS coding of PCIT skill use at home. Notably, the present study constitutes the first research investigation to remotely collect DPICS data from the homes of clients enrolled in PCIT.

It was hypothesized that parents receiving the Special Time app would demonstrate a higher level of CDI homework completion, would require fewer sessions to complete CDI, and would demonstrate a greater reduction in parent-reported child behavior problems at the conclusion of CDI compared to parents who received standard PCIT without the app. Furthermore, it was expected that DPICS coding of CDI skill use as recorded by the app would significantly and positively correlate with DPICS coding completed by PCIT therapists in session. Finally, it was expected that study therapists as well as parents assigned to the app

condition would express a high level of satisfaction with the app. Exploratory regression analyses additionally assessed hypothesized associations among pretreatment readiness, assigned treatment condition, homework completion, CDI completion time, and ECBI change score. Although all study hypotheses were ultimately not supported, the present evaluation nonetheless constitutes an important first step in the ongoing development and refinement of the Special Time Homework App and offers several key insights regarding possible future directions for this line of work.

CDI Outcomes and Attrition

Across conditions, significant improvements were observed in ECBI Intensity Score, increased use of positive parenting skills, and decreased use of negative skills from pretreatment to the completion of CDI. The mean ECBI Intensity score was also within the subclinical range (i.e., less than 131) for both study conditions at the conclusion of CDI. These results are consistent with previous research observing a significant decrease in self-reported use of ineffective parenting strategies as well as a significant decrease in parent-reported child behavior problems following CDI completion (Harwood & Eyberg, 2006). As such, these findings indicate that for some families the CDI phase of treatment alone may provide sufficient development of positive parenting strategies to adequately address child behavior problems. Still, the importance of PDI, the phase of PCIT in which effective discipline strategies are learned and practiced (Eyberg & Funderburk, 2011), is demonstrated by research reporting improved parent satisfaction and treatment outcomes when PDI was presented before CDI in contrast to the standard presentation of PCIT in which CDI is completed first (Eisenstadt, Eyberg, McNeil, Newcomb, & Funderburk, 1993). Thus, although the literature suggests that CDI and PDI both offer useful approaches for managing child behavior problems, families may be particularly

satisfied with the effective discipline strategies learned during PDI. Still, the integration of CDI with PDI within standard PCIT is logical given that it offers families a range of positive relationship-building strategies as well as structured discipline techniques, each of which have demonstrated effectiveness in addressing child problem behavior (Eisenstadt et al., 1993; Harwood & Eyberg, 2006).

When considering overall PCIT treatment outcomes in the present study, it is interesting to note that all treatment dropout occurred within the no app condition. Families enrolled in the app condition may have been more motivated to complete treatment due to a perception that their participation was especially vital to the research, as they were directly involved in both pilot-testing the app and providing feedback related to its functioning. Additionally, as seen in Table 4, the no app condition exhibited a higher ECBI Intensity score than the app condition at pretreatment, although this difference was not statistically significant. However, families experiencing higher levels of child problem behavior may have found treatment completion to be more difficult. A prior study examining attrition from PCIT did not find ECBI Intensity score to be a significant predictor of treatment drop-out among a sample of mothers, although parental stress was significantly associated with attrition (Werba, Eyberg, Boggs, & Algina, 2006). Yet previous research has nonetheless demonstrated an association between child behavior problems and parental stress (Neece, Green, & Baker, 2012) such that child behavior problems could be considered a possible indicator of parental stress in studies in which stress was not directly measured. Regardless, the 18.1% overall attrition rate observed in the present study compares favorably to previous PCIT research (Thomas & Zimmer-Gembeck, 2007) and suggests that a range of variables related to both client and therapist characteristics contributed to a high level of treatment retention.

Homework Completion

In light of previous research supporting the benefits of homework completion in PMT interventions (Danko et al., 2015; Ros et al., 2016; Stokes et al., 2016), the present study examined associations between use of the app and adherence to CDI homework (Hypothesis 1) as well as possible associations between CDI homework completion, CDI completion time, and ECBI change scores (Hypotheses 6 and 7). However, although individuals assigned to the app condition exhibited a numerically higher average percentage of completed homework sessions than individuals assigned to the no app condition (40.7% or 2.85 days per week on average for app condition, 35.7% or 2.5 days per week on average for no app condition), in contrast with previous research (Jones et al., 2014; Ros et al., 2016; Stokes et al., 2016), no significant associations between access to the app and homework completion were observed, nor did homework completion emerge as a significant predictor of CDI completion time or ECBI change scores. Interestingly, the average overall rate of CDI homework completion was 38.6%, which is somewhat lower than the average homework completion rate of 48% reported by Chacko et al. (2016) in a review of various PMT interventions as well as the average PCIT homework completion rates of 45% reported by Danko et al. (2016) for a community mental health sample and 70.5% reported by Stokes et al. (2016) for an efficacy sample receiving services at an academic medical center. Jones et al. (2014) even reported a homework completion rate of 91% for the app condition and 77% for the no app condition in their pilot evaluation of a PMT companion app. Future research should seek to determine if a specific rate of homework completion is required in order to best support treatment progress, as extant data in this area are currently limited.

Whereas the current study did not observe significantly higher levels of homework completion among participants assigned to receive the app, Jones et al. (2014) reported greater homework completion among participants who received an app designed for the Helping the Noncompliant Child program, a PMT intervention similar to PCIT. Of note, the Jones et al. (2014) app was evaluated via an efficacy study conducted in a university-based training clinic and specifically targeting low-income families. Participants volunteered for the study in response to community advertising, underwent an initial screening process before being approved for the study, and received financial compensation in exchange for certain aspects of their participation (although not for homework completion). Study therapists were doctoral students who currently held Master's degrees and received regular supervision and feedback regarding their fidelity of implementation of the Helping the Noncompliant Child intervention (Jones et al., 2014).

In contrast, the present evaluation constituted an effectiveness study conducted in a community mental health center with the intervention delivered by Master's level therapists, or, in some cases, by a student therapist currently enrolled in a Master's program. As such, most study therapists were practicing independently and therefore did not receive regular supervision or feedback related to the fidelity of their implementation of PCIT, although they did meet regularly to discuss matters related to data collection for the study. It is possible that the therapists in the Jones et al. (2014) study received additional guidance and supervision related to maintaining a high level of homework completion among their clients. Furthermore, Jones et al. (2014) recruited a sample of participants who specifically volunteered to participate in research, whereas the present study asked clients seeking therapy services to additionally volunteer for research. As such, the Jones et al. (2014) sample may have exhibited greater motivation to complete study-related tasks such as homework.

Importantly, the Jones et al. (2014) app additionally offered several features not available in the Special Time Homework App such as the ability to record at-home practice sessions and send the recordings to one's therapist, integrated videos demonstrating the use of each skill, and videoconferencing between the parent and therapist. One or more of these additional features may have contributed to greater engagement with the homework process among the participants in the Jones et al. (2014) study. Additionally, as discussed below, technical limitations and difficulties with the Special Time Homework App may have frustrated families enrolled in the current study and therefore limited their use of the app.

Pretreatment Readiness

Despite prior research suggesting that pretreatment readiness may play an important role in homework completion specifically and possibly treatment adherence more broadly (Proctor et al., 2018; Sutton & Dixon, 1986), these associations were not supported by the hierarchical regression and mediational analyses evaluating the present study's exploratory hypotheses. The lack of significant associations between pretreatment readiness, CDI homework completion, CDI completion time, and ECBI change scores observed in the current study may indicate that although parents seeking PCIT services for their children may uniformly report high readiness, this may not ultimately be predictive of homework completion or improved treatment gains. Additional research with a larger sample is needed to more fully evaluate the role of pretreatment readiness as a predictor of treatment engagement and outcomes.

Although hypotheses concerning pretreatment readiness were not supported, the present study offers an important contribution to a small but growing body of work examining the use of the READI-SF in clinical contexts (Cotter, 2019; Proctor et al., 2018). Notably, the mean READI-SF score for the present study (M=64.82, SD=4.49) is comparable to the mean READI-

SF score reported for the initial normative clinical sample (*M*=66.76, *SD*=9.7; *READI scoring manual*, 2016). In contrast, Cotter (2019) reported a somewhat higher mean overall score for a clinical sample of Latino parents (*M*=73.58, *SE*=.78), whereas Proctor et al. (2018) reported a somewhat lower mean score among a nonclinical, predominantly African American sample (*M*=41.5, *SD*=14.74). However, although the mean reported for Cotter (2019) utilized a 17-item version of the READI-SF, both the present study as well as Proctor et al. (2018) used a 15-item version in light of psychometric evidence suggesting that items 11 ("I will work on my child's behavior problems later") and 15 ("I have problems that are more important than my child's behavior right now") do not load onto the same construct as the rest of the measure (Cotter, 2019; Proctor et al., 2018). Importantly, the sample examined in the present study, as well as those utilized by Proctor et al. (2018) and Cotter (2019), were all collected from the Washington, D.C.-Baltimore, Maryland area. Taken together, these samples represent a range of ethnic and socioeconomic status (SES) backgrounds, and draw from predominantly Latino (Cotter, 2019), African American (Proctor et al., 2018), and White populations. Future research should continue to evaluate the psychometric properties of the READI-SF among a variety of diverse groups.

Client Accountability to Therapist

The ability for study therapists to remotely track client homework completion was included with the app to increase client accountability to the treatment process. This approach is supported by research from the health psychology literature illustrating the benefits of monitoring in supporting treatment adherence (Bartlett et al., 2002; Hilliard et al., 2011; Mohr et al., 2011; Otsuki et al., 2009; Wu & Hommel, 2014). Indeed, it is possible that the slightly higher rate of homework completion observed among the app condition was due in part to the electronic homework tracking offered by the app. However, when completing satisfaction surveys clients

reported ambivalence and therapists reported dissatisfaction regarding the helpfulness of this feature. Although clients and therapists did not provide additional detail regarding these ratings when completing open-ended items of satisfaction surveys, it is possible that therapists and clients may have perceived the paper homework sheet utilized as part of standard PCIT as offering adequate accountability without the additional tracking provided by the app. Additionally, the app presented the homework completion data to therapists in a deidentified format in which data for all participants was tracked in a single spreadsheet. This format may have been difficult for therapists to use when attempting to review information relevant to their specific clients and therefore may have contributed to therapist dissatisfaction with the remote homework tracking feature.

Furthermore, as noted by one of the study therapists, the remote homework tracking experienced technical difficulties at times, particularly during the initial weeks of the study as described in the Method section. Future versions of the app may benefit from assigning each client a unique tracking spreadsheet that allows therapists to clearly distinguish one client's homework completion from another's. For clients, the remote tracking feature may have been perceived as intrusive. Alternatively, client responses to satisfaction surveys suggest that some clients may not have consistently used the study-issued phone with the app installed due to a lack of convenience. The remote homework tracking offered by the app would therefore not function as a helpful feature for clients who did not use the app regularly during at-home practice sessions, thereby highlighting the importance of increasing the accessibility of the app across a range of smartphone operating systems.

Accuracy of DPICS Coding

Although previous work indicated that technological limitations prevented the app from reliably coding DPICS during live practice sessions (Brestan-Knight et al., 2018), it was hypothesized that CDI skill use as measured by the app at home would nonetheless broadly correlate with CDI skill use as measured by therapists in session. Despite the lack of support for this hypothesis, the graphical depiction of changes in Behavior Description and Reflection over time as measured by the app and therapist depicted in Figures 4 and 5 suggests that for at least some DPICS codes the app captured general trends in parent skill use. Behavior Descriptions and Reflections may have been easier for the app to accurately code given their somewhat unique linguistic structure. Specifically, behavior descriptions typically include the word "you", the phrase "you are" or the contraction "you're" followed by a verb (e.g., "You're coloring the dog brown."). Similarly, Reflections are distinguished by the emphasis typically placed on the verb when a parent repeats what a child just said (e.g., "You *do* have a green crayon.").

As established in prior research, the app's DPICS coding feature was ultimately hindered by technological limitations that rendered its coding of written transcripts more accurate than its coding of spoken audio (Brestan-Knight et al., 2018). Still, as discussed above, the present study nonetheless constituted an important first step in remotely collecting DPICS data related to parent skill use in the home environment. Future research will hopefully expand upon this line of work and ultimately produce software capable of accurate DPICS coding from live audio in both the home and clinic settings.

Therapist Perspective

As noted above, the present study is unique in that, in contrast to efficacy studies conducted in university training clinics under the supervision of doctoral level clinicians, it

examines data collected from a community clinic in which PCIT was implemented by a Level I Trainer and a team of predominantly Master's level therapists whose training and certification in PCIT she oversaw. Qualitative observations reported by the Level I Trainer include that parents and therapists appeared interested in the app initially but became frustrated with technological difficulties such as those described in the satisfaction surveys. In particular, frustration with the generic feedback provided by the app was perceived as contributing to reduced parent use of the app as treatment progressed. Additionally, differences in the quality of the WiFi connection available in participant's homes reportedly resulted in inconsistent tracking by the app of homework completion, which may have contributed to the therapist perspective that the remote homework tracking feature was unhelpful as reported when completing the Therapist Satisfaction Survey.

Limitations and Future Directions

Sample Characteristics

The present study was limited by the size and nature of the sample, certain elements of the clinical setting in which the research was conducted, and technological limitations related to the design of the Special Time Homework App as well as the devices with which the app was compatible. Given that the current study constituted a pilot evaluation of the app, the sample was necessarily small and was additionally limited in size by the COVID-19 pandemic. As expected given the size of the sample, post-hoc power analyses using G*Power (Faul et al., 2009) indicated that with a sample of n=14 power ranged from 6.3% for a small effect size to 13.6% for a medium effect size when conducting independent samples *t*-tests, and from 27.7% for a small effect size to 57.56% for a medium effect size when conducting regression analyses. The sample also exhibited a lack of racial and ethnic diversity, as all participating parents were White.

Furthermore, all participating families included at least one of the child's biological parents, meaning that the utility of the app for nontraditional families in which grandparents, stepparents, etc. serve as primary caregivers was unable to be assessed. Regarding therapist diversity, as with the sample of parents, all study therapists were White. Additionally, although therapists represented a range of years of experience working with children and families, they were each qualified at the Master's level or below, and no therapist with a doctoral degree participated in the study. Finally, no male therapists were represented in the study. Future research examining the Special Time Homework App should therefore seek to recruit a larger, more ethnically diverse sample of caregivers representing a variety of family structures. Similarly, the therapists administering the intervention should also represent a range of ethnic backgrounds and should include both male and female therapists as well as therapists at both the Master's and doctoral levels.

Community Setting

The collection of data from a community outpatient mental health clinic afforded access to a large pool of potential PCIT cases while enhancing the external validity of study results. Still, the less-controlled environment of a community facility as opposed to a university training clinic allowed for occasional minor errors in the implementation of the study procedure that occurred due to clinical necessity. Perhaps the most notable example of this was the loss of usable READI-SF data for several participants due to a therapist mistakenly administering the measure after treatment had begun instead of at pretreatment. Subsequent research in this area would therefore benefit from conducting the study in a more controlled academic clinic that facilitates more immediate supervision of the research team. Alternatively, therapists collecting data in a community setting may simply require additional training as well as regular meetings

with the research team to review correct procedures and to assess the degree to which therapists are adhering to the research protocol.

An additional consideration related to the community outpatient setting concerns possible response biases related to participants providing research data directly to their therapists. Although similar research has utilized therapists to collect at least some study data (Jones et al., 2014), little published work exists exploring ways in which therapists may influence client responses when therapists are primarily responsible for study data collection. For the present study, precautions taken to reduce therapist or participant biases included ensuring therapists were unaware of study hypotheses and encouraging participants to provide honest feedback by emphasizing the importance of the present study in contributing to future improvements to the app. The availability of trained research assistants separate from study therapists afforded by an academic setting is another possible advantage of future research in this area utilizing a more controlled environment.

App Design

Based on feedback from client and therapist satisfaction surveys, certain design elements of the app were perceived as unhelpful or frustrating by participants. Because the app was only available for the Android operating system, participants without an Android phone were issued a phone with the app installed to use for the duration of the study. Ultimately no participants assigned to the app condition owned an Android phone, and therefore all participants who received the app also received a separate phone with the app installed. Responses to satisfaction surveys indicated that some participants would have preferred to have the app installed on their personal smartphones and suggested that the requirement of accessing the app on a separate device may have reduced the frequency with which it was used. Notably, the absence of the app

on a parent's primary device may have reduced the effectiveness of features such as the daily push notification reminders to complete Special Time. Interestingly, Jones et al. (2014) also used study-issued phones for their pilot evaluation of a companion homework app for PMT, although their results suggest consistent use of the app by study participants. However, in contrast to the current study, Jones et al. (2014) exclusively recruited a low-income sample, of which only approximately one third reported owning a smartphone. As such, fewer of the participants in the Jones et al. (2014) study had access to a primary smartphone to compete with the study-issued device.

Whereas previous iterations of the Special Time Homework App provided parents with specific feedback regarding the number of times each CDI skill was used during an at-home practice session, the version used in the present study instead provided general feedback regardless of how parents performed (e.g., "Next time, try to use fewer COMMANDS and more LABELED PRAISES"; see Figure 1). However, participant frustration that this feedback did not change based on their use of specific skills emerged as a clear theme from satisfaction surveys and likely contributed to ambivalence regarding the app as a whole. In light of this result, parents may have preferred viewing the actual tally of their skill use as in previous versions of the app. Alternatively, future iterations of the app in which feedback changed to reflect parent improvement in use of the CDI skills may provide helpful positive reinforcement of parent skill development.

In contrast to the present evaluation, studies by Self-Brown et al. (2017) and Jones et al. (2014) each report high levels of parent satisfaction with interventions integrating technology and traditional parent training techniques. Furthermore, parents receiving the smartphone app in the Jones et al. (2014) study actually reported a higher level of satisfaction with the Helping the

Noncompliant Child program than did parents receiving the program without the app. Notably, both Self-Brown et al. (2017) and Jones et al. (2014) incorporated features such as video modeling of treatment skills and integrated educational content designed to both supplement the in-person instruction received during intervention sessions and to support at-home practice of the skills learned. Similar features would likely enhance the perceived usefulness of the Special Time Homework App for parents completing PCIT.

Conclusion

Despite the presence of technological limitations associated with the Special Time Homework App, the present study represents an important initial stage in the development of a companion homework app for PCIT and incorporated several novel approaches to the study of PCIT treatment outcomes. Importantly, the ability of the app to remotely log participant homework completion and provide rudimentary DPICS coding data from at-home practice sessions makes this the first known study to include DPICS data from independent parent practice as well as the first known study to allow PCIT therapists to track parent homework completion electronically. Additionally, the study contributed to a developing literature evaluating the psychometric properties of the READI-SF among individuals from a variety of cultural backgrounds. As a real-world effectiveness study, the present evaluation obtained valuable treatment outcome and participant satisfaction data related to services provided by community-based Master's level therapists practicing without the direct supervision of university-based PCIT practitioners or researchers while simultaneously providing a strong foundation for future efforts to improve the utility of the Special Time Homework App.

As seen in the work of Jones et al. (2014), such an app has the potential to serve as a useful tool for enhancing client engagement and improving treatment outcomes. Smartphone

apps and related companion software may offer increased accessibility to PMT for underserved groups through their availability on mobile devices, their capacity to present PMT content and support practice of PMT skills in a client's home, and the potential to create software featuring culturally-informed content (Baumel, Pawar, Kane, & Correll, 2016; Corralejo & Domenech Rodriguez, 2018; Hall & Bierman, 2015; Jones et al., 2013; Jones, Forehand, McKee, Cuellar, & Kincaid, 2010; McGoron & Ondersma, 2015; Parra-Cardona et al., 2017). Yet the results of this initial pilot evaluation suggest that although the current iteration of the Special Time Homework App did not significantly impede the successful completion of PCIT, it nonetheless requires substantial improvement and refinement before it may offer an enhanced treatment experience to users. Specifically, increasing the availability of the app across a range of smartphone operating systems, developing a more accurate DPICS coding algorithm for spoken audio while incorporating targeted feedback to parents that reflects their actual skill use, reducing technical glitches, and increasing the user-friendliness of the remote homework tracking feature should produce an app that offers additional value to stakeholders. Once these changes are implemented, future studies should move beyond small pilot work to full scale randomized controlled trials in both university and community settings to more fully evaluate the possible benefits offered by the app among diverse samples of both caregivers and therapists.

The present study constitutes one of the latest efforts to use technology to increase the accessibility of PMT services. Prior work has demonstrated the utility and range of possible benefits offered by online PMT interventions (Cotter et al., 2015; Baumel & Faber, 2017, Enebrink et al., 2012; Hogstrom et al., 2013, 2015; Sanders et al., 2012; Sourander et al., 2016; Stalker, et al., 2018), PMT interventions delivered via telehealth (Comer et al., 2015, 2017), and PMT interventions delivered with the aid of companion software (Jent et al., 2014, 2017; Jones

et al., 2014; Self-Brown et al., 2015, 2017). At the time of writing, the COVID-19 pandemic has resulted in the widespread implementation of telehealth across a range of mental health services. As such, the exploration of technological innovations to traditional interventions is especially timely as current events encourage accelerated development and implementation of Internet-based tools to maintain connections between clients and therapists.

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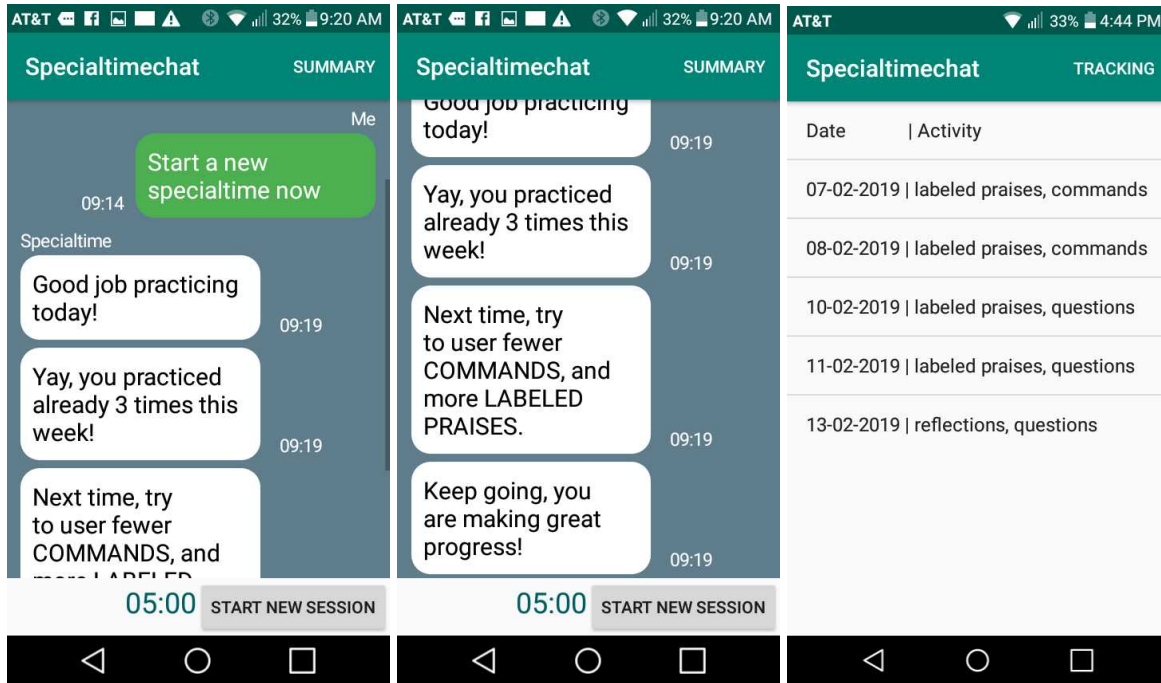
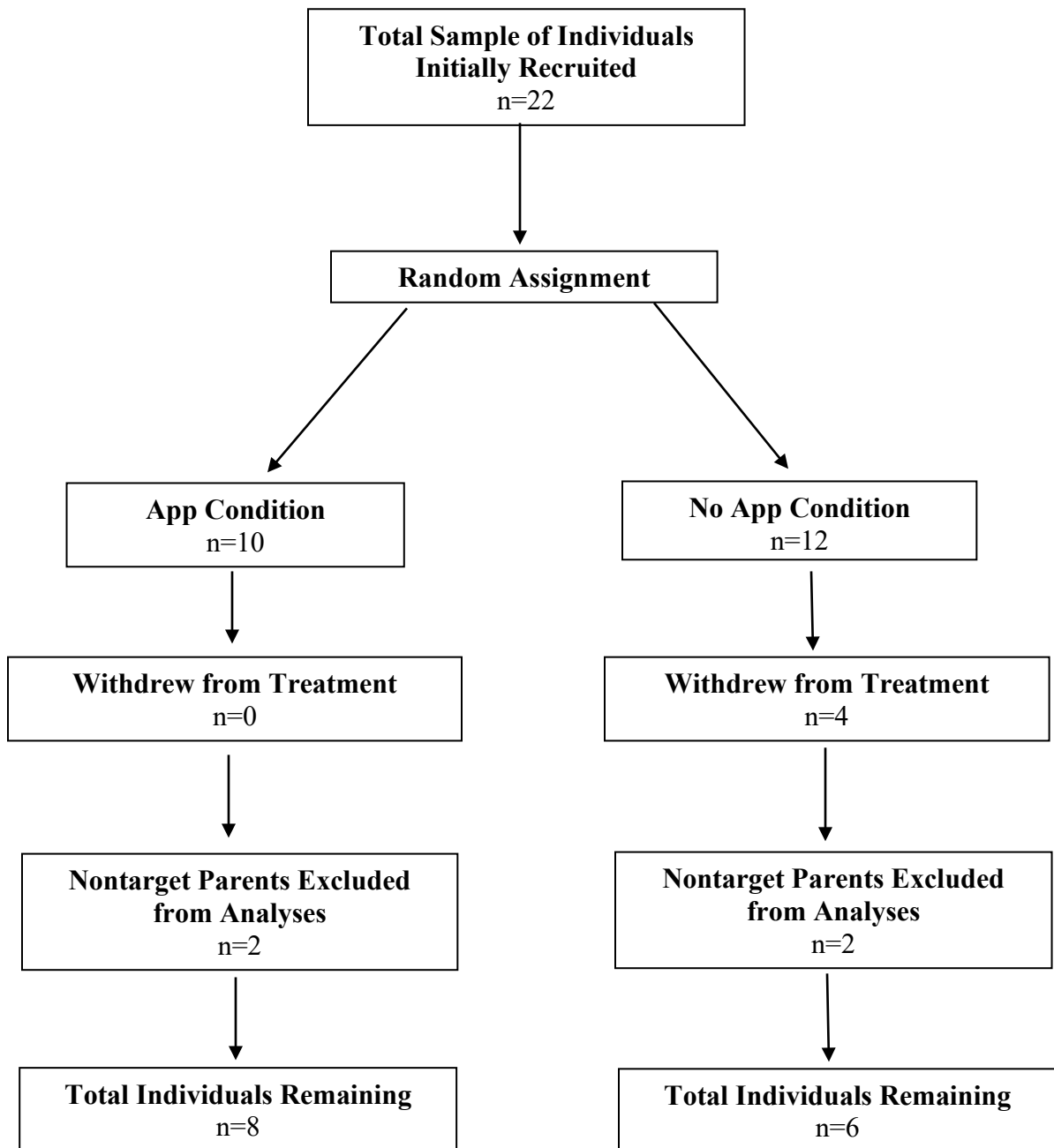*Figure 1*. Screenshots from the Special Time Homework App.

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                    ┌─────────────────────────────┐
                    │ Total Sample of Individuals │
                    │     Initially Recruited      │
                    │            n=22              │
                    └─────────────────────────────┘
                                  │
                                  ▼
                    ┌─────────────────────────────┐
                    │      Random Assignment       │
                    └─────────────────────────────┘
                      ╱                          ╲
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                    ▼                              ▼
         ┌──────────────────┐          ┌──────────────────────┐
         │  App Condition   │          │   No App Condition    │
         │      n=10        │          │        n=12           │
         └──────────────────┘          └──────────────────────┘
                  │                               │
                  ▼                               ▼
      ┌───────────────────────┐       ┌───────────────────────┐
      │ Withdrew from Treatment│       │ Withdrew from Treatment│
      │          n=0          │       │          n=4          │
      └───────────────────────┘       └───────────────────────┘
                  │                               │
                  ▼                               ▼
      ┌───────────────────────┐       ┌───────────────────────┐
      │ Nontarget Parents Excluded│   │ Nontarget Parents Excluded│
      │      from Analyses     │       │      from Analyses     │
      │          n=2          │       │          n=2          │
      └───────────────────────┘       └───────────────────────┘
                  │                               │
                  ▼                               ▼
      ┌───────────────────────┐       ┌───────────────────────┐
      │ Total Individuals Remaining│  │ Total Individuals Remaining│
      │          n=8          │       │          n=6          │
      └───────────────────────┘       └───────────────────────┘
```

Figure 2. Participant flow diagram.

Table 1

Participant Characteristics

Characteristic	Number	Percent of Sample
Child Age		
3-5	12	85.7
6-7	2	14.3
Child Gender		
Male	8	57.1
Female	6	42.9
Child Ethnicity		
White	13	92.9
Not reported	1	7.1
Caregiver Relationship to Child		
Mother	10	71.4
Father	4	28.6
Caregiver Ethnicity		
White	14	100
Caregiver Age		
25-30	4	28.6
31-35	5	35.7
36-42	5	35.7
Caregiver Years of Education		
12-15	7	50.0
16-20	7	50.0
Caregiver Relationship Status		
Single	2	14.3
Married/Partnered	11	78.6
Separated/Divorced	0	0
Widowed	1	7.1
Other Caregiver's Years of Education		
11-15	7	50.0
16-20	4	28.6
Not reported	3	21.4
Current Household Income		
<$30,000	2	14.3
$30,000-$50,000	2	14.3
$60,000	1	7.1
$100,000-$125,000	5	35.7
$200,000 or greater	2	14.3
Not reported	2	14.3
Number of Children in the Home		
1-2	8	57.1
3-4	6	42.9

Table 2

Therapist Characteristics

Characteristic	Number	Percent of Sample
Therapist Age		
Twenty-Six	1	20
Twenty-Seven	2	40
Thirty-Eight	1	20
Fifty-Two	1	20
Therapist Gender		
Female	5	100
Therapist Race/Ethnicity		
White or Caucasian	5	100
Therapist Education		
MA or MS	3	60
MSW	1	20
BA (MS student)	1	20
Primary Theoretical Orientation		
Behavioral	1	20
Cognitive-Behavioral	1	20
Eclectic or Integrative	2	40
Unsure	1	20
Number of PCIT Cases Per Week		
One	2	40
Two	1	20
Four	1	20
Eight	1	20
Years of Experience with Children and Families		
One year, six months	1	20
Four	1	20
Six	1	20
Fourteen	1	20
Twenty-Eight	1	20
Years in Current Position		
Four months	1	20
Seven months	1	20
Two	1	20
Four years, six months	1	20
Twenty-Eight	1	20
PCIT Certification Status		
Completing Certification	2	40
Certified for Less Than 5 Years	1	20
Certified for 5 Years or More	2	40

```
                          ┌─────────────────────────┐
                          │       Mediator:         │
                          │  Percentage of Homework  │
                          │       Completed          │
                          └─────────────────────────┘
                         ↗                          ↘
┌─────────────────────────┐                  ┌─────────────────────────┐
│   Predictor Variables:  │                  │   Outcome Variables:    │
│ Treatment Condition (App vs. │  ─────────→ │ Number of Sessions to CDI │
│        No App)          │                  │      Completion         │
│  Pre- Treatment Readiness │                │   ECBI Change Scores    │
└─────────────────────────┘                  └─────────────────────────┘
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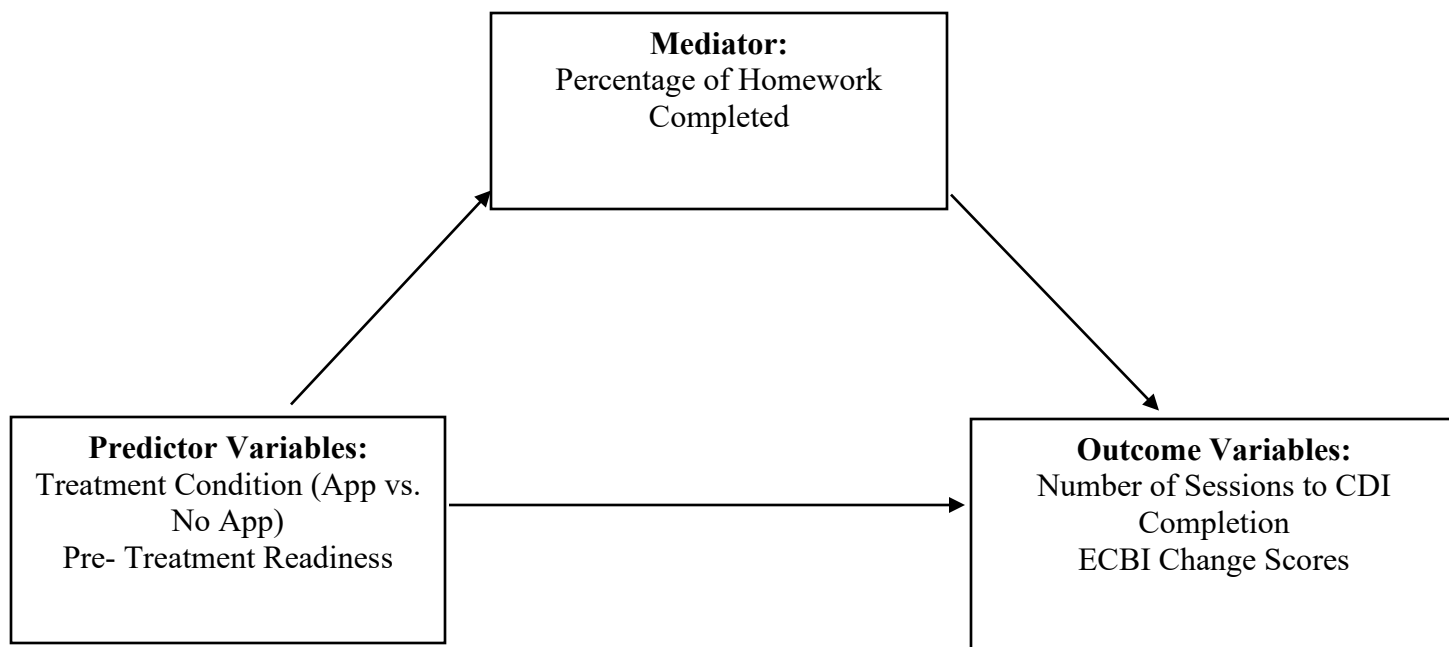
Figure 3. Conceptual model depicting the hypothesized role of homework completion as a

mediator of the relationships between treatment condition and pretreatment readiness and study

outcome variables.

Table 3

Descriptive Statistics

Variable	*M*	*SD*
Pretreatment Readiness	64.82	4.49
ECBI Intensity Pre CDI	146.21	30.70
ECBI Problem Pre CDI	19.25	7.17
ECBI Intensity Post CDI	128.57	45.26
ECBI Problem Post CDI	16.43	9.89
ECBI Intensity Change Score	17.64	27.72
Number of Sessions to CDI Mastery	5.79	1.53
Percentage of CDI Homework Completed	38.56	13.73
Client Satisfaction with App	18.37	4.31
Therapist Satisfaction with App	13.13	4.58

Note. Overall *N*=14, ECBI=Eyberg Child Behavior Inventory, CDI=Child Directed Interaction.

Table 4

Mean Comparisons Between Conditions

Variable	No App *M*/*SD*	App *M*/*SD*	*t*	df	*p*
Pretreatment Readiness	65.50/5.07	64.43/4.99	.34	9	.74
ECBI Intensity Pre CDI	153.00/36.07	141.13/27.42	.70	12	.50
ECBI Intensity Post CDI	127.17/58.45	129.63/36.89	-.10	12	.93
ECBI Intensity Change Score	25.83/28.02	11.50/27.66	.95	12	.36
Number of Sessions to CDI Mastery	5.33/1.37	6.13/1.64	-.96	12	.36
Percentage of CDI Homework Completed	35.66/20.13	40.73/6.92	-.67	12	.52
Total Positive Skills at Pre	4.67/4.97	3.25/1.83	.75	12	.47
Total Positive Skills at Post	38.67/4.13	37.50/5.61	.43	12	.68
Positive Skills Change Score	34.00/6.87	34.25/6.27	-.07	12	.95
Total Negative Skills at Pre	17.17/4.31	17.50/8.18	-.09	12	.93
Total Negative Skills at Post	1.17/1.47	1.25/1.04	-.13	12	.90
Negative Skills Change Score	16.00/3.79	16.25/8.66	-.07	12	.95

Note. Overall *N*=14, ECBI=Eyberg Child Behavior Inventory, CDI=Child Directed Interaction.

Table 5

Zero-Order Correlations

Variable	1	2	3	4	5	6	7	8	9
1.Family Income	-								
2.Parent Years of Education	.72*	-							
3.Number of Children	-.29	.10	-						
4.Therapist Years of Experience	.64*	.51	-.06	-					
5.Therapist PCIT Certification	.39	.50	.19	.58*	-				
6.Pretreatment Readiness	-.29	.31	.22	-.25	-	-			
7.ECBI Change Score	.47	.43	-.14	.44	-.24	-.24	-		
8.CDI Homework Completion Percentage	.50	.14	.17	.53	.22	-.17	.34	-	
9.Coach Sessions to CDI Mastery	-.25	-.02	.07	-.53	-.20	.40	-.42	-.40	-

*p<.05

Note. The correlation between therapist certification status and pretreatment readiness was unable to be computed given that the therapist was PCIT certified for the vast majority of the participants with usable READI-SF data. Overall *N*=14.
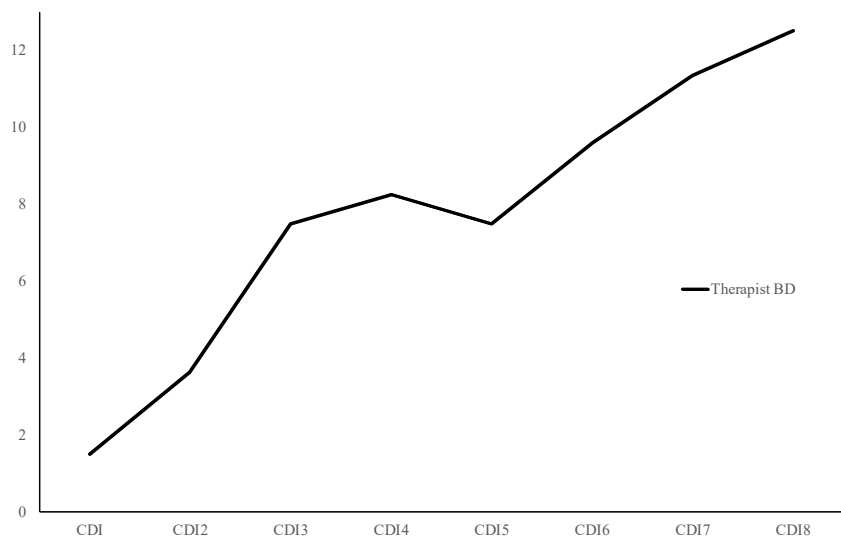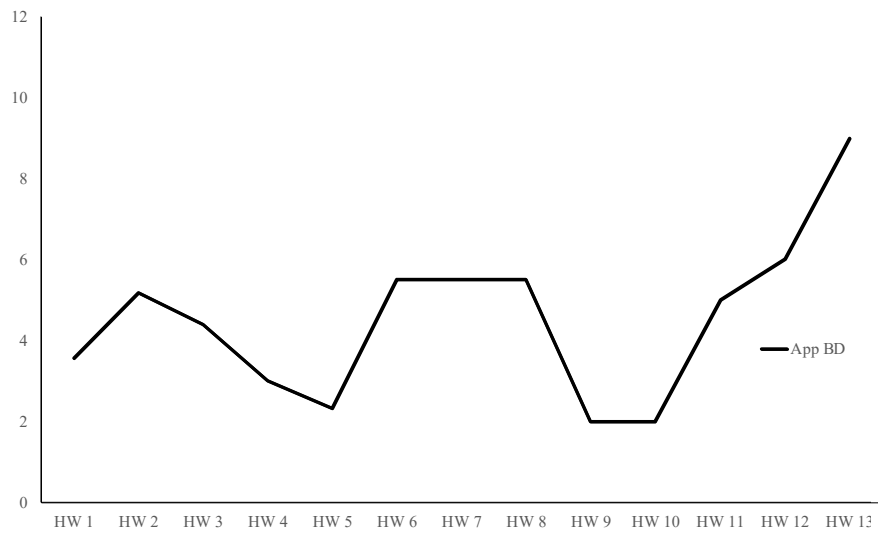
Figure 4. Graphs comparing average DPICS codes assigned for Behavior Descriptions by the app and therapist over time. $r(1)= -.76$, $p=.454$ for app and therapist codes at CDI Coach 1. $r(2)= -.58$, $p=.418$ for app and therapist codes at CDI Mastery.
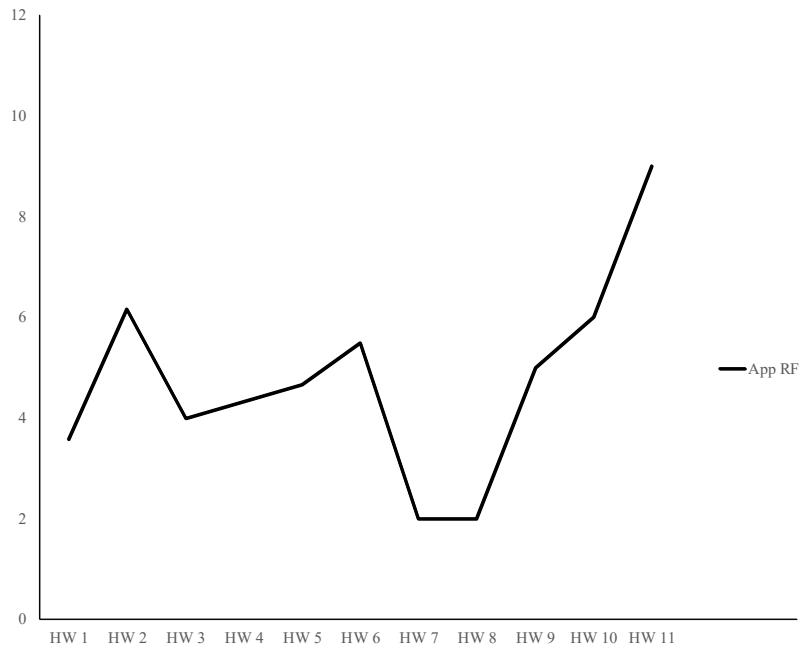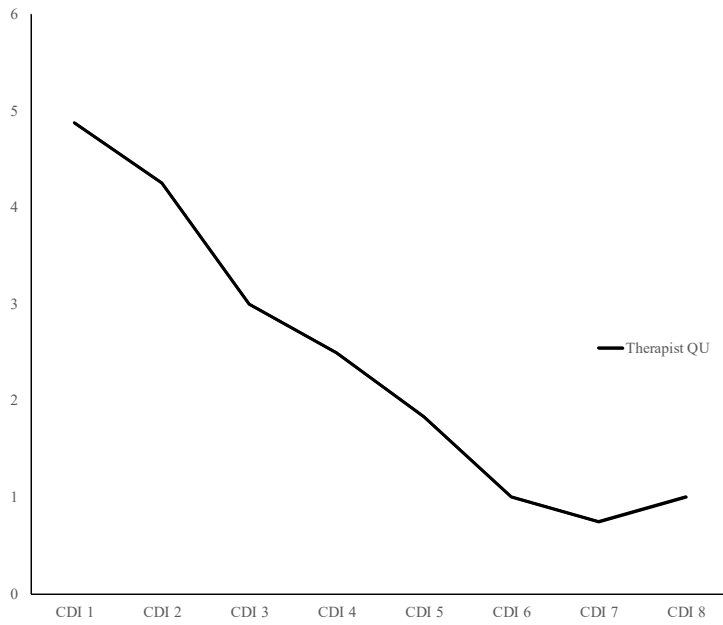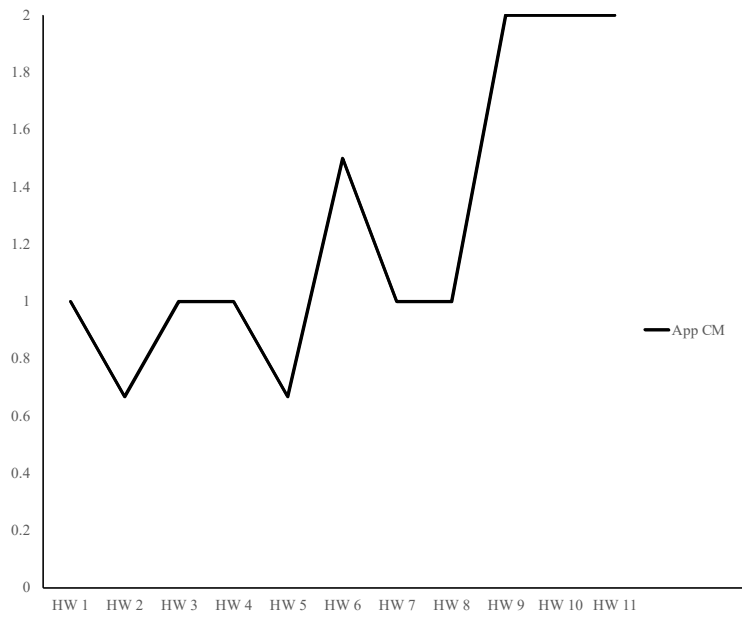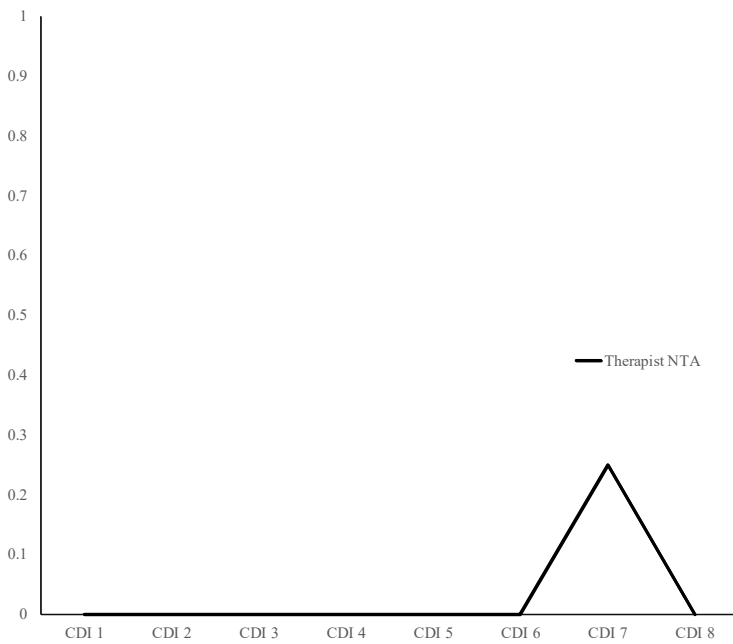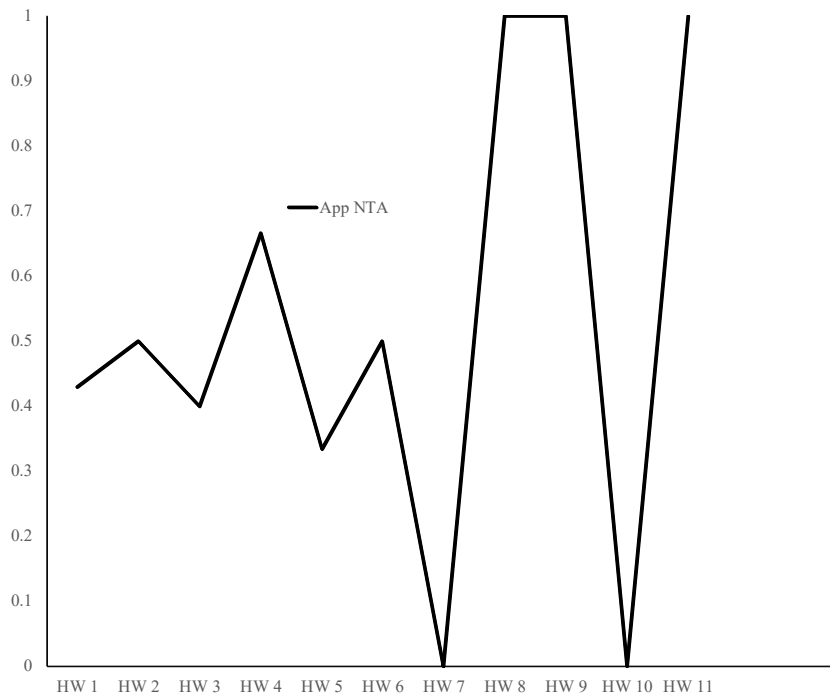
Figure 5. Graphs comparing average DPICS codes assigned for Reflections by the app and therapist over time. $r(1)= .72$, $p=.488$ for app and therapist codes at CDI Coach 1. $r(2)= .60$, $p=.400$ for app and therapist codes at CDI Mastery.
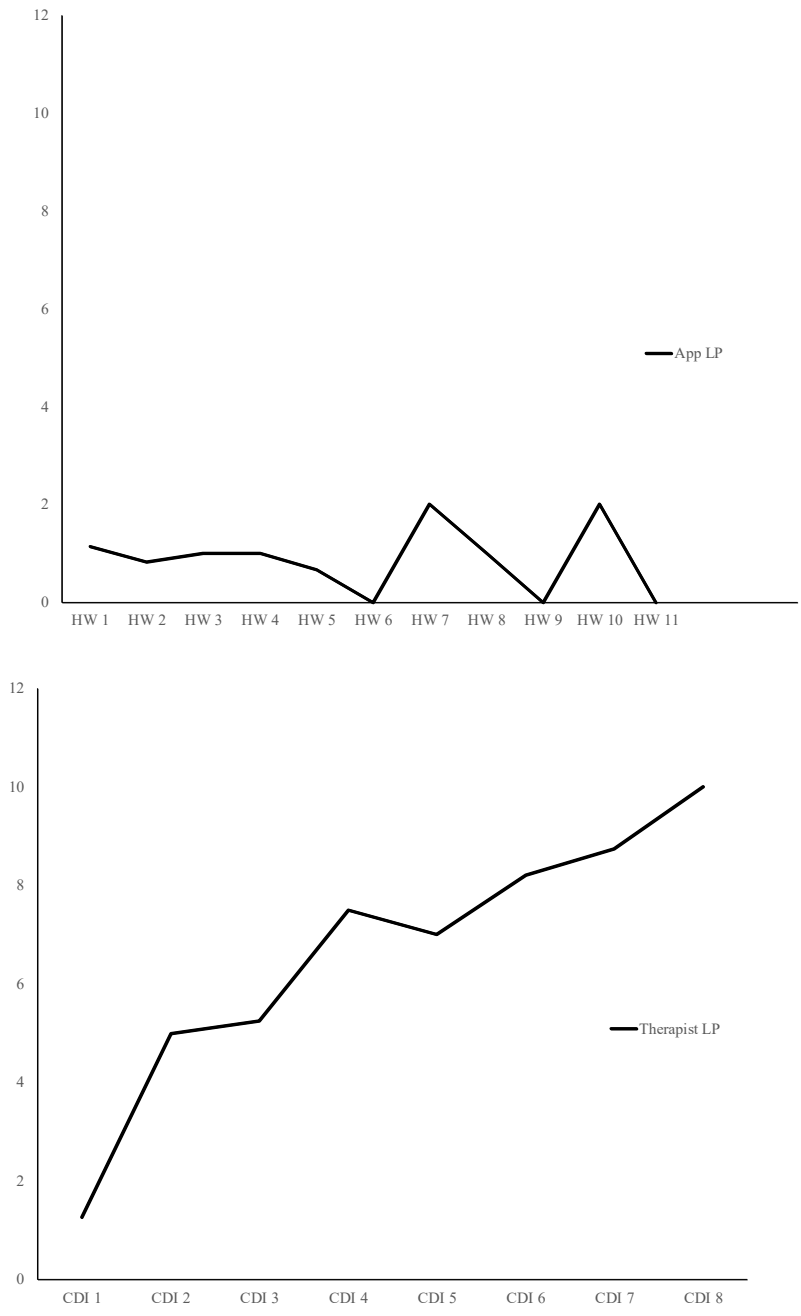
Figure 6. Graphs comparing average DPICS codes assigned for Labeled Praises by the app and therapist over time. $r(1)= -.50$, $p=.667$ for app and therapist codes at CDI Coach 1. $r(2)= .30$, $p=.698$ for app and therapist codes at CDI Mastery.

Figure 7. Graphs comparing average DPICS codes assigned for Questions by the app and therapist over time. *r*(1)= -.99, *p*=.106 for app and therapist codes at CDI Coach 1. *r*(2)= .30, *p*=.698 for app and therapist codes at CDI Mastery.

Figure 8. Graphs comparing average DPICS codes assigned for Commands by the app and therapist over time. $r(1)= -.76$, $p=.454$ for app and therapist codes at CDI Coach 1. $r(2) < .001$ for app and therapist codes at CDI Mastery.

Figure 9. Graphs comparing average DPICS codes assigned for Negative Talk by the app and therapist over time. Pearson correlations for app and therapist codes at CDI Coach 1 and CDI Mastery were unable to be computed due to the very low rate of occurrence of negative talk.

Table 6

Client and Therapist Satisfaction with the App

Item Content	Somewhat/Strongly Disagree	Neutral	Agree/Strongly Agree
PASS			
1.Easy to use	0%	12.5%	87.5%
2.Made HW time enjoyable	25%	75%	0%
3.Tracking was helpful	50%	25%	25%
4. Reminders were helpful	75%	12.5%	12.5%
5. Accountability to therapist was helpful	25%	62.5%	12.5%
6. App provided helpful feedback	62.5%	37.5%	0%
7.Satisfied overall	25%	62.5%	12.5%
TSS			
1.Easy for client to use	25%	12.5%	62.5%
2. Client enjoyed using app	50%	50%	0%
3. Ability to remotely track homework was helpful	62.5%	12.5%	25%
4. Reminders from app were helpful for client	50%	25%	25%
5. Satisfied overall	37.5%	37.5%	25%

Note. N for App Condition=8, PASS=PCIT App Satisfaction Survey, TSS=Therapist Satisfaction Survey.

Table 7

Pretreatment Readiness and Treatment Condition (App=1, No App=0) as Predictors of Study Outcomes

| Step	Homework Completion			CDI Completion Time			ECBI Change		
	b	*SE*	*β*	*b*	*SE*	*β*	*b*	*SE*	*β*
Step 1									
Constant	40.76***	4.62		5.73***	.45		18.64	8.61	
Readiness	-.52	1.01	-.17	.13	.10	.40	-1.37	1.88	-.24
Step 2									
Constant	39.55**	8.15		5.41***	.79		37.17*	12.80	
Readiness	-.50	1.08	-.16	.13	.10	.41	-1.72	1.69	-.30
Condition	1.91	10.24	.07	.50	.99	.16	-29.13	16.08	-.53
Step 3									
Constant	38.65**	8.36		5.42***	.85		35.24*	12.49	
Readiness	.81	1.88	.26	.12	.19	.36	1.12	2.81	.19
Condition	2.54	10.44	.09	.49	1.06	.16	-27.76	15.61	-.50
Readiness x Condition	-1.98	2.32	-.52	.03	.24	.07	-4.29	3.46	-.60

Note. Homework Completion Model: R^2=.029 for Step 1; ΔR^2 = .004 for Step 2 (*ns*); ΔR^2 = .091 for Step 3 (*ns*); CDI Completion Time Model: R^2 = .156 for Step 1; ΔR^2 = .026 for Step 2 (*ns*); ΔR^2 = .001 for Step 3 (*ns*); ECBI Change Model: R^2 = .056 for Step 1; ΔR^2 = .275 for Step 2 (*ns*); ΔR^2 = .121 for Step 3 (*ns*). N=12 for analyses examining pretreatment readiness.
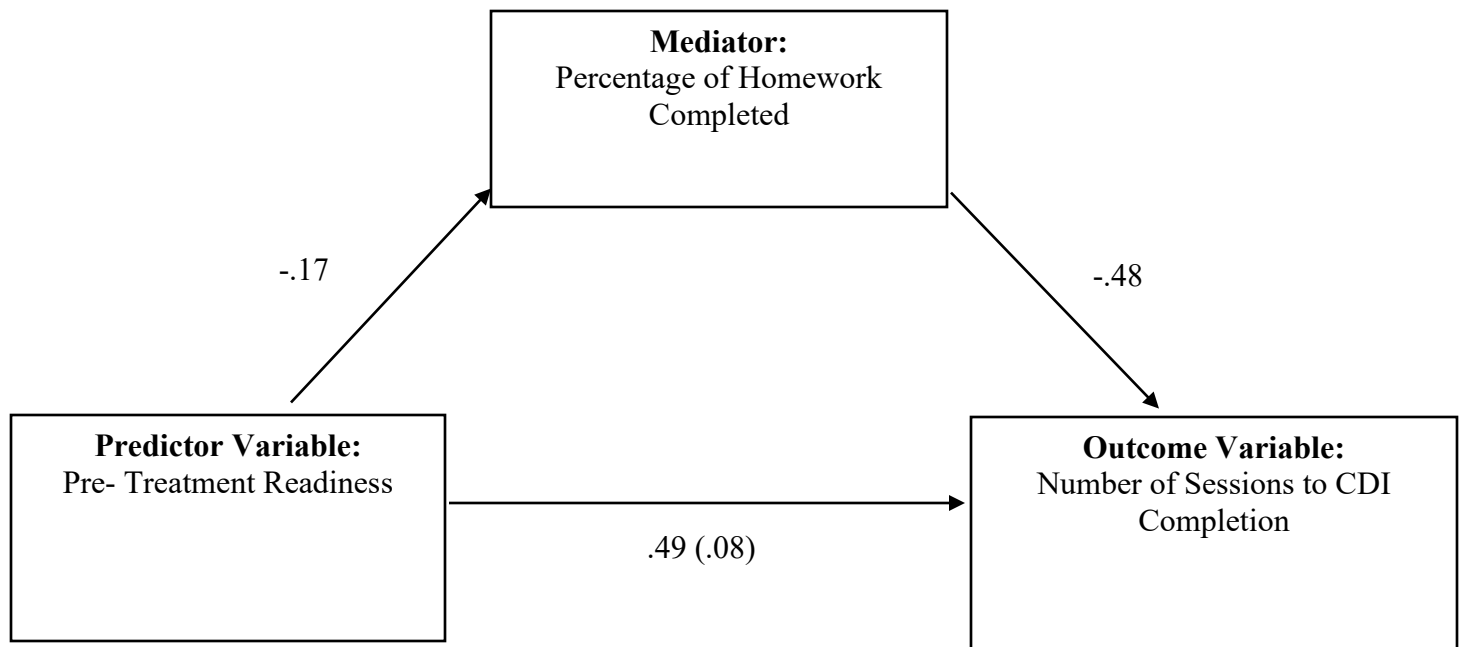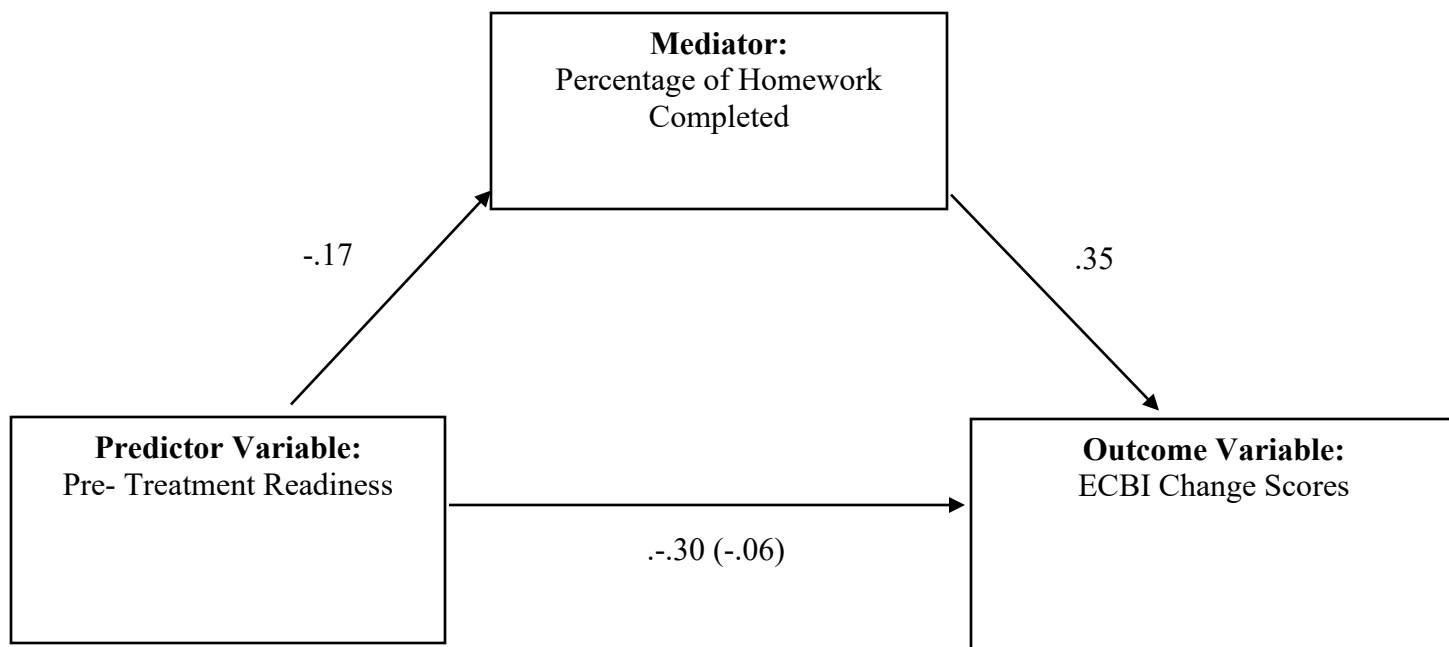
*p<.05 **p<.01 ***p<.001
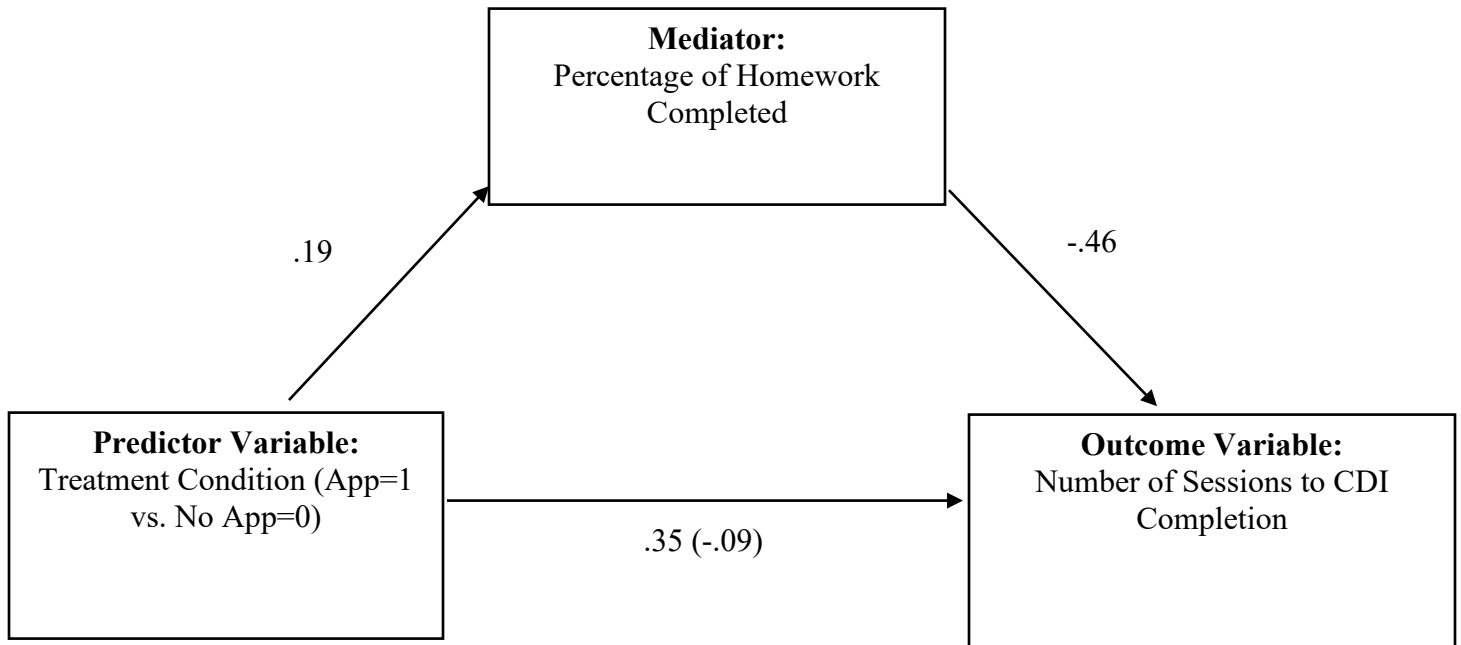
Figure 10. Results of mediational model testing the hypothesized role of homework completion as a partial mediator of the relationship between treatment condition and the number of sessions required to complete CDI. Path coefficients are standardized. The coefficient for the indirect effect is presented in parentheses. All effects were nonsignificant.
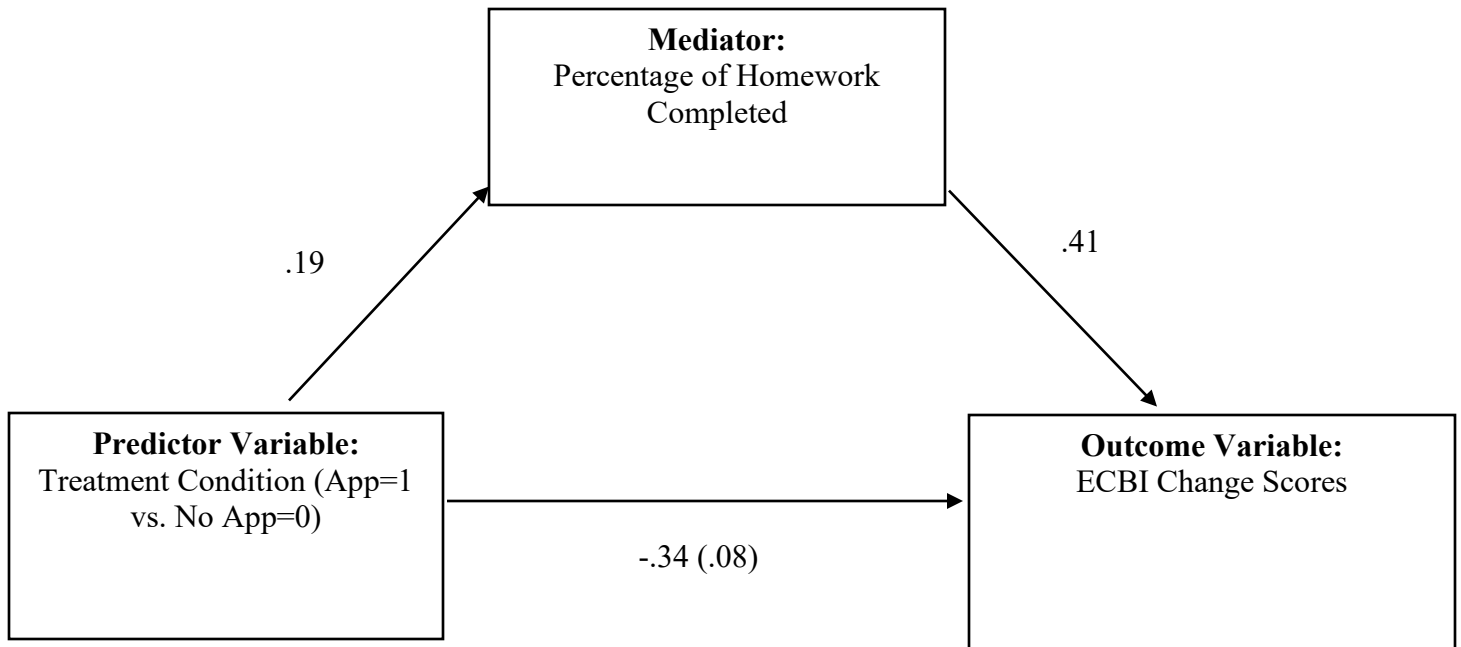
Figure 11. Results of mediational model testing the hypothesized role of homework completion as a partial mediator of the relationship between treatment condition and the change in parent-reported externalizing behavior problems. Path coefficients are standardized. The coefficient for the indirect effect is presented in parentheses. All effects were nonsignificant.

Figure 12. Results of mediational model testing the hypothesized role of homework completion as a partial mediator of the relationship between pretreatment readiness and the number of sessions required to complete CDI. Path coefficients are standardized. The coefficient for the indirect effect is presented in parentheses. All effects were nonsignificant.

Figure 13. Results of mediational model testing the hypothesized role of homework completion as a partial mediator of the relationship between pretreatment readiness and the change in parent-reported externalizing behavior problems. Path coefficients are standardized. The coefficient for the indirect effect is presented in parentheses. All effects were nonsignificant.

Appendix A

PCIT App Satisfaction Survey

Instructions: Please respond to the following items in reference to your experience with the Special Time app using the scale below. Circle **only one** number for each item.

1=Strongly Disagree **2**=Somewhat Disagree **3**=Neutral **4**=Somewhat Agree **5**=Strongly Agree

1. The Special Time app was easy to use.
        1   **2**   **3**   **4**   **5**

2. The Special Time app made homework time more enjoyable.

        1   **2**   **3**   **4**   **5**

3. The ability to track my homework completion was helpful.

        1   **2**   **3**   **4**   **5**

4. The reminders from the app helped me to remember to complete homework each day.

        1   **2**   **3**   **4**   **5**

5. The accountability to my therapist provided by the app was helpful.

        1   **2**   **3**   **4**   **5**

6. The Special Time app provided helpful feedback on my CDI skills.

        1   **2**   **3**   **4**   **5**

7. Overall, I was satisfied with the Special Time app.

        1   **2**   **3**   **4**   **5**

Please provide any additional feedback about the app here:

_____

_____

_____

_____

_____

Appendix B

Therapist Satisfaction Survey

Instructions: Please respond to the following items in reference to your experience using the Special Time app with this client using the scale below. Circle **only one** number for each item.

1=Strongly Disagree **2**=Somewhat Disagree **3**=Neutral **4**=Somewhat Agree **5**=Strongly Agree

1. The Special Time app was easy for this client to use.

> **1** **2** **3** **4** **5**

2. The client enjoyed using the Special Time homework app.

> **1** **2** **3** **4** **5**

3.The ability to track this client's homework completion remotely was helpful.

> **1** **2** **3** **4** **5**

4.The reminders from the app were helpful for this client.

> **1** **2** **3** **4** **5**

5.Overall, I was satisfied with the Special Time app as a tool for working with this client.

> **1** **2** **3** **4** **5**

Please provide any additional feedback about the app here:

_____
_____
_____
_____
_____