A Randomized Trial of Digitally Delivered, Self-Administered Parent Training in Primary Care: Effects on Parenting and Child Behavior

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Objective To evaluate the effects of a self-administered, digital behavioral parent training program on parent and child behavior for parents of young children.

Study design A randomized controlled trial compared *ez*Parent (digital delivery of the evidence-based Chicago Parent Program) with an enhanced usual-care control. Introduction to the study occurred during well-child visits at 4 primary care clinics. In total, 287 parents of children age 2-5 years were randomized to *ez*Parent or the control. Parents responded to surveys evaluating parent behavior, self-efficacy, and stress, and child behavior at baseline, and 3-, 6-, and 12-months postbaseline. Multilevel growth models examined parent and child outcomes for intervention efficacy in intent-to-treat analyses. Secondary moderation analysis explored intervention effects by program use and baseline parenting stress and child behavior problems.

Results The intervention main effect was not significant for parent and child behaviors. In exploratory moderation analysis, parents in the *ez*Parent condition with greater baseline parenting stress reported less corporal punishment ($P = .044$); and greater improvement in parental warmth ($P = .008$), setting limits ($P = .026$), and proactive parenting ($P = .019$). Parents reporting greater baseline child behavior problems reported greater improvements in parental warmth ($P = .007$), setting limits ($P = .003$), and proactive parenting ($P = .010$). There were no differences in outcomes based on program usage.

Conclusions Results suggest that *ez*Parent as a self-administered behavioral parent training program may not be intense enough for child and parent behavioral change as a universal prevention model. Parents may require different levels of support for completion based on their level of service seeking, family characteristics, risk profile, and motivation for change. *(J Pediatr 2021;231:207-14)*.

Trial Registration Clinicaltrials.gov: NCT02723916.

Nearly 10% of children younger than the age of 5 years exhibit clinically significant behavior problems and 80% exhibit normative yet-challenging behavior problems.[1,2] Despite evidence of early intervention in the form of behavioral parent training for parents of young children as a first-line treatment and prevention, access and availability are limited.[3-6] As a universal prevention approach, behavioral parent training is a key strategy to strengthen parenting skills and support parents.[4,7] Universal behavioral parent training provides empirically supported guidance on managing difficult child behavior and applying positive and supportive parenting skills (eg, praise, predictable environments, and promotion of prosocial behavior).[8]

Self-administered digital interventions maintain consistency in delivery and require less professional support; thus, they have high potential to scale up for broad public health impact.[9] In a single-group trial of a self-administered prevention behavioral parent training for parents of children aged 2-16 years, Piotrowska et al found improvements in child behavior problems and parenting.[10] Studies of behavioral parent training as indicated prevention (eg, for children with disruptive behavior) have reported digital programs to be effective in improving parenting and reducing child behavior problems and those that include interactive programming or provider support were more effective than noninteractive programs.[11-13]

A variety of delivery methods have been proposed and tested in pediatric primary care (PPC).[14-16] Because many PPCs lack the infrastructure to provide systematic contact points during program delivery, self-administered delivery represents an accessible method to be easily incorporated into practice. Therefore, we chose to test delivery of *ez*Parent as a fully self-administered program to test a low-intensity

CPP	Chicago Parent Program
ECBI	Eyberg Child Behavior Inventory
PPC	Pediatric Primary Care
PQ	Parenting Questionnaire
PSI-SF	Parenting Stress Index–Short Form
RCT	Randomized controlled trial
SDQ	Strengths and Difficulties Questionnaire

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form of delivery to balance the potential challenges a busy PPC site may experience in integrating touchpoints and contact during parent receipt of the intervention.

Methods

The *ez*Parent program is an interactive, digital adaptation of the evidence-based Chicago Parent Program (CPP). In a pilot randomized controlled trial (RCT; n = 83) *ez*Parent participants showed greater improvements in parenting warmth (F [1, 77] = 4.82, $P < .05$) and between-group effect sizes for improvements in parent and child outcomes from baseline to 6 months' postbaseline ranged from $d = -0.01$ to 0.31.[17] Parent (parenting behavior, parenting self-efficacy, and parenting stress) and child (child problems and prosocial behavior) outcomes are compared with an enhanced usual care control among parents with young children recruited through primary care settings.

Design

In this RCT, parents were randomized to the *ez*Parent program or an enhanced usual-care control (Health-*e* Kids). Data were collected at baseline, and 3, 6, and 12 months' postbaseline. The overall design and protocol for the study is published.[18] The study was approved by the university institutional review board and registered at ClinicalTrials.gov (NCT02723916).

Sample

Participants in the study were the parent or legal guardian (referred hereafter as parent) of a child aged 2-5 years. During a well-child visit at 4 urban primary care clinics, parents received study information and verbal referral from their primary care provider.[18,19] Parents completed an interest form at the clinic and research staff picked up the interest forms and contacted interested parents to describe the study and assess eligibility. Parents had to speak and read English to participate in the study because the *ez*Parent program is currently only available in English. We included all parents, including those with and without potential risk for children with behavior problems, as *ez*Parent provides universal strategies to develop effective and positive parenting skills.

After parents completed informed consent procedures and baseline surveys, they were randomized to either the intervention (*ez*Parent) or control (Health-*e* Kids) via a random number generator. Data collectors were blind to condition until all baseline surveys were completed. To promote accessibility, all parents received a tablet computer for the entirety of the study to access the assigned intervention content.

Intervention and Control Conditions

The *ez*Parent program is a digital delivery adaptation of the group-based CPP and consists of 6 modules designed to promote learning of behavioral parent training skills. Consistent with the CPP, *ez*Parent is grounded in social learning and attachment theory.[20] Each module includes didactic teaching via video narration, video vignettes of parents and children, questions regarding the vignettes and skills, and interactive activities.[21] At the end of each module, parents receive a practice assignment to complete. Module completion is sequential, and the next module is unlocked after parents review the practice assignment. After completing a module, parents can review the module content as frequently as they wish. Parents were instructed to complete a module every 1-2 weeks and complete all 6 modules in 12 weeks. This time frame was chosen to allow parents time in-between modules to practice the skills they were learning with their children. In a previous study, parents (n = 42) completed 4.9 of 6 (82%) modules and spent M = 37.15 minutes per module during the 3-month intervention period.[22] Parents received automatic text messages based on their use to either remind them to complete a module or to reinforce their completion. In this study, we tested self-administered with no in-person touch points to evaluate the efficacy of the least intensive form of delivery. For more information about the *ez*Parent Program, see Breitenstein et al.[21]

Health-*e* Kids was designed for this study.[18] Health-*e* Kids does not include any behavioral parenting content or skill development and was developed to function as an enhanced usual care to control for technology use and allow full testing of the interaction effect. Health-*e* Kids includes information sheets, websites, and relevant resources typically provided to parents at PPC practices during well-child visits for children aged 2-5 years. Topics include child development, common childhood illnesses, nutrition and fitness, health and safety, and vaccinations. Parents were instructed to complete a health topic of their choice every 1-2 weeks. Parents were able to review all topics as frequently as they wished.

Measures

The primary outcome was parenting behavior and attitudes and secondary outcomes were parenting stress, competency, and child behaviors. **Table I**[23-29] provides a description of parent and child outcome measures; all outcome measures were parent self-reported and collected at 4 data-collection time points (baseline, 3, 6, and 12 months' postbaseline). We collected family demographics, intervention, and control use metrics and parent satisfaction with the allocated program. Demographics and income were collected at baseline. Use data were collected for the *ez*Parent and Health-*e* Kids groups and automatically uploaded to secure servers when parents were connected to the internet and accessing the program. In this analysis, dose for *ez*Parent will be reported by the module completion rate by parents and the number of pages opened in the Health-*e* Kids control application. Use reported in this paper includes *ez*Parent or Health-*e* Kids use between baseline and the 3 months' postbaseline data collection time point.

Program satisfaction data were collected 3 months' postbaseline (at the end of the intervention phase). Parents responded to an end-of-program survey corresponding to their intervention allocation. The end-of-program surveys assessed parental satisfaction, perceived usefulness/

Table I. Description of parent and child outcome measures

Variables/measures	Description	Scale	Subscale (number of items)	Scale range*	Cronbach alpha†
Parenting behavior					
PQ[23]	Parenting behavior and discipline strategies	1 = almost never 5 = very often	Parental warmth (22)	1-5 (M)	0.87
			Parental follow through (6)	1-5 (M)	0.76
			Corporal punishment (4)	1-5 (M)	0.61
PARYC[24]	Parenting strategies for parenting a young child	1 = not at all 7 = most of the time	Supporting good behavior (7)	1-7 (M)	0.80
			Setting limits (7)	1-7 (M)	0.83
			Proactive parenting (7)	1-7 (M)	0.83
Parenting self-efficacy					
PSOC[25,26]	Parent self-efficacy and perceptions	1 = strongly disagree 6 = strongly agree	Total scale (17)	17-102 (S)	0.83
Parenting stress					
PSI-SF[27]	Stress in the context of parenting role.	1 = strongly agree 5 = strongly disagree	Parental distress (12)	12-60 (S)	0.87
			Parent–child dysfunctional interaction (12)	12-60 (S)	0.82
			Difficult child (12)	12-60 (S)	0.84
Child behavior					
ECBI[28]	Severity (intensity)	1 = never happens 7 = always happening	Intensity scale (36)	1-7 (M)	0.94
	Frequency (problem) of child behaviors	*0 = no* *1 = yes*	Problem scale (36)	0-1 (M)	0.94
SDQ[29]	Child behavior problems and prosocial behavior	0 = not true 1 = somewhat true 2 = certainly true	Emotional symptoms (5)	0-10 (S)	0.54
			Conduct problems (5)	0-10 (S)	0.68
			Hyperactivity/inattention (5)	0-10 (S)	0.74
			Peer relationship problems (5)	0-10 (S)	0.51
			Prosocial behavior (5)	0-10 (S)	0.70

PARYC, Parenting Young Children; *PSOC*, Parenting Sense of Competence Scale.
*Letter in parentheses indicates whether mean (M) or sum (S) scored.
†Cronbach alpha reliability coefficient in study sample at baseline assessment (N = 287).

helpfulness of the program content, and facilitators/barriers to the delivery methods.

Statistical Analyses

Based on our original power analysis,[18] the target analytic sample size was 272 providing power of 0.80 to detect difference in the analysis of intervention effects based on an effect size of $d = 0.31$, $\alpha_{2\text{-tailed}} = .05$, and a correlation between assessments of $r = 0.50$. SAS software (v.9.4; SAS Institute) was used for all statistical analyses. Missing assessments were handled through full information maximal likelihood estimation within the multilevel linear models.

Descriptive statistics are used to report program usage metrics and satisfaction. Multilevel linear growth models (SAS Proc Mixed) with 2 levels (assessments [Level 1] within parent [Level 2]) examined parent and child outcomes for intervention efficacy in intent-to-treat analyses. We planned to include primary care clinic as a Level 3 variable or covariate but found no evidence for differences by site; therefore, we excluded site from analyses. Intervention condition was coded at level 2. Covariates were selected based on associations with outcome variables and/or change over time for outcome variables. Three covariates (parent age, number of children, and age of target child) were included in all analyses. Analyses adjusted for the baseline measure of the outcome being evaluated. Thus, initial treatment effects were tested as the effect of the intervention condition on the intercept (ie, 3-month assessment) and maintenance of effects over time (ie, across 3 postintervention assessments) were tested as the interaction of intervention condition with time. All analyses used continuous measures of the outcomes. Although some measures of child behavior displayed evidence of skewed distributions, analyses using log-transformed outcome measures yielded minimal differences in results. To maintain interpretability of the parameter estimates, we present the original, untransformed measures. Parenting behavior as measured by the Parenting Questionnaire (PQ) was treated as the primary outcome. Effect size estimates (Cohen d) were calculated at the parameter estimate for the intervention effect divided by the pooled baseline SD. For condition × time interactions, we multiplied the parameter by 9 to account for the 9 months between the end of the intervention and the fourth assessment. Finally, for result interpretation of outcome measures, improvements are in the direction of the scale (eg, increases in PQ [warmth and follow through scales], Parenting Young Children, Parenting Sense of Competence, and Strengths and Difficulties Questionnaire [SDQ; prosocial behavior scale only] and decreases in PQ [corporal punishment scale], Parenting Stress Index–Short Form [PSI-SF], Eyberg Child Behavior Inventory [ECBI], and SDQ).

Although not a planned analysis, based on results of the initial treatment effects, we explored moderation of intervention effects by 3 factors: (1) program use, (2) baseline child behavior problems (ECBI intensity scale), and (3) baseline parenting stress (PSI-SF difficult child scale). The second 2

factors were chosen a priori to explore factors that represent an indicator of potential risk related to parent and child behavior based on normative scores on these measures. The 3 terms were added to the models described previously: (1) a binary term for the moderator being tested, (2) a moderator by treatment condition interaction, and (3) a moderator by treatment condition by time interaction.

Results

Study Participants

The study started in September 2015 and enrollment in the RCT occurred between April 2016 and April 2018. All data collection was completed by June 2019. Of the 287 parents enrolled in the study, 272 (95%) completed at least 1 follow-up data collection. Noncompletion across data-collection time points was not significantly different across the 2 conditions. Of 272 participants with at least 1 follow-up assessment, 239 (88%) completed all 3 assessments, 24 (9%) completed 2 assessments, and 9 (3%) completed only 1 assessment. The **Figure** (available at www.jpeds.com) shows the participant flow chart. The majority of parents were African American (62%) or Latinx (24%). Nearly one-half (47%) were married or living as married (**Table II**).[30,31] The mean age of parent participants was 32.8 years (SD = 7.9) and children in the study were on average 2.2 years of age (SD = 1.1). Parents were mostly mothers (91.3%) with an average of 2 children (SD = 1.3 range = 1-7). Sixty-four percent of the sample were low income (≤200% of the federal poverty level). Although we recruited from clinics with large populations of low-income families with potentially elevated risk for stress and behavior problems, comparing baseline data with available published norms (PSI-SF,[32] ECBI,[33] and Parenting Sense of Competence[34]), we found that parents in the present sample reported significantly lower levels of parental stress (P values <.001 for PSI parent–child dysfunctional interaction and difficult child) and child behavior problems (P <.001 for ECBI intensity and P = .03 for ECBI problem); and greater parenting self-efficacy (P < .001).

Table II. Sociodemographic characteristics of families (n = 287)

	Treatment (n = 144)		Control (n = 143)	
Sociodemographic characteristics	**n**	**%**	**n**	**%**
Child sex				
Female	68	47.2	74	51.7
Male	76	52.7	69	48.3
Relationship with child				
Mother	130	90.3	132	92.3
Father	8	5.6	7	4.9
Other (foster parent, grandmother, aunt)	6	4.2	4	2.8
Parental marital status				
Single	79	54.9	74	51.7
Married and/or living as married	65	45.1	69	48.3
Race/ethnicity				
African-American	101	70.1	78	54.5
Latinx	28	19.4	40	28
White	10	6.9	12	8.4
Other/don't wish to answer	5	3.5	13	9.1
Income based on FPL*				
Less than FPL	57	39.6	55	38.5
Between FPL and 150% FPL	23	16.0	13	9.1
Between 150% and 200% FPL	18	12.5	17	11.9
Greater than 200% FPL	43	29.9	54	37.8
Don't wish to answer	3	2.1	4	2.8

FPL, federal poverty level.
Significance testing of baseline differences were not assessed in accordance with CONSORT 2010[30] and recommendations by de Boer et al.[31]
*Income based on FPL was calculated based on household size and FPL rates for the year that subjects were enrolled.

Program Use and Satisfaction

Parents in the *ez*Parent condition completed an average of 2.5 (SD = 2.4) modules of 6 possible. On average, parents in the Health-*e* Kids control condition visited 11.9 pages (SD = 14.7). One-third (33%; n = 47) of participants in *ez*-Parent completed 4 or more modules (25%; n = 36 completed all 6 modules), 37% completed 1-3 modules, and 31% completed no modules. Based on use of Health-*e* Kids, the top 31% of participants (n = 44) were coded as high users, consistent with the rate of completion of 4 or more modules of *ez*Parent.

The majority (74%) of parents in the *ez*Parent condition identified the program as very helpful, and 65% reported they would highly recommend the program to another parent. Similarly, 70% of parents in the Health-*e* Kids control rated the program as very helpful and 53% would highly recommend the program to another parent. In an open ended query, 33% of parents in the *ez*Parent condition reported finding the time and needing help and motivation to stay on track and complete the program as major obstacles for completing the program.

*ez*Parent Effects on Parent and Child Behavior

Initial treatment effects at the 3-month assessment (postintervention) were nonsignificant for all parent and child outcomes (**Table III**). The parameter estimates for initial treatment effects represent the mean change from baseline to 3-month assessment for the participants randomized to *ez*Parent relative to those randomized to Health-*e* Kids. Maintenance of effects over time (ie, condition × time over 1-year follow up) represent the mean change per month from the 3-month assessment through the 12-month assessment for the participants randomized to *ez*Parent relative to those randomized to Health-*e* Kids. All initial treatment effects and maintenance of effects over time were nonsignificant and small in size for *ez*Parent relative to Health-*e* Kids. For example, mean parental warmth in the *ez*Parent condition decreased by 0.02 (0.05 SD) from baseline to 3-month assessment, relative to Health-*e* Kids. From 3-12 months' postbaseline, mean parental warmth decreased in the *ez*Parent condition by 0.01 per month relative to Health-*e* Kids, translating to an average reduction of 0.14 SD. Although in the opposite direction of the hypothesized effects, these results show no evidence of difference between conditions. In addition to small

Table III. Main parent and child outcomes of intervention effects

Measures	Scale	Effect*	Est.	SE	*P*	d†
PQ	Parental warmth	Initial treatment	−0.02	0.03	.543	−0.05
		Maintenance over time	−0.01	0.00	.133	−0.14
	Parental follow through	Initial treatment	−0.06	0.06	.377	−0.08
		Maintenance over time	0.00	0.01	.636	0.05
	Corporal punishment	Initial treatment	0.03	0.05	.571	0.06
		Maintenance over time	0.01	0.01	.480	0.10
PARYC	Supporting good behavior	Initial treatment	−0.19	0.10	.064	−0.20
		Maintenance over time	−0.01	0.01	.710	−0.05
	Setting limits	Initial treatment	−0.06	0.11	.560	−0.06
		Maintenance over time	0.00	0.02	.919	−0.01
	Proactive parenting	Initial treatment	−0.03	0.12	.808	−0.02
		Maintenance over time	−0.01	0.02	.385	−0.10
PSOC	Total scale	Initial treatment	0.20	0.97	.833	0.02
		Maintenance over Time	0.07	0.13	.572	0.06
PSI-SF	Parent distress	Initial Treatment	0.69	0.84	.416	0.08
		Maintenance over Time	−0.02	0.11	.832	−0.02
	Parent–child dysfunctional interaction	Initial treatment	−0.28	0.56	.618	−0.05
		Maintenance over time	0.03	0.08	.688	0.04
	Difficult child	Initial treatment	−0.39	0.60	.519	−0.05
		Maintenance over time	0.03	0.08	.724	0.03
ECBI	Intensity scale	Initial treatment	0.01	0.06	.893	0.01
		Maintenance over time	0.01	0.01	.166	0.12
	Problem scale	Initial treatment	−0.01	0.01	.732	−0.02
		Maintenance over time	0.00	0.00	.587	0.05
SDQ	Emotional symptoms	Initial treatment	0.01	0.13	.931	0.01
		Maintenance over time	0.00	0.02	.926	0.01
	Conduct problems	Initial treatment	−0.17	0.16	.298	−0.10
		Maintenance over time	0.00	0.02	.831	0.02
	Hyperactivity/inattention	Initial treatment	−0.19	0.19	.325	−0.08
		Maintenance over time	0.05	0.03	.063	0.20
	Peer relationship problems	Initial treatment	−0.14	0.14	.346	−0.08
		Maintenance over time	0.01	0.02	.570	0.07
	Prosocial behaviors	Initial treatment	0.10	0.17	.537	0.06
		Maintenance over time	0.01	0.02	.504	0.07

PARYC, Parenting Young Children; *PSOC*, Parenting Sense of Competence Scale.
*The initial treatment effect represents the difference between treatment and control in change from baseline to 3-month assessment. The maintenance effect represents the difference between treatment and control in change over time from the 3-month assessment through the 12-month assessment.
†The effect size for the initial treatment effect is the parameter estimate divided by the baseline SD. The effect size for the maintenance effect is the parameter estimate multiplied by 9 months (ie, time from 3-month assessment until the 12-month assessment) and divided by the baseline SD.

treatment effects relative to control, the means by wave and condition presented in **Table IV** (available at www.jpeds.com) fail to show evidence of change over time for either condition.

Secondary analyses testing moderation of intervention effects by program usage found no significant condition-by-use effects (**Tables V-VII**; available at www.jpeds.com). For moderation analyses by baseline levels of child behavior problems and parental stress, the ECBI intensity scale and PSI-SF difficult child scale were dichotomized at the mean of the normative sample for each measure. For ECBI, 112 (39%) of participants were above the mean of the normative sample. For PSI, 98 (34%) were above the mean of the normative sample. Parents reporting greater child behavior problems and greater parenting stress on the difficult child domain exhibited trends for greater improvement in parental warmth, setting limits, proactive parenting, and child prosocial behaviors in the *ez*Parent condition. Conversely, the parents in the *ez*Parent condition who scored lower than the published norms reported less improvement in parenting warmth, setting limits, proactive parenting, supporting good behavior, and hyperactivity/inattention on the SDQ than similar controls.

Discussion

Our findings suggest that *ez*Parent as a fully self-administered digital intervention did not improve parent or child behavior in this population of parents recruited from primary care. Exploratory moderation analyses suggest improved parenting and child behavior over time compared with similar controls among parents in the *ez*Parent condition who reported greater child behavior problems and parenting stress at baseline.

Because the group-based CPP has proven efficacy[35,36] and an initial RCT pilot study of *ez*Parent suggested evidence of parent and child improvements,[17] we do not believe program content to be the primary factor driving nonsignificant results. Instead, our results are likely due to multiple factors with implications for intervention delivery. In the pilot RCT of *ez*Parent (n = 83), research staff provided a one-on-one individualized introduction of the intervention to parents.[17] With the intention of testing a fully self-administered program, this opportunity for dialogue was scaled back for the current study. Instead, a brief video embedded in the program and required to view before starting the program was used to introduce the *ez*Parent program

to the parents. Although standardized instructions improve dissemination and program scalability, it eliminates the opportunity for interactive dialogue with parents during the initial phase of the intervention. Indeed, content relevance and perceived task value are key components of adult learner motivation.[37,38] A personalized introduction to *ez*Parent might provide important contextual information for parents in terms of purpose of parent training, foundational aspects of parenting strategies, and the behavior change mechanisms. In addition, parents could ask questions, share goals or concerns, and receive guidance about how *ez*Parent might best serve their parenting needs. A customized approach may be of particular benefit to parents who may not see a need to change their parenting behaviors, a particular concern related to universal prevention efforts.[39]

A potential delivery component that cannot be included in a fully self-administered program is the supportive tailoring of program strategies via real time feedback. Feedback plays an important role in supporting sustained behavior change and has been identified as an essential component of behavioral parent training effectiveness.[40,41] *ez*Parent was designed to provide opportunities for parents to receive feedback during the learning process through interactive activities, knowledge questions, video vignettes, and practice assignments; however, as a self-administered intervention, *ez*Parent cannot provide individualized feedback adapted to unique parenting concerns and needs.

Recruitment of parent participants was focused in primary care clinics serving a high percentage of families experiencing social and economic challenges, factors that can contribute to higher risk for the emergence of child behavior problems.[42,43] In the study sample, parents reported lower baseline levels of stress and child behavior problems than would be expected based on similar community samples[32-34] and may help explain the lack of main intervention effects. Interestingly, in exploratory moderation analysis parents reporting greater child behavior problems and greater parenting stress on the difficult child domain exhibited trends for greater improvement in setting limits, proactive parenting, parental warmth, and child prosocial behaviors in the *ez*Parent condition. Although the design of this study was to test the main effects of the *ez*Parent program and not for subgroup analysis we suggest some potential hypotheses that may explain these results and provide recommendations for further study. Parents reporting higher levels of parent stress and high child problem behaviors have demonstrated higher levels of participation in a prior parenting support program.[44] It is possible that parents with more perceived problems were more motivated or engaged in changing their parenting behaviors and more likely to apply what they were learning in the program in their day-to-day activities. Conversely, although they found the program content helpful, parents who do not report their children's behavior as problematic may be less likely to prioritize behavioral parent training over other tasks and less likely to adapt their own parenting behaviors. Variations in family-level subgroup characteristics can predict variations in behavioral parent training program effectiveness for problem behaviors in children with conduct problems.[45] It is possible that *ez*Parent delivery is more efficacious with a selective or indicated population. Future research focusing on subgroup analysis and potential moderations of intervention effects could provide important information regarding for whom and how the program may be most effective in a self-administered intervention format.

One limitation of this study is the inclusion of only parent self-report outcome data potentially creating reporting bias of parent and child behavior. In addition, although our attention control group is a strength in mitigating the attention of receiving online resources and a study tablet, the Health-*e* Kids control was not fully comparable with the amount of time parents would need to use the *ez*Parent program. Using an imperfect comparison to dose may have affected the secondary analysis related to intervention dose response. Finally, given the secondary and exploratory nature of the moderation analyses, the findings should be interpreted cautiously, and we use these findings primarily to explore next steps and recommendations for future research.

Our findings have implications for *ez*Parent delivery, parent engagement, and future research. This trial was a test of the efficacy of self-administered *ez*Parent with minimal intervention guidance or touchpoints during the intervention period, designed to maximize ease of implementation in PPC. We found that in a general population fully self-administered delivery may not provide enough support to improve parent and child behavior. It is possible parents might require different levels of support based on their level of service seeking, family characteristics, risk profile, and motivation for change.

Barriers to the use of technology based interventions and subsequent behavior change can be addressed in a variety of ways. One solution is to pair *ez*Parent with in-person touchpoints using a hybrid delivery method. Examples of hybrid delivery formats include technology supplemented face-to-face, individualized program feedback, discussion blogs, and digitally-delivered behavioral parent training augmented with facilitator touchpoints.[46] Digitally-delivered behavioral parent training interventions that incorporate interactive touchpoints have demonstrated the ability to promote significant and sustained parent and child behavior changes.[13,46-48] These touchpoints could be done individually or group-based via videoconferencing or in-person. In a pilot of *ez*Parent plus brief (<15 minutes) weekly telephone coaching calls with parents, a sample of 10 parents recruited from a neonatal intensive care unit follow-up clinic had high *ez*Parent completion rates (85%) and participated in 89% of weekly scheduled calls.[49] Parents reported the calls were helpful to maintain program use, tailor program strategies to the developmental needs of their child, and promote accountability.

A hybrid *ez*Parent with the addition of interactive touchpoints has the potential to increase parent motivation and program effectiveness while maintaining its relative cost

savings over group-based behavioral parent training programs. In a primary care setting, these touch points could be integrated into the role of integrated behavioral health providers or the primary care nurse. The effectiveness of personalized feedback in a hybrid delivery model may be especially important to promote accountability and individualization for parents who may not perceive a high need for behavioral parent training. A hybrid platform would allow parents to explore and receive feedback on the specific ways in which *ez*Parent can help them meet their parenting goals. Testing a hybrid model is an essential next step in finding a balance between feasibility and effectiveness of *ez*Parent as a preventive intervention in primary care.

Finally, longer-term follow-up of *ez*Parent effects is warranted. Preventive behavioral parent training demonstrate smaller overall effect sizes than similar treatment-based programs.[50] In addition, evidence suggests preventive parenting interventions appear likely to exhibit increasing effects over time.[51,52] A 2-year follow up of technology-supported behavioral parent training intervention showed improvements at 24 months over 12-month outcomes,[52] but few data exist on outcome trajectories of digital parenting interventions.[53] If *ez*Parent outcomes follow other preventive behavioral parent training trajectories, longer-term follow-up of participants may reveal sleeper effects (eg, later effects emerging due to change in parenting behavior creating a self-reinforcing snow ball effect)[54] that did not manifest as significant within our intervention time frame.

As PPC providers seek to improve access to efficacious face-to-face behavioral parent training, testing digital health alternative may be important to advance the science and reach of behavioral parent training delivery. Further assessment related to program aspects such as optimal length and strategies for sustaining engagement are warranted. Taken together, our findings have implications on methods for delivery of behavioral parent training. First, they suggest fully self-administered programs may not be the most effective delivery method to promote child and parent behavioral change in the general population recruited from PPC. Second, further research should investigate for whom and why specific delivery models work. It is possible parents with perceived need for support and motivation to change may be more likely to benefit from self-administered behavioral parent training. Finally, low-intensity touch points with parents may augment the intervention effects of self-administered programs by promoting individualization of parenting strategies and promoting accountability and motivations for program use. ■

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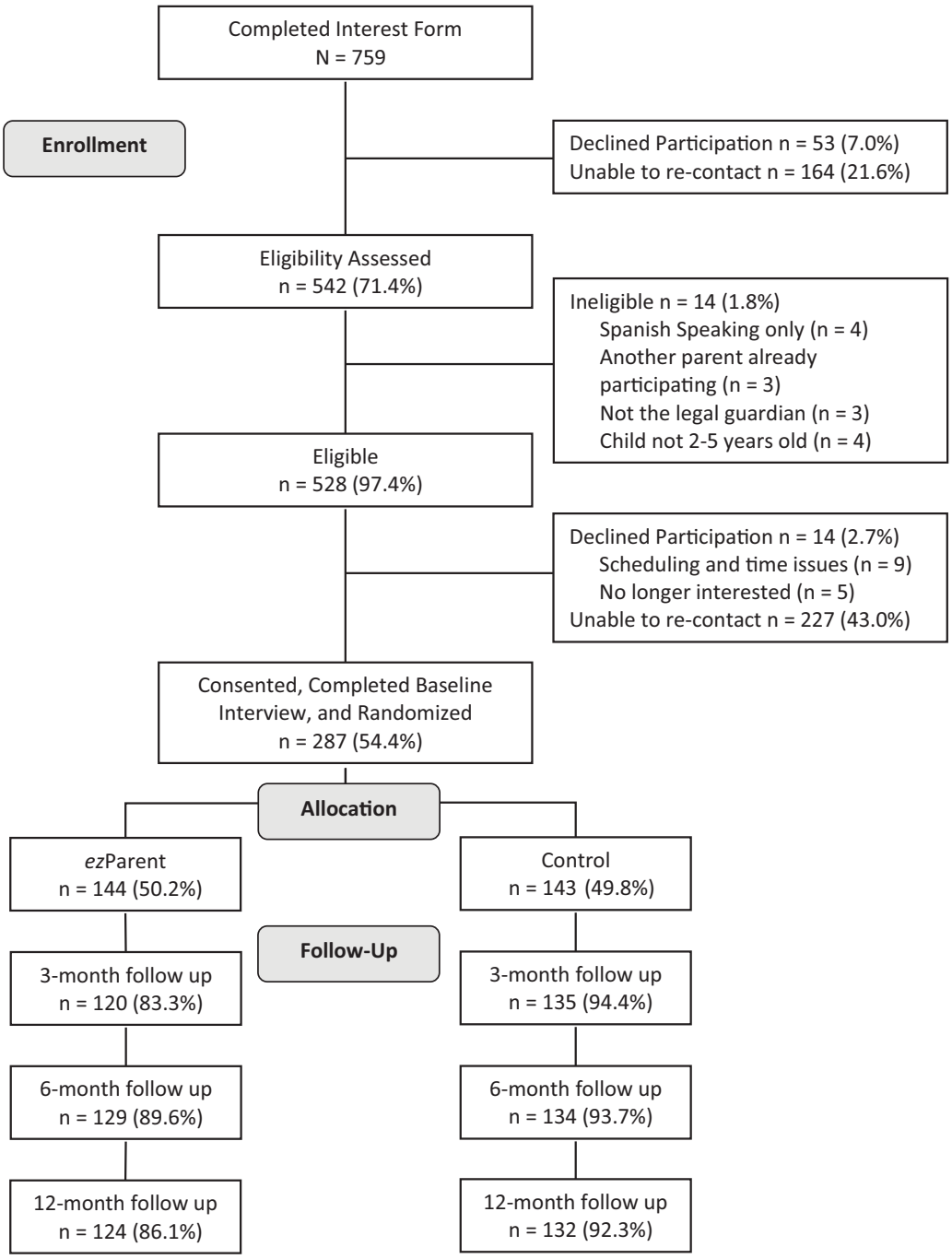

Figure. CONSORT diagram for participant flow. All participants (n = 287) included in intent-to-treat analysis.

Table IV. Descriptive data means and SDs by data-collection time point and treatment condition

		*ez*Parent treatment group				Health-*e* Kids control group			
Measures	Scale/subscale	T1* M (SD) n = 134	T2* M (SD) n = 120	T3* M (SD) n = 129	T4* M (SD) n = 124	T1* M (SD) n = 138	T2* M (SD) n = 135	T3* M (SD) n = 134	T4* M (SD) n = 132
PQ	Parental warmth	4.30 (0.46)	4.26 (0.42)	4.29 (0.39)	4.27 (0.46)	4.27 (0.41)	4.25 (0.41)	4.30 (0.44)	4.34 (0.40)
	Parental follow through	3.46 (0.68)	3.47 (0.75)	3.58 (0.77)	3.64 (0.75)	3.37 (0.78)	3.49 (0.71)	3.52 (0.70)	3.59 (0.76)
	Corporal punishment	1.43 (0.49)	1.47 (0.55)	1.44 (0.59)	1.42 (0.58)	1.51 (0.53)	1.49 (0.55)	1.47 (0.57)	1.39 (0.50)
PARYC	Supporting good behavior	5.63 (0.96)	5.36 (1.11)	5.54 (0.99)	5.53 (1.15)	5.70 (0.98)	5.65 (1.00)	5.70 (1.07)	5.85 (0.87)
	Setting limits	5.17 (1.18)	5.14 (1.10)	5.31 (1.07)	5.41 (1.10)	5.24 (1.04)	5.23 (1.06)	5.37 (1.19)	5.52 (1.12)
	Proactive parenting	5.08 (1.32)	5.04 (1.21)	5.20 (1.26)	5.29 (1.27)	5.13 (1.27)	5.08 (1.26)	5.30 (1.21)	5.48 (1.28)
PSOC	Total score	71.07 (11.41)	71.51 (11.20)	72.99 (11.16)	72.90 (12.10)	71.28 (10.62)	70.94 (10.70)	71.73 (12.24)	72.10 (11.00)
PSI-SF	Parent domain	26.06 (9.58)	25.90 (9.26)	25.39 (10.04)	25.30 (9.72)	25.53 (7.86)	25.25 (8.17)	25.41 (9.56)	24.64 (8.18)
	Parent-child domain	20.28 (6.38)	19.62 (6.50)	19.62 (6.53)	19.52 (6.03)	19.76 (6.05)	20.02 (5.79)	19.70 (6.87)	19.62 (6.07)
	Child domain	24.72 (8.02)	23.97 (7.62)	23.37 (7.45)	23.11 (7.18)	24.24 (6.86)	24.34 (7.29)	23.46 (7.66)	23.18 (7.60)
ECBI	Problem scale	0.18 (0.22)	0.14 (0.18)	0.14 (0.20)	0.12 (0.18)	0.19 (0.21)	0.16 (0.19)	0.15 (0.19)	0.13 (0.19)
	Intensity scale	2.80 (0.84)	2.69 (0.85)	2.64 (0.80)	2.65 (0.74)	2.84 (0.80)	2.69 (0.72)	2.67 (0.75)	2.56 (0.74)
SDQ	Emotional symptoms	1.06 (1.39)	1.10 (1.61)	1.02 (1.43)	1.03 (1.44)	1.12 (1.33)	1.03 (1.21)	0.97 (1.36)	0.92 (1.23)
	Conduct problems	1.93 (1.90)	1.63 (1.79)	1.56 (1.83)	1.40 (1.81)	1.94 (1.77)	1.77 (1.64)	1.75 (1.76)	1.53 (1.52)
	Hyperactivity/inattention	3.50 (2.29)	3.18 (2.26)	3.09 (2.49)	3.09 (2.32)	3.38 (2.28)	3.46 (2.22)	2.91 (2.14)	2.84 (2.20)
	Peer relationship problems	1.62 (1.56)	1.40 (1.60)	1.27 (1.41)	1.49 (1.71)	1.52 (1.64)	1.53 (1.56)	1.31 (1.47)	1.45 (1.57)
	Prosocial behaviors	8.01 (1.94)	8.43 (1.94)	8.50 (1.81)	8.72 (1.92)	8.26 (1.74)	8.24 (1.96)	8.60 (1.55)	8.45 (1.86)

PARYC, Parenting Young Children; *PSOC*, Parenting Sense of Competence Scale.
*T1 = baseline; T2 = 3 months' postbaseline; T3 = 6 months' postbaseline; T4 = 12 months' postbaseline.

Table V. Summary of treatment moderation by ECBI Intensity Scale

			Interaction with ECBI intensity (low vs high)*			ECBI high intensity†			ECBI low intensity†		
Measures	Scale	Effect‡	Estimate	SE	*P*	Estimate	SE	*P*	Estimate	SE	*P*
PQ	Parental warmth	Initial	−4.03	1.49	.007	2.08	1.17	.078	−1.95	0.91	.033
		Maintenance	0.07	0.20	.730	−0.19	0.16	.240	−0.12	0.13	.363
	Parental follow through	Initial	−0.20	0.80	.803	−0.23	0.63	.711	−0.43	0.49	.377
		Maintenance	0.02	0.11	.865	0.02	0.09	.854	0.04	0.07	.620
	Corporal punishment	Initial	0.14	0.46	.753	0.03	0.37	.937	0.17	0.28	.533
		Maintenance	0.03	0.06	.644	0.00	0.05	.979	0.03	0.04	.439
PARYC	Supporting good behavior	Initial	−0.40	0.21	.057	0.05	0.17	.759	−0.35	0.13	.007
		Maintenance	0.03	0.03	.295	−0.02	0.02	.298	0.01	0.02	.703
	Setting limits	Initial	−0.68	0.22	.003	0.35	0.18	.046	−0.33	0.14	.017
		Maintenance	0.05	0.03	.091	−0.03	0.02	.170	0.02	0.02	.320
	Proactive parenting	Initial	−0.63	0.24	.010	0.36	0.19	.064	−0.27	0.15	.069
		Maintenance	0.07	0.03	.044	−0.06	0.03	.027	0.01	0.02	.644
PSOC	Total scale	Initial	−1.56	2.01	.439	1.13	1.59	.477	−0.43	1.23	.728
		Maintenance	−0.28	0.26	.285	0.25	0.20	.222	−0.03	0.16	.850
PSI-SF	Parent domain	Initial	−0.49	1.73	.779	1.04	1.36	.445	0.56	1.06	.599
		Maintenance	0.31	0.23	.179	−0.21	0.18	.236	0.10	0.14	.500
	Parent-child domain	Initial	0.07	1.16	.951	−0.28	0.92	.758	−0.21	0.71	.768
		Maintenance	0.21	0.15	.168	−0.10	0.12	.406	0.11	0.10	.242
	Child domain	Initial	−0.32	1.24	.796	−0.17	0.98	.865	−0.49	0.76	.520
		Maintenance	0.11	0.16	.510	−0.04	0.13	.757	0.07	0.10	.505
ECBI	Problem scale	Initial	0.01	0.03	.722	−0.01	0.02	.635	0.00	0.02	.974
		Maintenance	0.00	0.00	.867	0.00	0.00	.861	0.00	0.00	.625
SDQ	Emotional symptoms	Initial	−0.12	0.28	.664	0.10	0.22	.641	−0.02	0.17	.915
		Maintenance	0.03	0.04	.443	−0.02	0.03	.564	0.01	0.02	.612
	Conduct problems	Initial	0.05	0.33	.884	−0.18	0.26	.486	−0.13	0.20	.506
		Maintenance	−0.02	0.04	.584	0.02	0.03	.587	−0.01	0.03	.844
	Hyperactivity/inattention	Initial	0.19	0.40	.637	−0.28	0.32	.369	−0.10	0.24	.691
		Maintenance	0.04	0.06	.462	0.03	0.04	.566	0.07	0.03	.059
	Peer relationship problems	Initial	0.23	0.30	.447	−0.27	0.23	.251	−0.04	0.18	.808
		Maintenance	0.00	0.05	.968	0.01	0.04	.704	0.01	0.03	.682
	Prosocial behaviors	Initial	0.21	0.35	.539	−0.04	0.28	.877	0.17	0.21	.418
		Maintenance	−0.09	0.04	.044	0.07	0.03	.046	−0.02	0.03	.461

PARYC, Parenting Young Children; *PSOC*, Parenting Sense of Competence Scale.
*Interaction term represents treatment condition by ECBI intensity parameter in the model that establishes whether the moderation of the given effect is significant.
†High and low ECBI Intensity Scale columns are the specified effects for the subgroups.
‡The initial treatment effect represents the difference between treatment and control in change from baseline to 3-month assessment. The maintenance effect represents the difference between treatment and control in change over time from the 3-month assessment through the 12-month assessment. The effect size for the initial treatment effect is the parameter estimate divided by the baseline SD. The effect size for the maintenance effect is the parameter estimate multiplied by 9 months (ie, time from 3-month assessment until the 12-month assessment) and divided by the baseline SD.

Table VI. Summary of treatment moderation by level of program (*ez*Parent and Health-*e* Kids) use

			Interaction with program use*			High program use†			Low program use†		
Measures	Scale	Effect‡	Estimate	SE	*P*	Estimate	SE	*P*	Estimate	SE	*P*
PQ	Parental warmth	Initial	2.32	1.53	.130	−1.95	1.25	.121	0.38	0.88	.670
		Maintenance	−0.01	0.21	.959	−0.14	0.17	.397	−0.15	0.12	.216
	Parental follow through	Initial	−0.05	0.82	.951	−0.34	0.67	.611	−0.39	0.48	.414
		Maintenance	0.14	0.11	.238	−0.06	0.09	.518	0.08	0.07	.268
	Corporal punishment	Initial	0.68	0.47	.145	−0.30	0.38	.431	0.38	0.27	.161
		Maintenance	−0.12	0.07	.061	0.10	0.05	.060	−0.02	0.04	.540
PARYC	Supporting good behavior	Initial	0.30	0.22	.164	−0.39	0.18	.026	−0.09	0.13	.481
		Maintenance	0.00	0.03	.923	0.00	0.02	.894	−0.01	0.02	.732
	Setting limits	Initial	−0.15	0.23	.510	0.04	0.19	.844	−0.12	0.14	.394
		Maintenance	0.05	0.03	.160	−0.03	0.03	.239	0.02	0.02	.440
	Proactive parenting	Initial	0.24	0.25	.339	−0.19	0.21	.352	0.05	0.15	.728
		Maintenance	0.02	0.04	.565	−0.03	0.03	.337	−0.01	0.02	.742
PSOC	Total scale	Initial	−2.14	2.05	.298	1.69	1.67	.311	−0.45	1.19	.707
		Maintenance	0.16	0.27	.562	−0.04	0.22	.864	0.12	0.16	.460
PSI-SF	Parent domain	Initial	−2.52	1.79	.160	2.27	1.45	.119	−0.24	1.04	.814
		Maintenance	0.12	0.23	.616	−0.09	0.19	.611	0.02	0.14	.875
	Parent-child domain	Initial	0.90	1.19	.450	−0.93	0.97	.339	−0.02	0.70	.973
		Maintenance	−0.06	0.16	.686	0.08	0.13	.550	0.01	0.09	.902
	Child domain	Initial	−0.29	1.28	.822	−0.23	1.04	.823	−0.52	0.74	.482
		Maintenance	0.14	0.17	.412	−0.06	0.14	.684	0.08	0.10	.409
ECBI	Problem scale	Initial	−0.01	0.03	.678	0.00	0.03	.922	−0.01	0.02	.564
		Maintenance	0.01	0.00	.107	0.00	0.00	.363	0.00	0.00	.141
	Intensity scale	Initial	−0.10	0.12	.404	0.08	0.10	.448	−0.03	0.07	.705
		Maintenance	0.00	0.02	.929	0.01	0.01	.364	0.01	0.01	.293
SDQ	Emotional symptoms	Initial	−0.09	0.29	.747	0.07	0.23	.773	−0.03	0.17	.880
		Maintenance	0.02	0.04	.541	−0.01	0.03	.703	0.01	0.02	.611
	Conduct problems	Initial	−0.40	0.34	.241	0.10	0.28	.721	−0.30	0.20	.130
		Maintenance	0.01	0.04	.791	0.00	0.03	.928	0.01	0.03	.750
	Hyperactivity/inattention	Initial	0.16	0.41	.699	−0.27	0.33	.412	−0.12	0.24	.627
		Maintenance	−0.06	0.06	.271	0.09	0.05	.050	0.03	0.03	.428
	Peer relationship problems	Initial	−0.27	0.30	.382	0.03	0.25	.904	−0.24	0.18	.183
		Maintenance	−0.02	0.05	.688	0.03	0.04	.484	0.01	0.03	.789
	Prosocial behaviors	Initial	−0.43	0.36	.225	0.39	0.29	.178	−0.04	0.21	.836
		Maintenance	0.03	0.04	.525	0.00	0.04	.919	0.02	0.03	.360

PARYC, Parenting Young Children; *PSOC*, Parenting Sense of Competence Scale.

*Interaction term represents treatment condition by compliance parameter in the model that establishes whether the moderation of the given effect is significant.

†High- and low-use columns are the specified effects for the subgroups based on program use.

‡The initial treatment effect represents the difference between treatment and control in change from baseline to 3-month assessment. The maintenance effect represents the difference between treatment and control in change over time from the 3-month assessment through the 12-month assessment. The effect size for the initial treatment effect is the parameter estimate divided by the baseline SD. The effect size for the maintenance effect is the parameter estimate multiplied by nine months (ie, time from 3-month assessment until the 12-month assessment) and divided by the baseline SD.

Table VII. Summary of treatment moderation by PSI-SF Child Domain

Measures	Scale	Effect‡	Interaction with PSI-SF child domain* (low vs high)			PSI-SF child domain high†			PSI-SF child domain low†		
			Estimate	SE	*P*	Estimate	SE	*P*	Estimate	SE	*P*
PQ	Parental warmth	Initial	−3.85	1.43	.008	1.59	1.05	.129	−2.26	0.98	.022
		Maintenance	0.25	0.20	.199	−0.27	0.14	.061	−0.02	0.14	.909
	Parental follow through	Initial	0.27	0.78	.730	−0.50	0.57	.377	−0.23	0.53	.664
		Maintenance	−0.15	0.11	.185	0.11	0.08	.186	−0.04	0.08	.597
	Corporal punishment	Initial	0.90	0.44	.044	−0.38	0.33	.250	0.52	0.30	.083
		Maintenance	−0.03	0.06	.604	0.04	0.05	.417	0.00	0.04	.908
PARYC	Supporting good behavior	Initial	−0.42	0.20	.038	0.02	0.15	.893	−0.40	0.14	.004
		Maintenance	0.04	0.03	.220	−0.02	0.02	.270	0.01	0.02	.536
	Setting limits	Initial	−0.48	0.22	.026	0.18	0.16	.252	−0.30	0.15	.041
		Maintenance	0.02	0.03	.431	−0.01	0.02	.557	0.01	0.02	.600
	Proactive parenting	Initial	−0.56	0.24	.019	0.26	0.17	.130	−0.30	0.16	.068
		Maintenance	0.05	0.03	.108	−0.05	0.02	.063	0.01	0.02	.709
PSOC	Total scale	Initial	−1.16	1.92	.545	0.74	1.40	.597	−0.42	1.31	.747
		Maintenance	−0.31	0.26	.235	0.25	0.19	.192	−0.06	0.18	.729
PSI-SF	Parent domain	Initial	−0.53	1.69	.755	1.01	1.23	.413	0.48	1.15	.674
		Maintenance	0.16	0.22	.480	−0.11	0.16	.505	0.05	0.15	.747
	Parent-child domain	Initial	1.48	1.12	.186	−1.02	0.82	.214	0.47	0.76	.541
		Maintenance	0.05	0.15	.740	0.00	0.11	.992	0.05	0.10	.637
ECBI	Problem scale	Initial	−0.01	0.03	.758	0.00	0.02	.987	−0.01	0.02	.663
		Maintenance	0.01	0.00	.141	0.00	0.00	.440	0.00	0.00	.183
	Intensity Scale	Initial	−0.02	0.12	.889	0.02	0.09	.841	0.00	0.08	.991
		Maintenance	0.03	0.02	.067	0.00	0.01	.686	0.02	0.01	.026
SDQ	Emotional symptoms	Initial	0.09	0.27	.727	−0.03	0.20	.870	0.06	0.18	.736
		Maintenance	0.03	0.04	.388	−0.02	0.03	.553	0.02	0.03	.528
	Conduct problems	Initial	0.32	0.32	.325	−0.32	0.23	.169	−0.01	0.22	.971
		Maintenance	−0.03	0.04	.485	0.02	0.03	.536	−0.01	0.03	.718
	Hyperactivity/inattention	Initial	0.25	0.39	.514	−0.30	0.29	.301	−0.04	0.26	.866
		Maintenance	0.08	0.05	.137	0.01	0.04	.886	0.09	0.04	.019
	Peer relationship problems	Initial	0.02	0.29	.946	−0.14	0.21	.511	−0.12	0.20	.539
		Maintenance	0.03	0.04	.461	−0.01	0.03	.868	0.03	0.03	.367
	Prosocial behaviors	Initial	−0.21	0.34	.539	0.20	0.25	.412	0.00	0.23	.989
		Maintenance	−0.04	0.04	.294	0.04	0.03	.220	−0.01	0.03	.821

PARYC, Parenting Young Children; *PSOC*, Parenting Sense of Competence Scale.

*Interaction term represents treatment condition by PSI-SF Child Domain parameter in the model that establishes whether the moderation of the given effect is significant.

†High and low PSI-SF Child Domain columns are the specified effects for the subgroups.

‡The initial treatment effect represents the difference between treatment and control in change from baseline to 3-month assessment. The maintenance effect represents the difference between treatment and control in change over time from the 3-month assessment through the 12-month assessment. The effect size for the initial treatment effect is the parameter estimate divided by the baseline SD. The effect size for the maintenance effect is the parameter estimate multiplied by nine months (ie, time from 3-month assessment until the 12-month assessment) and divided by the baseline SD.