Pocket PCIT Online: A RE-AIM Open Trial for Young Children with Disruptive Behaviors

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Abstract

Background: Parent-Child Interaction Therapy (PCIT) is an evidence-based treatment for child disruptive behavior problems, but access barriers historically limit its reach.

Objective: This study examined Pocket PCIT Online, a self-directed web-based adaptation of PCIT, as a potential scalable public health intervention to increase accessibility.

Methods: In an open trial, 1,480 caregivers accessed the free Pocket PCIT Online intervention. Measures of child behavior, parenting stress, and family conflict were collected pre- and post-intervention. Effectiveness, engagement, retention, and implementation were assessed through an implementation science framework.

Results: Significant improvements were observed across all outcome measures for intervention completers (n= 204). Caregivers reported increased positive child behaviors (d= 0.87) and decreased parenting distress (d= -0.30). Of note, approximately 36% of caregivers reported clinically significant improvements in their children's frequency of disruptive behaviors. However, only 16.5% of participants completed post-intervention measures. No significant sociodemographic predictors of engagement or retention were identified.

Conclusions: While Pocket PCIT Online demonstrates potential as a low-cost, accessible and saleable public health intervention for child disruptive behaviors, strategies to enhance retention and reach historically underserved populations are needed. Strategies for improving engagement and retention are discussed.

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Keywords: Parent-Child Interaction Therapy (PCIT); Behavioral parent training; mHealth intervention; Child disruptive behavior; Online parenting program; RE-AIM framework; Intervention engagement

Introduction

Though mild disruptive behaviors— such as aggression, tantrums and noncompliance— are common in early childhood, clinically significant levels of these behaviors can increase the risk of impairment and child and family dysfunction [1]. In 2011, the estimated prevalence of significant disruptive behavior problems among children aged 3 to 17 in the United States was 3.5% [2]. By 2016, this figure increased to 7.4% [3]. If left untreated, disruptive behavior problems are associated with several suboptimal long-term outcomes, including future risk for academic challenges, conduct problems, adult psychiatric disorders, encounters with criminal justice, substance abuse disorders, occupational challenges, and housing instability [1,4-6].

To mitigate child disruptive behavior problems, several professional organizations, including the American Academy of Child and Adolescent Psychiatry and the American Academy of Pediatrics, recommend behavioral parent training (BPT) as the primary intervention [7-8]. BPT is widely regarded as a well-established and effective intervention for childhood disruptive behavior problems [9-10]. BPT programs, such as Incredible Years, Parent Management Training-Oregon Model, Triple P Positive Parenting, and Parent-Child Interaction Therapy (PCIT), share a theoretical basis in family systems theory, social learning theory, and operant conditioning [11-15]. These programs emphasize key strategies such as differential caregiver attention, effective delivery of commands, and consistent consequences for noncompliance, which are taught to caregivers using didactic instruction, modeling, and live coaching of caregivers with their children [16].

BPT programs have a strong track record of effectively reducing disruptive behaviors in children. Moderate improvements in child behavior have been shown even for families who complete a portion of BPT programs [17]. However, greater levels of engagement (e.g., attendance, homework completion) are associated with greater improvements across child and family outcomes, with families who complete treatment demonstrating the greatest benefit [17-18]. In addition to

reductions in disruptive behavior problems, BPT has been shown to improve other family-level outcomes, including parenting stress, parenting self-efficacy, family conflict, and the use of effective parenting strategies [19-21].

Access and Engagement

Despite the effectiveness of BPT programs, access to these interventions remains a significant challenge. Only about 10% of children in need of mental health services receive treatment [22]. Challenges related to access are compounded by high attrition rates, with more than 50% of those who initiate services discontinuing services before completion [23]. A meta-analysis on caregiver engagement in BPT reported a similar attrition rate of 51%, with even higher rates reported among ethnically minoritized families and families of lower socioeconomic status [24-25]. Multiple barriers contribute to limited access and high attrition, including knowledge of available services, financial barriers, lack/shortages of trained providers, and lengthy waitlists [26-29]. Additional logistical barriers, such as childcare, transportation, scheduling conflicts, and competing family stressors, further hinder engagement [19, 30-31].

The Potential of Technology: Online Parenting Programs

The potential of technology to address BPT access and engagement has gained significant research attention over the past decade. Several meta-analyses have shown that mobile health (mHealth) BPT effectively reduces child behavior problems, with effect sizes ranging from small to moderate [32-34]. Additionally, these interventions have been shown to positively impact caregiver use of positive parenting skills, parenting self-efficacy, parenting stress, and parenting knowledge [33, 35-36]. Further, a qualitative study revealed that 70% of caregivers who discontinued BPT expressed interest in hybrid services, such as internet-facilitated BPT, to reduce barriers [37].

Despite the benefits of mHealth BPT programs at the child and family levels, there is a lack of consensus regarding the optimal delivery format (e.g., benefits of additional consultation) and the

specific populations for whom mHealth BPT may be most beneficial, given variations in effectiveness based on socioeconomic factors (e.g., caregivers with higher education and income levels reporting larger reductions in child disruptive behaviors) [38]. No differences in behavioral outcomes have been found across mHealth BPT programs serving racially minoritized families compared to programs serving predominantly White families [39].

Maintaining engagement with mHealth BPT remains a challenge [40]. Research examining the sociodemographic characteristics of families who have accessed mHealth BPT programs has yielded mixed findings regarding engagement. Notably, caregiver race, ethnicity, and income level generally do not predict program completion or retention [41]. However, caregiver factors such as higher parenting self-efficacy, greater internet usage, and fewer depressive symptoms at baseline are associated with greater engagement in mHealth BPT [41-42]. Additionally, lower ratings of child behavior problems at baseline have been associated with higher engagement and completion rates [43]. Qualitatively, caregivers report that time constraints, technical difficulties (e.g., internet connectivity), and registration requirements (i.e., providing an email, pretest measures) contribute to discontinuing mHealth BPT programs [44].

Advancing and Evaluating mHealth BPT

Despite strong evidence for mHealth BPT, several critical challenges remain unaddressed in this field. While initial findings highlight the efficacy of these programs, challenges include the identification of optimal program delivery formats, the pinpointing of specific populations who may derive the greatest benefit from these interventions, and the persistent difficulty of sustaining caregiver engagement with online content. To more fully understand the broader impact and potential of mHealth BPT programs, it is crucial to examine them through a more comprehensive implementation science lens. The RE-AIM (*Reach, Effectiveness, Adoption, Implementation, and Maintenance*) framework, a tool used to evaluate public health interventions and programs, offers a

valuable approach for this purpose [45].

Very few mHealth BPT programs have been examined through a RE-AIM lens [46]. A RE-AIM framework provides researchers and practitioners with a more holistic view of mHealth BPT, addressing not just their efficacy, but also their practical implementation and long-term viability. This approach could inform strategies to overcome engagement and retention challenges, ultimately enhancing the population-level scaling of mHealth BPT programs. Measurement of the *Reach* domain provides important information regarding the extent to which mHealth BPT programs are reaching their intended audience. Given mHealth BPT engagement challenges, analyzing *Reach* could reveal whether certain sociodemographic characteristics of families are underrepresented relative to the general population, and could inform future strategies to improve access. While existing literature supports the effectiveness of mHealth BPT, the RE-AIM approach encourages a more nuanced examination of *Effectiveness*, including assessing who the intervention works best for and the potential heterogeneity of outcomes across different subgroups. Evaluating *Adoption* rates among caregivers could illuminate facilitators and barriers to engagement in mHealth BPT programs, which is crucial for scaling up effective interventions. Given retention challenges in mHealth BPT interventions, examining *Implementation* factors such as caregiver fidelity to mHealth BPT intervention models (e.g., homework completion) may provide valuable insights into factors affecting participant engagement. Finally, when feasible, assessment of long-term outcomes and program sustainability or *Maintenance* is critical for understanding the lasting impact of mHealth BPT programs. Evaluation of these factors through a RE-AIM framework is essential for bridging the gap between the proven effectiveness of mHealth BPT interventions and their successful implementation in diverse real-world contexts.

Given the need for a more holistic evaluation of mHealth BPT, the present study aimed to examine an mHealth version of PCIT through a RE-AIM framework lens. Building on the success of a PCIT-related multimedia book [47], the content was adapted and expanded into a web-based

platform. By adapting PCIT to a mobile platform (Pocket PCIT Online) and systematically evaluating it using RE-AIM, we sought to provide a comprehensive understanding of its potential for widespread implementation and impact. Specifically, we sought to examine: the sociodemographic characteristics of those who accessed Pocket PCIT Online (Reach), the extent that completion of the intervention positively impacted family outcomes (Effectiveness), engagement rates and predictors of engagement and retention in Pocket PCIT Online (Adoption), and caregiver fidelity to the model and ongoing costs of maintaining the website (Implementation). Maintenance was not evaluated in this open trial. This multifaceted investigation will not only advance our understanding of the complex interplay between Pocket PCIT Online characteristics and outcomes, it will also inform the future design of more targeted and efficient mHealth BPT that are personalized to the needs and preferences of diverse families.

Method

Participants

Participating caregivers (*N*=1,480) enrolled in the Pocket PCIT Online open trial from 7/1/2019 to 6/30/2024. Pocket PCIT Online was advertised on a national parenting website related to PCIT (PCIT.org) and to English speaking families at a local PCIT clinic when they were being placed on a waitlist for services. Pocket PCIT Online content was freely available to any caregivers with children ages 2-7 years who completed informed consent for this study. Demographic information was collected through an online database management system, REDCap,[48] wherein caregivers self-selected responses. For additional demographic characteristics, see Table 1. Study inclusion criteria consisted of (a) being the caregiver of a child between the ages of 2 and 7 years, (b) being fluent in English (as text and videos were only available in English for pilot trial), and (c) expressing caregiver concerns about their children's disruptive behaviors. Institutional Review Board (IRB) approval was obtained from the university and all participants who agreed to be in the study

signed an informed consent. All study procedures were conducted in accordance with the ethical standards of the IRB.

Pocket PCIT Online Intervention

Pocket PCIT Online is a brief, self-directed web-based adaptation of Parent-Child Interaction Therapy, developed to increase accessibility of evidence-based parenting strategies [14, 49-51]. Building on the Pocket PCIT eBook's success [47], this four-week intervention mirrors PCIT's Child-Directed Interaction (CDI) and Parent-Directed Interaction (PDI) phases. It offers multimedia content teaching positive parenting skills, effective discipline, and applied PCIT principles [52-55]. Key features include: on-demand access, multimedia education on PCIT skills, flexible navigation of parenting topics, daily skill practice guidance, and written content at a 7th-grade reading level. Unlike traditional PCIT, Pocket PCIT does not include guided practice and uses a return-to-chair procedure instead of time-out room as a back-up to the time out chair [56]. Website content is only in English, with efforts made to incorporate diverse family representation, although the clinicians featured are primarily non-Hispanic White.

Procedures

Caregivers completed pre-intervention measures including: sociodemographic information, caregiver reports of parenting stress, family conflict, and their children’s disruptive behaviors. Caregivers were then provided with instructions on how to access and use Pocket PCIT Online. Caregivers were provided the lead investigator’s contact information if they experienced technical difficulties accessing the website. Following pre-assessments, caregivers received a weekly email reminder (for three weeks) to practice their Pocket PCIT Online skills during daily special time practice with their child. Each week, caregivers reported the number of days they practiced these skills with their child during special time. Following four weeks of Pocket PCIT Online use, caregivers were again asked to rate their parenting stress, level of family conflict, their children’s

disruptive behaviors, and complete a satisfaction questionnaire about the intervention.

Of the 1,480 families enrolled, 1,234 (83.4%) completed a pre-intervention assessment. Of those who completed the initial assessment, 204 (16.5%) caregivers also completed a post-intervention assessment. Beyond caregiver reports and characteristics, Pocket PCIT Online website utilization and costs were tracked during the study period.

Measures

Reach Measures

Sociodemographic Questionnaire

Information about the family (e.g., caregiver role, gender, race, ethnicity, education level, income, language) was collected.

Pocket PCIT Online Access

Intervention access was measured as the percentage of caregivers who completed pre-intervention measures relative to the total number of caregivers who registered to use the Pocket PCIT Online website. A link to access Pocket PCIT Online was provided to participants when they completed the informed consent.

Effectiveness Measures

Weekly-Assessment of Child Behavior Inventory- Positive (WACB-P)

The WACB-P measured caregiver reports of the frequency that their children engaged in positive child behaviors, and the number of types of behaviors they would like to change in their child.[57] This instrument is a brief, 9-item caregiver-report measure designed to assess changes in children's positive behaviors on a weekly basis. Caregivers rate each item on a Likert scale, ranging from 1-7, reflecting the frequency of these behaviors over the past week. Higher scores indicate a

greater frequency of positive child behaviors; total scores below 37 are considered clinically significant [57]. Caregivers also rate the number of the nine listed behaviors that they would like to change in their child (range from 0 to 9). Higher scores represent a greater number of total behavior problems. The WACB-P has previously demonstrated strong convergent validity with the Eyberg Child Behavior Inventory [58], the standard measure for intensity and number of child disruptive behaviors [57]. The WACB-P within the current study demonstrated good internal consistency (Cronbach's α = .84) and test-retest reliability (r = .63, P < .001).

The Parenting Stress Index Short-Form: Fourth Edition (PSI-SF-4) Parental Distress

This subscale was employed to assess caregivers' stress levels related to their parenting role and is part of the broader PSI-SF-4, a widely used and validated measure in child and family research [59]. The Parental Distress subscale consists of 12 items that evaluate the distress a caregiver experiences due to personal factors directly related to parenting. Caregivers respond to each item on a 5-point Likert scale. Higher scores indicate higher levels of parenting-related distress. Within the current sample, the subscale demonstrated good internal consistency (Cronbach's α = .88) and test-retest reliability (r = .69, P < .001).

Family Conflict Scale

Family conflict was measured using the 5-item family conflict subscale of Bloom’s Family Processes Scale [60]. Participants rated the extent to which they agreed that a statement reflected their family life over the past month using a five-point response scale, with higher scores reflecting higher family conflict over the past month. This subscale was found to have adequate validity and internal reliability in previous studies [60]. In the present study, internal consistency was adequate (Cronbach's α = .73).

Adoption Measures

Any Pocket PCIT Online Engagement

Caregivers were rated as engaging in Pocket PCIT Online if they reported completion of homework practice at least once during the intervention (1= engaged, 0= did not engage).

Pocket PCIT Online Retention

Caregivers who completed post-intervention measures were listed as study completers (1= completed; 0= did not complete).

Adapted Therapy Attitude Inventory (TAI)

Caregiver attitudes toward Pocket PCIT Online were assessed using an adapted version of the TAI [61]. The original TAI is a 10-item self-report questionnaire that measures caregiver satisfaction with parenting programs. It uses a 5-point Likert scale, with higher scores indicating greater satisfaction or agreement with the statement. For this study, the TAI was modified to capture satisfaction specific to the Pocket PCIT Online experience. The adapted TAI within the current sample demonstrated excellent internal consistency ($\alpha = 0.90$). For the current study, individual item descriptive statistics were examined to explore specific elements of Pocket PCIT Online which may impact its adoption.

Pocket PCIT Webpage and YouTube Metrics. Due to the web platform's tracking limitations, individual user metrics for Pocket PCIT Online were not available. Instead, to gauge overall engagement, we relied on aggregate data. Specifically, we monitored total web page views for Pocket PCIT throughout the study period, providing a general indication of website utilization regardless of study measure completion. Additionally, we tracked the total watch time of embedded Pocket PCIT YouTube videos on the website during the study timeframe. These aggregate measures, while not user-specific, offered insights into the general Pocket PCIT usage.

Implementation Measures

CDI and PDI Homework Completion

The homework completion measure used in this study assessed caregivers' reported adherence to daily CDI and/or PDI skills practice, as recommended by the PCIT protocol [14]. During the four-week mHealth intervention, caregivers were asked weekly to report the frequency with which they practiced CDI and PDI skills [62].

Pocket PCIT Online Ongoing Operational Costs

Understanding the implementation cost is essential for organizations considering adopting and sustaining the program. Therefore, we measured the cost of hosting Pocket PCIT Online over the study period. The cost of the website platform and domain name from 2019 to 2024 was $1,895.

Data Analytic Plan

Descriptive statistics, correlation, *t* test, and one way ANOVA analyses were completed in SPSS 29.0. All regression analyses were conducted within Mplus 8.10.

Reach analyses included descriptive statistics which were calculated for all sociodemographic variables. Effectiveness analyses included paired sample *t* tests that were conducted to examine pre-post changes in child disruptive behaviors, parental distress, and family conflict and the magnitude of changes. To examine the extent that different sociodemographic characteristics and caregiver factors impacted changes in outcome variables, bivariate correlations were conducted and any variable that was correlated with post outcome scores were included in multiple linear regression analyses. To examine predictors of post-intervention family conflict, we conducted multiple regression analyses. We used robust maximum likelihood estimation (MLR) to account for potential non-normality in the data. Missing data were handled using full information maximum likelihood (FIML), as indicated by the TYPE = MISSING command. This approach allowed for the inclusion of all available data,

potentially reducing bias and increasing statistical power compared to listwise deletion [63].

For measuring adoption, within SPSS 29.0, Chi square analyses were calculated to determine if there were any sociodemographic differences between caregivers who completed Pocket PCIT Online and those lost to follow-up. Further, one-way ANOVAs were conducted to evaluate whether pre-intervention caregiver ratings of child disruptive behavior and parental distress were related to Pocket PCIT Online completion. Preliminary correlations were conducted to examine the extent that dummy coded sociodemographic variables and caregiver predictor variables were correlated with engagement in Pocket PCIT Online; total CDI and PDI homework completion; and Pocket PCIT Online completion; see Supplementary table). Only variables or categories of dummy-coded variables (e.g., income) were included in regression analyses if they were correlated with outcome variables. Logistic regression was utilized to examine the extent that sociodemographic variables and pre-intervention parental distress and caregiver reported child disruptive behaviors predicted Pocket PCIT Online engagement and/or completion. Two logistic regression analyses were conducted to examine factors potentially associated with engagement in Pocket PCIT Online and completion of PCIT.

For implementation, linear regression analyses were also conducted to examine the extent that sociodemographic characteristics (dummy coded for the analysis) and pre-intervention caregiver parental distress and caregiver-reported child disruptive behaviors predicted CDI and PDI homework completion. Finally, costs per caregiver were calculated by total participants, total study completers, and clinical responders by dividing each sample size by the website implementation cost.

Results

Reach

Sociodemographic and family characteristics

In examining the study sample population (Table 1) relative to the general US population of

caregivers of children ages 2-7 years old descriptively, several differences emerged. Educational attainment in the sample was markedly higher than national averages, with 76.9% of caregivers holding a bachelor's degree or higher, compared to approximately 32.1% in the general US adult population. This finding was mirrored in household income, where 65.3% of the sample reports earnings at or above the national median (i.e., $74,580 US median income) [64]. Racial and ethnic composition of the sample also differed from national demographics, with 66.9% of the sample identifying as non-Hispanic White, and Hispanic representation at 18.2%, slightly below national averages. On average, caregivers who enrolled in Pocket PCIT Online reported clinically elevated child disruptive behaviors and within normal limits levels of parental distress (See Table 1).

Access

1,480 caregivers initially accessed Pocket PCIT Online. However, 246 caregivers (16.6%) did not complete pre-intervention measures and were subsequently lost to follow-up. Therefore, sociodemographic characteristics could not be calculated.

Effectiveness

Significant improvements were observed across all measures from pre- to post-intervention (See Table 2). Caregiver reports of the frequency that their child demonstrated positive behaviors (WACB-P Frequency) showed a substantial increase from pre- to post-Pocket PCIT Online completion, t (203) = 12.49, P <.001, d = .87. Statistically significant reductions from pre- to post-intervention completion were also observed in the number of behaviors caregivers wanted to change in their child, t(203) = -6.01, P <.001, d = -.42; parental distress, t(203) = -4.27, P <.001, d = -.30; and caregiver reported family conflict, t(203) = -4.91, P <.001, d = -.35.

Several linear regression analyses were conducted to determine if family factors impacted the extent that Pocket PCIT Online impacted child disruptive behavior, parental distress, and family conflict (See Table 3). A linear regression analysis was conducted to examine the predictors of post-

intervention caregiver report of child disruptive behaviors, controlling for pre-intervention scores and various demographic factors. The model explained 58% of the variance in post-intervention behavior problems ($R^2 = 0.58$, $P < 0.001$). Pre-intervention frequency of child positive behaviors significantly predicted post-intervention positive behaviors, indicating that higher initial positive behaviors were associated with higher post-intervention positive behaviors. Higher rates of pre-intervention parental distress was also predictive of higher post-intervention child positive behaviors. However, while other variables were held constant, family conflict, caregiver race, and caregiver education level were not significant predictors of post-intervention child positive behaviors.

A linear regression analysis was also conducted to examine the predictors of post-intervention parental distress, controlling for pre-intervention scores and various demographic factors. The model explained 51% of the variance in post-intervention parental distress ($R^2 = 0.51$, $P < 0.001$; See Table 3). Pre-intervention parental distress was the only significant predictor of post-intervention distress, indicating that higher initial distress was associated with higher post-intervention distress.

To examine predictors of post-intervention family conflict, a linear regression analysis controlling for pre-intervention scores and demographic factors was conducted. The model explained 28% of the variance in post-intervention family conflict ($R^2 = 0.28$, $P < 0.001$; see Table 3). Pre-intervention family conflict emerged as the only significant predictor of post-intervention conflict, indicating that higher initial conflict was associated with higher post-intervention conflict.

Finally, caregivers reported varying degrees of clinical change in their children's frequency of disruptive behaviors over one month. The largest proportion of caregivers (41.7%) reported no changes in their children's disruptive behaviors. However, 35.8% of caregivers reported clinically significant improvements in their children’s disruptive behaviors. Additionally, 21.6% indicated that their children's behaviors remained within normal limits. Only 1.0% of caregivers reported a clinically significant increase in child disruptive behaviors.

Adoption

Any Engagement and Completion

Among caregivers who completed pre-intervention measures, 31.8% reported engaging in CDI or PDI homework during the four-week Pocket PCIT Online intervention and 16.5% of caregivers completed the intervention.

Engagement in Pocket PCIT Online

A logistic regression model was used to explore predictors of engagement in Pocket PCIT Online, including child age, child gender, and caregiver education. Only variables that correlated with engagement were included in the model. The overall model was not statistically significant (McFadden's R^2 = .16, P = .33), indicating that these factors, collectively, did not reliably distinguish between those who engaged in Pocket PCIT Online and those who did not. Examining individual predictors, neither child age (OR = 0.56, 95% CI [0.50, 3.20], P = .51) nor child gender (female: OR = 0.74, 95% CI [0.23, 2.37], P = .62) were related with engagement. Caregiver education level (bachelor's degree or higher) approached statistical significance (OR = 1.00, 95% CI [0.99, 1.00], P = .06).

A second logistic regression model was employed to explore potential predictors of PCIT completion, using child race: American Indian/Alaska Native (significant correlation with completion variable) and income (above US household median income) as predictors. This model also failed to reach statistical significance (McFadden's R^2 = .01, P = .44), explaining only 1% of the variance in PCIT completion. Within this model, neither child race (American Indian/Alaska Native: OR = 0.77, 95% CI [0.42, 1.41], P = .40) nor income level (above median: OR = 1.33, 95% CI [0.87, 2.04], P = .19) were predictors of Pocket PCIT completion.

CDI and PDI Homework Engagement

A linear regression model was employed to examine potential predictors of rate of CDI homework completion in the Pocket PCIT Online Program. The model included pre-intervention family conflict and child race (White and Asian categories). The overall model was not statistically significant (R^2 = 0.07, P = .200), and none of the individual predictors were statistically significant [i.e., pre-treatment family conflict (β = 0.16); child race White (β = 0.18), and child race Asian (β = 0.03)] indicating that the included variables did not reliably predict CDI homework completion rates. A separate linear regression model was used to predict PDI homework completion. This model included pre-intervention parental distress, pre-treatment family conflict, caregiver education (bachelor's degree or higher), and household income relative to the US median. Like the CDI model, this overall model for PDI homework completion was not statistically significant (R^2 = 0.06, P = .418), explaining only 6% of the variance in PDI homework completion. In this model, the individual predictor effects of pre-intervention parental distress (β = 0.08), pre-intervention family conflict (β = 0.09), caregiver education at the bachelor's degree level or higher (β = -.07), and household income above the US median (β = 0.04) were not statistically significant.

Pocket PCIT Caregiver Attitudes

Caregiver attitudes toward the Pocket PCIT Online intervention as measured by the TAI, were generally positive across multiple domains (see Table 4).

Pocket PCIT Webpage and YouTube Metrics

Given that the web platform could not measure individual user website usage, overall Pocket PCIT page views and Pocket PCIT YouTube metrics are reported as a general estimate of overall engagement over the study period (June 1, 2019-June 30, 2024). Pages within PocketPCIT.com were viewed a total of 32,063 times during the study period. Within Pocket PCIT Online, there were 93 instructional and demonstration videos related to CDI and PDI. Overall, videos were viewed a total

of 121,777 times for a total viewing time of 3,694.88 hours. This indicates that while only 204 caregivers formally completed Pocket PCIT post intervention measures, it is likely that a significantly higher rate of user engagement of the web platform was not captured via pre-post measure collection.

Implementation

CDI and PDI Homework Completion

Homework completion rates (n = 174) revealed varying levels of engagement across the 4-week intervention period. For CDI homework, caregivers completed tasks on average 50.11% of the days (M = 14.03 days, SD = 6.91). PDI homework showed lower completion rates, with caregivers engaging on average 32.07% of the days (M = 8.98 days, SD = 8.50). The higher mean and lower standard deviation for CDI homework suggest more consistent completion compared to PDI homework. These findings may reflect the sequential nature of how the Pocket PCIT Online program is presented to users, with CDI skills presented first, serving as a foundation for later PDI skill development, which is presented in later sections of the website.

Website Implementation Costs

While initial development of a mHealth BPT can be costly, the relative cost of maintaining a web-based platform is relatively low. Website hosting and domain hosting costs during the study period cost a total of $1,895. If only study completers (N= 204) were included in the cost per participant, the cost of web hosting per participant would only be $9.29 per caregiver. The costs become much lower ($1.28 per caregiver) when considering the total number of participants who accessed Pocket PCIT Online (N= 1,480). Moreover, given that 35.8% of study completers (N = 72) reported that their child reported clinically significant improvements in their disruptive behavior, that means that it took only $26.32 for this intervention to significantly improve one child’s disruptive

behavior. That estimate is also assuming that none of the study non-completers experienced clinically significant improvements in their disruptive behavior and is therefore likely a conservative overestimate of the cost to clinically improve one child's disruptive behavior.

Discussion

This RE-AIM trial evaluated Pocket PCIT Online, a self-directed web-based adaptation of PCIT. This study extends prior mHealth BPT research by providing insights into the reach, effectiveness, adoption, and implementation of this mHealth BPT program. By examining the results through this comprehensive framework, researchers and developers can gain valuable knowledge that can be applied to enhance the accessibility, impact, uptake, and successful execution of other mHealth BPT programs.

Reach.

The sociodemographic characteristics of our sample reveal significant disparities in the reach of Pocket PCIT Online, with an overrepresentation of highly educated, high-income, non-Hispanic White caregivers. These sociodemographic characteristics of the caregivers represented in the study limits the generalizability of our findings and highlights the need for targeted strategies to enhance the intervention's accessibility for under-resourced and historically underserved populations. Because it was not known if or how Pocket PCIT Online would work, the investigators were conservative with their recruitment approaches (e.g., national parenting website, families on a waitlist for actual PCIT services). To address these disparities, we propose several approaches. First, partnering with community organizations and healthcare providers in underserved areas could improve recruitment of historically underserved communities.[64] Further, advertising this parenting resource beyond just one website may significantly increase who accesses Pocket PCIT Online, including advertising within pediatrician offices, childcare settings, federally funded nutrition programs, faith-based organizations, and social media parenting groups [65]. By enhancing reach to underserved

populations, Pocket PCIT Online could potentially more effectively serve as a public health intervention.

Effectiveness.

This 4-week open trial of Pocket PCIT Online was associated with improvements across all measured family outcomes. While the lack of a control group limits causal inferences, these preliminary findings suggest that the intervention may hold promise for families of children with disruptive behaviors. The observed improvements align with previous mHealth BPT research [32-33, 35, 38] and the magnitude of change in child disruptive behaviors exceeds what might be expected from natural recovery alone within one month [66]. Of note, approximately 36% of caregivers reported clinically significant reductions in their children's disruptive behaviors. These findings are encouraging for Pocket PCIT Online as a potential scalable public health intervention, because of the low cost and limited human support required to maintain the intervention over time. While Pocket PCIT Online shows promising initial effectiveness, enhancements in reach, adoption, and implementation are needed to strengthen its potential to broadly impact child behavioral health.

Adoption and Implementation

Caregiver adoption of Pocket PCIT Online presents both encouraging aspects and significant challenges. Engagement in the intervention was relatively low. Interestingly, no sociodemographic or family factors predicted engagement, CDI or PDI homework completion, or study retention. The absence of significant predictors for adoption is somewhat encouraging as it suggests that the foundational elements of Pocket PCIT Online are broadly applicable and manageable for caregivers. However, the impact of other important aspects of engagement including relationships (e.g., no human support), expectancy (e.g., Pocket PCIT will be helpful), and clarity (e.g., understanding of PCIT approach and caregiver skill implementation) was not measured in the current study [67].

Perhaps the most striking challenge of Pocket PCIT Online is the high attrition rate, with only

16.5% of caregivers completing the full intervention. This low retention rate is concerning and warrants further investigation into the factors contributing to discontinuing the intervention. The discrepancy between formal completion rates and overall engagement metrics (page views and video watch time) indicates that many caregivers may be interacting with the content without completing all formal assessments. This highlights a limitation in our ability to fully capture user engagement and suggests that the intervention may have a broader reach than initially apparent from completion rates alone. Future iterations might consider incorporating more robust user tracking and reminders,[34] providing incentives for assessment completion, and/or offering strategies (e.g., asynchronous health coach, gamification of intervention features, peer support forums) that have been shown to increase mHealth intervention engagement [41, 68-70].

Despite engagement and retention challenges, caregiver attitudes towards Pocket PCIT Online were generally positive. Participants who completed Pocket PCIT Online reported high satisfaction, perceived improvements in child behavior and the parent-child relationship, and increased confidence in parenting skills. These positive attitudes are encouraging and suggest that Pocket PCIT Online is generally well-received and perceived as beneficial.

As it relates to implementation, the total web hosting cost for families who reported clinically significant improvements (approximately 36%) in their child's disruptive behavior was only $26.32 per family. This low cost is notable, given that even the most affordable child psychotherapy sessions in the United States cost approximately $65 a session, with more typical costs ranging from $100-$200 per session [71]. So, Pocket PCIT Online costs the equivalent of about 40% of the cheapest single session of psychotherapy a family could find to affect clinically significant change. Pocket PCIT Online's potential to deliver clinically significant improvements in child behavior at a fraction of the cost of traditional therapy suggests a promising avenue for expanding access to evidence-based parenting interventions.

Conclusions

This open trial of Pocket PCIT Online demonstrates preliminary support for the potential of self-directed, mHealth BPT as scalable public health tools for addressing child disruptive behaviors. The intervention's effectiveness in improving child behavior and parenting outcomes, coupled with its low implementation costs, highlights its promise for increasing access to evidence-based parenting strategies. However, this open trial also underscores significant challenges in reach, engagement, and retention that must be addressed to maximize the intervention's impact.

While this open trial of Pocket PCIT Online presents a cost-effective and potentially highly accessible approach to BPT, there are multiple limitations. First, while the study was advertised on a national parenting website and free for use, the resulting sample does not reflect the United States national demographics in terms of educational attainment, socioeconomic status, or racial and ethnic diversity per Census data. Second, like other in-person [24] and mHealth BPT programs [40], attrition was significant within the present sample. Additions to the Pocket PCIT Online platform (e.g., on-demand help chatbot, presentation as interactive learning modules) may reduce barriers to engagement. Future research should focus on identifying and addressing barriers to engagement (e.g., duration of usage, number of times used, number of modules completed) and exploring ways to better capture and encourage sustained user participation in mHealth BPT interventions [69]. Third, due to both attrition and the lack of included follow-up measures, the *Maintenance* aspect of RE-AIM was unable to be evaluated in the present study. As such, long-term changes in family outcomes could not be evaluated. Finally, the open trial did not include a comparison group and did not ask families if they were concurrently receiving other related services. Future research should include randomized controlled trials comparing Pocket PCIT Online with and without human support (i.e., coaching, skill feedback). Ultimately, such research and intervention refinement efforts may contribute to reducing the prevalence and long-term consequences of childhood disruptive behaviors on a population level.

Conflicts of Interest: There are no conflicts of interest for any of the authors related to this study.

Data Availability: De-identified data that support the findings of this study are available from the corresponding author upon reasonable request and with appropriate data sharing agreements in place. Access to the data will be granted for research purposes that align with participant consent and institutional review board approval.

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Table 1. Demographic Information for Pocket PCIT Online Participants

	N	**%**
Accessed Pocket PCIT Online and completed informed consent	1480	100
Accessed Pocket PCIT Online but did not complete pre-intervention measures	246	16.6
Completed pre-intervention measures	1234	83.4

Completed any Pocket PCIT homework	393	31.8
Completed Pocket PCIT Online	204	16.5
Child Gender		
Male	818	66.3
Female	416	33.7
Caregiver Age		
18-24	23	1.9
25-44	1048	84.9
45-64	160	13
65 or older	3	0.2
Caregiver Education		
< Bachelor's Degree	285	23.1
Bachelor's Degree or Higher	949	76.9
US Median Household Income Range		
Below US Household Median Income	429	34.7
At or Above US Household Median Income of $74,580	805	65.3

	***N* (%)**	***N* (%)**
	Hispanic	**Not Hispanic**
Child Race		
American Indian or Alaska Native	10 (0.8%)	14 (1.1%)
Asian	6 (0.5%)	90 (7.3%)
Black or African American	12 (1.0%)	71 (5.8%)
Native Hawaiian or Other Pacific Islander	4 (0.3%)	9 (0.7%)
White	193 (15.6%)	825 (66.9%)
Total	225 (18.2%)	1009 (81.8%)
	M	***SD***
Child Age in Years	4.73	1.58
PSI-SF Parental Distress Pre-Intervention Raw Score	33.30	9.16
WACB-P Pre-Intervention Total Score	32.53	6.68

Notes. PSI-SF= Parental Stress Index Short Form; WACB-P= Weekly Assessment of Child Behavior- Positive

Table 2. Pre-Post Changes in Pocket PCIT Online Outcome Variables.

Scale	*N*	*Pre M*	*SD*	*Post M*	*SD*	*t*	*P-value*	*Cohen's d*
WACB-P Frequency	204	33.33	6.24	38.19	6.64	12.49	<.001	0.87
# of Behaviors to Change in their Child	204	5.17	2.2	4.21	2.31	-6.01	<.001	-0.42
PSI-SF Parental Distress	203	32.48	8.65	30.42	8.74	-4.27	<.001	-0.30
Family Conflict	202	2.85	0.92	2.60	0.82	-4.91	<.001	-0.35

Note. WACB-P Frequency scores below 37 indicate clinically elevated disruptive behaviors.

Table 3. Family Factors and Characteristics That Predict Family Outcomes

Outcome variable	Pre WACB-P	Pre Parental Distress	Pre Family Conflict	Child Race: White	Child Race: Black	Child Age	Caregiver Education: Bachelor's or Higher	CDI Total Homework Completed	R^2	*P*-value
Post WACB-P	0.38***	0.50***	-0.04	-0.02	-	-	0.04	0.10	0.58	<.001
Post PSI-SF Parental Distress	-0.06	0.67***	0.00	0.09	-	-	-	-	0.51	<.001
Post Family Conflict	-0.03	-0.19	0.43***	-0.09	0.00	0.00	-	-	0.28	<.001

Note. *** $P < .001$. The first column is the outcome variable that is being predicted. Every other column is a pre-intervention or demographic predictor's association with each outcome variable or homework completion, after controlling for all other pre-intervention and demographic predictors in its' row. Some predictors are not reported (as indicated by dashes) because they were not significantly correlated with the outcome variables and therefore not included in the final multivariate regression models to ensure model stability and in the interest of parsimony. Categorical variables were dummy coded.

Table 4. Pocket PCIT Online Caregiver Attitudes

Caregiver Perceptions of Pocket PCIT Online	N	Min.	Max.	*M*	*SD*
Regarding techniques of disciplining, I feel I have learned (1= nothing to 5= very many useful techniques)	201	1	5	3.43	1.06
Regarding techniques for teaching my child new skills, I feel I have learned (1= nothing to 5= very many useful techniques)	199	1	5	3.45	1.02
Regarding the relationship between myself and my child, I feel we get along (1= much worse than before to 5= very much better than before)	201	1	5	3.90	0.70
Regarding my confidence in my ability to discipline my child, I feel (1= much less confident to 5= much more confident)	201	1	5	3.72	0.72
The major behavior problems that my child presented at home before the Pocket PCIT Online program started are at this time (1= considerably worse to 5= greatly improved)	201	2	5	3.79	0.60
I feel that my child's compliance to my commands or requests is at this time (1= considerably worse to 5= greatly improved)	201	2	5	3.72	0.64
Regarding the progress my child has made in his/her general behavior, I am (1= very dissatisfied to 5= very satisfied)	201	2	5	3.84	0.77
To what degree has Pocket PCIT Online helped with other general personal or family problems not directly related to the program (1= hindered much more than it helped to 5= helped very much)	201	1	5	3.79	0.76
I feel the type of program (Pocket PCIT Online) that was used to help me improve the behaviors of my child was (1= very poor to 5= very good)	201	1	5	3.96	0.90
My general feeling about the program (Pocket PCIT Online) I participated in, is (1= I disliked it very much to 5= I liked it very much)	201	1	5	4.36	0.81

Supplementary Table. Correlations Among All Study Variables of Interest

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. WACB-P Raw Score (Post)	—																				
2. Post Family Conflict	-.22**	—																			
3. Post PSI Parental Distress	-.22**	.33**	—																		
4. CDI Total Homework	.21*	-.16	-.06	—																	
5. PDI Total Homework	.27**	-.32**	-.24**	.37**	—																
6. Completed Pocket PCIT	—	—	—	.06	.04	—															
7. Any Pocket PCIT Engagement	.06	.08	.00	.31**	.16*	.58**	—														
8. Pre-WACB-P Raw Score	.63**	-.16*	-.27**	-.08	.04	.05	.05	—													
9. Pre-Family Conflict	-.16*	.65**	.32**	-.21**	-.27**	-.01	.02	-.21**	—												
10. Pre-PSI-SF Parental Distress	-.16*	.30**	.69**	-.06	-.21**	-.04	-.02	-.30**	.35**	—											
11. Child: American Indian/Alaska Native	—	—	—	-.01	.10	-.06*	.01	-.04	.04	.03	—										
12. Child: Asian	.19**	.05	-.18**	-.17*	-.12	.01	-.01	.15**	.02	.02	-.04	—									
13. Child: Black/African American	.03	-.24**	-.12	.02	.10	.04	.05	-.02	.00	-.01	-.04	-.08**	—								
14. Child: Native Hawaiian/Pacific Islander	.01	-.04	.04	-.13	-.03	.00	-.04	.00	.00	.02	-.01	-.03	-.03	—							
15. Child: White	-.16*	.15*	.21**	.15*	.00	-.01	-.02	-.08**	-.03	-.03	-.30**	-.64**	-.58**	-.22**	—						
16. Child: Hispanic/Latino	-.14	-.08	-.05	.12	.08	.00	.00	-.04	-.09**	-.07*	.09**	-.09**	-.03	.03	.04	—					
17. Child: Not Hispanic/Latino	.14	.08	.05	-.12	-.08	.00	.00	.04	.09**	.07*	-.09**	.09**	.03	-.03	-.04	-1.00**	—				
18. US National Median Household Income	.04	-.08	-.04	.00	-.20**	.06*	.05	.17**	-.03	-.08**	-.12**	-.05	-.04	-.04	.11**	-.10**	.10**	—			
19. Education Level-Bachelor's Degree	.14*	.04	-.04	-.14	-.24**	.05	.07*	.21**	-.02	-.05	-.09**	.07*	-.03	.00	.00	-.05	-.05	.46**	—		
20. Child Age	.12	.21**	.04	-.05	.04	-.04	-.06*	.23**	.11**	.02	.02	-.02	.03	-.02	-.12**	.12**	-.03	.02	.03	—	
21. Child Gender	.10	-.06	-.00	.08	-.08	-.04	-.06*	.13**	.03	-.00	-.01	-.02	-.01	-.02	.02	.01	-.01	-.02	.02	.02	—

Note. N ranges from 142 to 1249 on correlations due to missing data or participant being lost to follow up. WACB-P= Weekly Assessment of Child Behavior- Positive PSI = Parenting Stress Index; CDI = Child Directed Interaction; PDI = Parent Directed Interaction; PCIT = Parent-Child Interaction Therapy; US National Median Household Income: 1= above US national household median income, 0= at or below US national median household income; Education Level: 1= Bachelor's Degree or higher, 0= below Bachelor's Degree; Child Gender: 1= male, 2= female. *P < .05. ** P < .01. Dashes (—) indicate that the correlation could not be computed due to at least one of the variables being constant or all values for one variable being missing.