Long-Term Impact of a Cell Phone Enhanced Parenting Intervention

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Abstract

Home visiting programs support positive parenting in populations at-risk of child maltreatment, but their impact is often limited by poor retention and engagement. The current study assessed whether a cellular phone enhanced version (PCI-C) of Parent-Child Interactions (PCI) improved long-term parenting practices, maternal depression and children's aggression. Low-income mothers (n=371) of pre-school-aged children were assigned to one of three groups: PCI-C, PCI, and a wait list control group (WLC). Parenting improved in both intervention groups between baseline and 12-month follow-up compared to the WLC. Children in the PCI-C group were rated to be more cooperative and less aggressive than children in the WLC. Drop-out rates were more than twice as high for the PCI group during the intervention (16 vs 43) and five times as high at 12-months follow-up than PCI-C (2 vs 10). The results offer evidence of the long-term effectiveness of PCI and the additional benefits of cellular phone supports for promoting intervention retention and improving children's behavior.

Children who experience harsh or neglectful parenting during their early years are at increased risk for poor developmental outcomes, especially in emotional and behavioral regulation (McKee, Roland, Coffelt, Olson, Forehand, Masari, & Zens, 2007). As an antidote, home visitation programs have been developed to promote positive parenting practices and prevent child maltreatment. Results from these programs, however, are often mixed, depending greatly on the type of program as well as the specific outcomes addressed (e.g., Avellar & Supplee, 2013) and even programs with the strongest evidence of effectiveness have limited impacts on family outcomes (NAS, 2016). Positive results from parenting interventions are likely attenuated when parents either become less engaged or prematurely drop out of interventions that last for several months or years (Gomby, 2005; Ingoldsby, 2010). Cost-effective programs that encourage full participation for fewer weeks or months hold the greatest potential for improving parenting and subsequent child outcomes.

A relatively new approach to increasing the effectiveness of home visitation involves the use of cell phones. Texting via mobile phones offers a novel and cost-effective means to increase communication between families and intervention staff, promote intervention retention and engagement, and provide reminders to use recently learned skills. Mobile phones have been used in a variety of health-related interventions to increase contact with patients, provide reminders of targeted behaviors in health protocols, and offer messages of encouragement for maintaining involvement (Krishna, Boren, & Balas, 2009; Klasnja & Pratt, 2012; Lazev, Vidrine, Arduino & Gritz, 2004). They have also been used in a clinical setting to increase therapy attendance rates for children with behavioral problems (Watt, Hoyland, Best, & Dadds, 2007) and in an educational setting to increase children's literacy skills by texting tips to their parents (York & Loeb, 2014). Adding cellular phone enhancements to parenting interventions likely promotes the

repetition and generalization of recently learned skills, facilitates more frequent communication between mothers and intervention staff, and provides a quick and reliable means to schedule and re-schedule intervention visits. While the use of mobile phone technologies and texting to support parents is growing, research examining their efficacy in changing parenting behavior and child outcomes is scarce. Data demonstrating their sustained effectiveness in promoting parent and child outcomes are non-existent.

Two different meta-analyses of parenting programs have reported that prevention programs that are skills-based, that is those that focus on helping parents learn specific behaviors that increase responsiveness to their children, are more likely to produce better outcomes for families than those that provide other types of supports (i.e. social support, problem-solving; Bakersman-Kranenburg, Van Ijzendoorn, & Juffer, 2003; Kaminski, Valle, Filene, & Boyle, 2008). For at-risk families, programs that were shorter term and had a specific behavioral focus were more effective at improving parental sensitivity (Bakersman-Kranenburg et al., 2003). Programs focused on the improvement of child behavior were likely to have a larger effect if they improved parent-child interactions and emotional communication, as well as the consistency of parenting (Kaminski et al., 2008). In addition, having parents practice the skills as part of the sessions helped them *generalize* a set of skills learned in one context to new circumstances as well as to *maintain* the skills over time.

In the current study, we assessed the sustained, one-year effects of mobile phone enhancements involving frequent voice and text messaging on parenting skills that were the focus of the Parent-Child Interactions (PCI) component of the SafeCare model (Lutzker & Bigelow, 2001). This evidence-based parent-training curriculum for parents who are at-risk or have been reported for child maltreatment (Edwards & Lutzker, 2008) incorporates many of the

identified attributes of effective home visiting interventions (i.e., short-term, behavioral focus with practice during the session, improve parent-child interactions). The goal of PCI is to promote positive interactions between parents and children by teaching parenting skills that structure and engage children in daily activities and increase parental responsiveness to their children. Through direct teaching of specific parenting behaviors as well as modeling and coaching by a trained interventionist, parents learn to plan activities in advance, prepare the child for daily activities, and engage the child using positive interaction skills and incidental teaching. Parents are taught to attend to, and reinforce, appropriate desired behaviors and ignore minor misbehaviors. By doing so, the parent can prevent challenging child behaviors and enjoy positive interactions and activities along with the child. A prior evaluation of the complete SafeCare model (including health and safety modules) showed increased PCI skills and positive parenting behaviors (Gershater-Molko et al., 2003).

The current study examined the long-term effects of a cellular phone-enhanced PCI, and compared its effectiveness to the original version of the PCI parenting program without cellular phone enhancements. The Cellular-phone-enhanced PCI (PCI-C) condition was designed to promote parental engagement, reduce attrition from the parenting intervention, and encourage the frequency of use and generalization of the newly learned skills following carefully programmed home visits. In the PCI-C condition, parents were provided with a cell phone and free service to use throughout the intervention phase. Mothers received twice-daily text messages and at least one phone call between home visits. The text messages were typically linked to the most recent intervention visit and were a planned mix of PCI-related questions, prompts to use the PCI skills, and supportive messages.

Earlier results of this project, the first randomized controlled trial assessing the effectiveness of the PCI module, have offered promising evidence of the effectiveness of the intervention at retaining families and increasing positive parenting behaviors. Mothers assigned to the cell phone-supported condition (PCI-C) completed the series of intervention sessions at much higher rates than mothers in the traditional PCI intervention (citation removed; note: the intervention was referred to as Planned Activities Training (PAT) in previous publications). There were also significant group differences with mothers in the PCI-C group demonstrating more responsive parenting behaviors, lower clinical rates of depression, and children with mothers in the PCI-C group exhibiting more cooperative behaviors and mothers reporting more adaptive behaviors at post-test and at a 6-months follow-up assessment (citation removed). Other short-term parenting interventions (Family Check-Up, PMTO) have been able to show decreased use of coercive parenting behaviors (Wachlarowicz, Snyder, Low, Forgatch, & DeGarmo, D., 2012), decreased maternal depression (Shaw, Connell, Dishion, Wilson, & Gardner, 2009) and decreased destructive child behaviors (Dishion et al., 2008; Shaw, Dishion, Supplee, Gardner, & Arnds, 2006) one to two years post-intervention. Given the large effect sizes observed between the groups at post-test, we anticipated that the effects of the PCI and PCI-C interventions would persist to 12-months follow-up.

The current paper reports on the long-term outcomes of the intervention with data collected 12-months post-intervention, comparing traditionally implemented PCI with a cell-phone supported PCI (PCI-C) and a "business as usual" wait-list control group (WLC). Our primary research question was whether the intervention group differences in parenting skills would persist through 12-months post-intervention. Our secondary research questions related to intervention group differences in maternal depression and children's behaviors at 12-months

post-intervention. One exploratory research question was whether there were differences in retention rates at 12-month follow-up for the two intervention groups. We hypothesized that the intervention groups would show higher levels of PCI skills and responsive parenting than the WLC. We also expected improvements in children's cooperative behaviors, adaptive and externalizing behaviors, because children would have more positive daily interactions and experiences with clear parental expectations and predictable routines as a result of the mother's experience with and long-term implementation of PCI. We expected that the more frequent phone contact within PCI-C would enhance the effect of the intervention in terms of long-term maintenance and generalization of the parenting skills and higher rates of retention throughout the project. We also anticipated that the positive contact with the family coach, via the cell phones, as well as other gains associated with the intervention, would reduce maternal depression.

Method

Participants

A sample of 371 mother-child dyads were recruited from community health, early education, and social service agencies that served low-income families in metropolitan South Bend, IN (49%) and inner-urban Kansas City, KS and MO (51%). Mothers were the focus of this study as they are more likely to be the primary care providers for young children. Mothers were eligible for the study if they had a preschool-aged child and if they had one or more of the following risk factors: less than 18 years of age at the birth of the target child, having less than a high school diploma or equivalent, receiving financial assistance, or meeting the income eligibility requirement for the local WIC or Head Start programs. The dyads were recruited from June 2007 through March 2010. Mean maternal age was 28.91 years ($SD = 5.80$); average annual

estimated family income was $18,608 (*SD* = 15,835). Mothers self-identified as belonging to the following groups: Hispanic (46%); African-American (33%); white, non-Hispanic (17%); and mixed race or Asian-American (4%). The racial and ethnic diversity of the sample matched the diversity of the populations served by the organizations from which we recruited in our communities. Children's mean age at enrollment was 4.56 years (*SD* = .57); more than half were boys (56%).

Design and Procedures

A randomized-controlled experimental design was used to evaluate the efficacy of two parenting interventions. This trial was registered at www.clinicaltrials.gov (identifier NCT01294475). After consent and enrollment, mothers were randomly assigned to one of three conditions using a weighted random number vector: Parent-Child Interactions (PCI; 38%), cellular phone enhanced PCI (PCI-C; 31%), or a wait-list control condition (WLC; 30%). Mothers were informed of their assigned condition by the interventionist, after opening a sequentially numbered, sealed, and signed envelope. Mothers and their children were assessed at baseline, post-intervention, 6-month and 12-month post-intervention. Outcome measures focused on parenting, maternal depression, and children's behaviors (both direct observations and maternal reports). Each visit included observation of dyadic interaction and maternal self-report survey or interview. The interactions were coded on site for maternal parenting behaviors as well as child behavior. Mothers reported on their own depression as well as their children's adaptive skills and externalizing behaviors. All assessments, including consent and enrollment, took place in the participants' homes by assessors who were blind to intervention group assignment. All assessments and interventions were conducted in either English (65%) or Spanish (35%; with bi-lingual staff), depending on the mother's preference.

Intervention Conditions

Parent-Child Interactions (PCI). In session one of the intervention, mothers selected two to three routines in which they would like to see improvements from a list of typical daily routines. The most commonly selected activities were 'when mother is busy' (34%) and 'when there are visitors' (25%). The routines chosen by the mother were made the focus of a series of approximately 5 semi-weekly sessions (range of 3-8), lasting 90 minutes to 2 hours. The intervention was introduced through the context of play, with Family Coaches describing the rationale for PCI and each of the 10 PCI behaviors: Preparing in Advance, Explaining the Activity, Explaining the Rules, Explaining the Consequences, Giving Choices, Talking About What You Are Doing, Using Positive Interaction Skills, Ignoring Minor Misbehavior, Giving Feedback, and Providing Rewards/Consequences. The family coach modeled the use of the PCI steps with the child in that play activity, and the mother was then asked to practice. Coaching was provided as needed to support the mother in implementing each behavior during the interaction. Following the activity, the coach provided positive and corrective feedback, and additional practice took place as needed in order to reach the 80% correct mastery criterion during play (at least 8 of the 10 possible PCI steps). To determine when mothers met the mastery criterion in each activity, family coaches observed and rated mothers' use of PCI in the activity addressed during the previous session.

In sessions two, three, and four, PCI was taught in a similar manner (discussion, modeling, practice, and feedback) within two or three mother-selected daily routines to promote generalization across activities. One or two additional sessions were conducted if mothers needed additional practice to meet mastery criterion on a total of three activities. In the final

session, mothers engaged in additional practice, progress was reviewed, and additional planning and problem solving for applying PCI to novel situations was conducted.

Cell-phone enhanced PCI (PCI-C). In addition to the delivery of PCI, as described above, mothers in the PCI-C condition were provided with a cell phone and service to use throughout the intervention phase. There were two components of the cellular phone enhancement that promoted more frequent contact between the Family Coaches and the mothers: (1) twice-daily text messages, and (2) phone calls between home visits. Family coaches sent text messages twice per day, five days per week. Text message content was individualized for each mother, and related to the current focus of the intervention taking place during the home visit during that week. The majority of the text messages were questions pertaining to the intervention or prompts to use the newly learned skills. Interspersed were messages that did not pertain directly to the intervention, such as suggestions for free- or low-cost activities within the community, or supportive messages to the mother (e.g., messages of encouragement, community resources). In addition to text messages, Family Coaches conducted a weekly check-in phone call between home visits to inquire about PCI use, mother and child activities, and child behavior.

Wait-list control. Families assigned to the wait-list control group participated in all assessments and observations. After completing the 12-month follow-up assessment, families were offered the PCI version of the intervention.

Measures

Parenting. At each assessment, maternal behaviors were coded via direct observations of parent-child interactions. The *Keys to Interactive Parenting Scale* (KIPS; Comfort & Gordon, 2006) was used to code responsive parenting behaviors across three activities: a Play-doh

activity, a free play activity, and a clean-up activity. To assess the generalization of the intervention skills to new activities, the *Parent-Child Interactions (PCI) Checklist-Clean-Up* was used. Specifically, mothers' use of the 10 PCI strategies was assessed using the *PCI Checklist* (Lutzker & Bigelow, 2001) within the clean-up task. This task was selected as a generalization activity in order to observe the extent to which the mother applied her learning to activities that were not directly within the intervention. A total score was created by dividing the number of PCI strategies each mother completed correctly by the total number of behaviors possible for the activity. Internal consistency reliability was stable across the four assessment points, ranging from α = .68 to .78. The *KIPS* was used to code parenting behaviors along 12 dimensions (e.g., response sensitivity, reasonable expectations, supportive directions) using a 5-point scale. A total score was created using the average across all 12 dimensions. Internal consistency reliability was consistently high across assessment sessions (α = .94 - .96).

Child behavior. Children's outcomes were based on direct observation of behaviors during observations of mother-child dyads in Play-doh, free play, and clean-up activities (*Child Behavior Rating Scale (CBRS)*) and on maternal reports of behavior (*Behavior Assessment Scale for Children-2-Parent Report Scale (BASC-2-PRS)*) at baseline, 6-month and 12-months follow-up sessions. The *CBRS*, developed for this project, was used to rate five dimensions of child behaviors observed during parent-child interactions at all time points. The constructs include engagement with materials, appropriateness of attention seeking, response to caregiver's directions, response to caregiver's initiations, and general affect. A total CBRS score was calculated by obtaining a sum of the 5-point rating across each of the five items, and then dividing by the total number of items rated. Internal consistency for this measure was high over time (α = .80 - .87). The *BASC-2-PRS* (Reynolds & Kamphaus, 2004) is a parent report measure

of child adaptive and problem behaviors and was collected at the pre-test, 6-month and 12-month follow-up assessments. The preschool version (ages 2-5) was used as a measure of child externalizing problems as well as adaptive behavior. Internal consistency reliability coefficients for the current project ranged from .88 for the Externalizing subscale (at all 3 time points) and from .89 to .91 for the Adaptive Skills subscale.

Maternal depression. The Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) was administered at baseline, post-intervention, and both long-term follow-up assessments. The measure consisted of 21 groups of statements pertaining to depressed mood and somatic complaints. A range of 0 to 3 points were assigned for each group of statements based on the severity of depressed affect that was endorsed and were summed to create a total depression score (ranging from 0 to 63). Internal consistency reliability was high across time (α = .87-.93).

Data Analysis Plan

Prior to beginning analyses, the presence of extreme scores was examined at both the univariate and multivariate level. Scores that were three standard deviations from the means were considered extreme scores and removed. This resulted in the removal of 21 scores across time, group, and variables (less than 1%). After univariate outliers were removed, Mahalanobis distance was used to examine the existence of multivariate outliers (Tabachnick & Fidell, 2007); no multivariate outliers were detected.

As expected in longitudinal designs, attrition was apparent in the sample, with the 12-month follow-up exhibiting the most missing data. Very little data were missing at pre-test (approximately 6%), followed by post-test (24%), 6-month follow-up (30%) and 12-month follow-up (37%). See Figure 1. Mplus Version 7 (Muthén & Muthén, 1998 - 2013) using full

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information maximum likelihood (FIML) estimation for missing data was used to address this issue. FIML improves accuracy and power compared to other traditional approaches of handling missing data (e.g., listwise or pairwise deletion; Enders, 2010) and has proven to be efficient and accurate with similar sample sizes and attrition rate as the current data set (Enders & Bandalos, 2001).

Linear modeling was used to test the effect of the treatment groups on changes in parenting, maternal depression and children's outcomes across time. To answer the research questions concerning post-intervention differences, 12-month follow-up scores for each measure of interest (i.e., PCI Clean-up, KIPS, BDI, CBRS, and the Externalizing and Adaptive subscales of the BASC) were predicted by pre-test levels of functioning on the same measure so that the remaining variance to be explained in the dependent variable would be uniquely associated with change across the whole study. Interactions were also considered for all models in order to test whether intervention effects were stronger for participants who were low or high on the dependent measure at pre- or post-test. In this way, strength and significance of intervention effects as well as maintenance of the effects were determined. Per protocol analyses were also completed and revealed a near-identical pattern of group differences as those described in the results section.

To answer the question related to the retention of families in the study as well as differential rates of attrition between groups, dropout rates at each time-point were predicted by group in a discrete time survival analysis (Tabachnick & Fidell, 2007). Discrete time survival analysis, a modification of logistic regression, allows for estimation of the participants' odds of leaving the study at each time-point as well as how those odds differ by other variables (in this case, intervention group). Since the purpose of these analyses was to specifically test whether the

added cell phone component of the PCI-C condition contributed to improved retention versus the PCI condition, only differences between these two groups were examined.

Results

Parenting, Children's Behavior, and Maternal Depression across Time by Condition

Descriptive statistics for all measures appear in Table 1, presented by group at all assessment points. Mothers in the intervention groups showed higher scores than the control group on measures of parenting interactions (PCI-CU and KIPS) at post-test but the differences between intervention and control groups narrowed at 6-months and 12-months follow-up. Although there were declines in the PCI and KIPS parenting scores at the 6 and 12 month follow-up points, these scores were still higher at 12-months follow-up than they were at pre-test. In contrast, parenting scores for mothers in the control condition remained much lower than those of the other two groups, relatively stable over time and never increased over baseline levels. With regard to children's behaviors, in both intervention conditions, mothers reported lower levels of children's externalizing behavior and increases in adaptive behavior. Moreover, higher levels of child cooperative behaviors were observed by independent raters in both intervention conditions. In contrast, children's externalizing, adaptive and cooperative behaviors in the control group remained consistent over time (for both observed behavior and maternal reports of behavior), with scores remaining approximately one standard deviation below the clinical cut-off (T=70). Mean levels of maternal depression declined in each group across time. In the intervention groups the decline was steeper, with a small rebound at 12-months follow-up; mothers in the control condition had smaller but consistent declines over time.

Intervention Effects on Parenting Outcomes at 12-Month Follow-Up

The results of the regression analysis (Table 2) indicated that both intervention groups had significantly more growth in parenting behaviors from pre-test to 12-months post-test when compared to the control group. Mothers in the cell-phone enhanced group (PCI-C) had stronger effects than the traditional intervention group (PCI) for the skills directly taught in the intervention (PCI Checklist), but not for the more general measure of responsive parenting (KIPS). For the observed PCI strategies, there was a medium effect size for the difference between the PCI-C and the control ($\beta = 0.139$; $SE = 0.029$; $p < .001$; Cohen's $d = 0.680$) and a small-to-medium effect for the difference between the PCI group and the control ($\beta = 0.078$; $SE = 0.029$; $p = 0.007$; Cohen's $d = 0.373$). Further, there was a small but significant effect size for the difference between the PCI-C and PCI intervention groups in terms of the growth of their use of PCI strategies from pre-test to 12-months follow-up ($\beta = 0.061$; $SE = 0.030$; $p = 0.041$; Cohen's $d = 0.278$). For the more general measure of parenting (KIPS), the PCI group showed a medium effect over the WLC ($\beta = 0.403$; $SE = 0.090$; $p < .001$; Cohen's $d = 0.581$) and the PCI-C group demonstrated a small-to-medium effect versus the WLC ($\beta = 0.259$; $SE = 0.090$; $p = 0.004$; Cohen's $d = 0.352$). There was no significant difference between the two treatment groups, however ($\beta = -0.143$; $SE = 0.093$; $p = 0.124$; Cohen's $d = -0.235$).

Intervention Effects on Maternal Depression at 12-Month Follow-Up

Since the relationship between intervention conditions and changes in maternal depression exhibited a more complex relationship, an interaction between intervention condition and pre-test level of depression was included in the model. Mothers with high pre-test depression scores had a significantly greater benefit (i.e., reduction in depression) if they had participated in PCI-C ($\beta = -0.508$; $SE = 0.119$; $p < .001$) or PCI ($\beta = -0.271$; $SE = 0.127$; $p = 0.033$) interventions compared to mothers in the WLC condition. An observation of the interaction can

be found in Figure 2a where it can be seen that the PCI-C intervention had an increasingly beneficial effect on reducing depression at 12-month post-intervention for mothers with pre-intervention depression scores above 9.6. When comparing mothers in the PCI intervention group to mothers in the WLC condition, the effect was similar but with a slightly higher threshold (13.7 points). Mothers with mild to severe depression who participated in either PCI-C or PCI interventions had greater reductions in depression compared to those in the WLC. There were no significant differences between PCI-C and PCI (β = -0.237; SE = 0.129; p = 0.066 for interaction with pre-test score; β = 1.542; SE = 1.498; p = 0.303 for the main effect). It should be noted that a score of 9.6 would still be considered 'minimal' depression, in terms of clinical ratings; a score of 13.7 would be at the lowest end of 'mild' depression.

Intervention Effects on Child Outcomes at 12-Month Follow-Up

Results of the regression analysis predicting 12-month follow-up scores in the children's outcomes, including observed cooperative behaviors (CBRS) and maternal report of adaptive and externalizing behaviors can be seen in Table 2. For the observed measure of cooperative behavior (CBRS), children with mothers in the PCI-C group exhibited a small-to-medium intervention effect on behavior improvement compared to children in the WLC group (β = 0.187; SE = 0.069; p = 0.042; Cohen's d = 0.383). No significant differences were found between the PCI and the WLC (β = 0.129; SE = 0.069; p = 0.061; Cohen's d = 0.281) or between the PCI-C and the PCI (β = 0.058; SE = 0.071; p = 0.414; Cohen's d = 0.141). There were also no significant differences between any of the intervention groups for maternal report of adaptive behaviors.

A more complex effect of the interventions on externalizing behaviors was observed: Pre-test maternal report of externalizing behaviors moderated the impact of the PCI-C intervention

on 12-months post-intervention externalizing scores (PCI-C condition versus both the WLC (β = 0.302; SE = 0.106; p = 0.004) and the PCI condition (β = 0.275; SE = 0.134; p = 0.041)). An analysis of the interaction in Figure 2a revealed that participation in the PCI-C condition was related to reduced maternal report of externalizing behaviors at a significantly higher rate than participating in the PCI and WLC conditions when pre-test BASC Externalizing scores were less than 44.4 and 54.4, respectively. Children in the PCI condition, on the other hand, were not significantly different from those in the WLC condition across any range of prior BASC Externalizing scores (β = 0.028; SE = 0.114; p = 0.807).

Group Differences in Rates of Retention in the Intervention and Long-term Follow-Up

A summary of results of the survival analysis relating to differential dropout between groups is presented in Table 3. No significant differences were found between the intervention groups at pre-test and 6-month follow-up in terms of odds of dropout (8 vs 5; β = -0.74; SE = 0.59; p = 0.06; O.R. = 0.28 and 4 vs 3; β = 0.13; SE = 0.07; p = 0.06; O.R. = 0.28, respectively). Participants in both PCI and PCI-C groups had an approximately 7-8% chance of dropping out before pretest and a 3-5% chance of dropping out between post-test and 6-month follow-up. Significant differences emerged, however, for dropout rates during the intervention period and 12-month follow-up. Participants in the PCI group had 2.55 times the odds of dropping out of the study between pre-test and post-test (the intervention period) as those in the PCI-C group (16 vs 43; β = 0.93; SE = 0.33; p = 0.004; O.R. = 2.55), this means that during the time of active intervention, the participants with the cell phone supports were significantly more likely to complete the intervention. Participants in the PCI group also had 5.12 times the odds of dropping out of the study between 6-month and 12-month follow-up sessions (2 vs 10; β = 1.63; SE = 0.79; p = 0.04; O.R. = 5.12) when compared to PCI-C. Even beyond the active intervention

phase and without further cell phone supports, participants in the PCI-C group were significantly more likely to remain in the study. Put in perspective, participants in the PCI-C group had probabilities of 18% and 2% for dropping out at post-test and 12-month follow-up, respectively; the same probabilities for PCI group members were 46% and 12%, respectively.

Discussion

This study provides evidence that parenting effects attributable to both the PCI and PCI-C interventions persisted 12-months beyond the final intervention session. Mothers in both intervention conditions continued to engage in greater levels of Parent-Child Interactions parenting strategies and scored higher in responsive parenting than mothers in the control condition. Moreover, mothers in the cell-phone enhanced condition were more likely to demonstrate generalization of their newly learned parenting skills to an untrained activity (picking up toys after free play) than were mothers in the traditional (non-cell phone) intervention. Although a variety of parenting interventions have shown treatment durability for more than a year post intervention (e.g., Bernat, August, Hektner, & Bloomquist, 2007; Brotman, et al., 2008; Olds et al., 2004), this is the first evidence of long-term parenting outcomes resulting from Parent-Child Interactions (PCI), in either its traditional or cell-phone enhanced versions.

A review of parenting interventions focused on preschool-aged children reported that only one third examined maintenance of parenting skills one year post-intervention or longer (Sandler, Schoenfeder, Wolchik, & MacKinnon, 2011). Among those that did examine long-term parenting outcomes, many showed short-term positive outcomes with diminishing parenting effects over time (Clingempeel & Henggeler, 2002). The current study found that while mothers in both intervention groups declined in their parenting skills and child-oriented interactions at the

one year follow-up, they maintained higher levels of parenting responsiveness over baseline levels than mothers in the control group.

Another positive long-term effect noted only in the cell phone condition were sizable improvements in children's behaviors: Those in the PCI-C group were found to be more cooperative and have lower levels of reported externalizing behavior than children in the WLC control. This same effect was not found for children in the PCI group. This finding of long-term effects of the PCI-C intervention on children's behavior is consistent with other studies showing the association between parental supports, consistent discipline, and children's emotional regulation (e.g., Eisenberg, Spinrad, & Eggum, 2010). Why these effects were obtained only for the mothers who received the cell-phone enhanced version of the parenting intervention is intriguing; one hypothesis is that they were more likely to embed their newly learned parenting competencies throughout their everyday routines. Therefore, children whose mothers engaged in more positive parenting interactions on a consistent basis may have developed greater coping, attentional control, and social support seeking behaviors, resulting in fewer behavior problems for their children. Similar findings have been reported in other studies of long-term effects of parenting interventions on children's externalizing problems (Brotman et al., 2008; Gross, Garvey, Julion, Fogg, Tucker, & Mokros, 2009).

An unanticipated long-term effect of both the traditional and cell-phone enhanced PCI intervention was the reduction of maternal depression at the 12-month follow-up. We initially found that mothers in the cell phone supported condition had the largest declines in depression during the intervention period (from pre-test to immediate post-test; citation removed); yet the impact on maternal depression was even greater at the 12-months follow-up. Mothers in both intervention groups who started with higher depression scores showed less depression at 12-

months follow-up than mothers in the control group. Even though the intervention was not designed to alter depression, we found that mothers who began the intervention with relatively elevated depression symptoms showed the greatest improvements in depression from pre-test to the 12-months follow-up. This same pattern was found by Lowell and colleagues (Lowell, Carter, Godoy, Paulicin, & Briggs-Gowan, 2011) with their Child FIRST intervention, in which no effects of the intervention on depression were observed at 6-months, with changes noted by 12 months post-intervention. Other researchers exploring the relationship between parenting interventions and long-term effects on depression have speculated about various mechanisms to explain this finding. Quite possibly, individuals who have learned new parenting skills through their participation in an intervention and experienced positive changes in their children's behavior may gain a greater sense of self-efficacy, which could, in turn, be related to reductions in parental depression (Sandler et al., 2012).

The positive effects of the cell phone supports on attrition lasted up to a year after the cell phones were returned. This difference in attrition rates across groups was initially noted post-intervention (citation removed), with effects remaining at 12-months post-intervention. We believe that the additional contact inherent in cell-phone support led to greater rapport with the family coaches and a greater commitment to the research project. That is, once positive relationships were established, participants continued to follow through with research-related activities. Although it was not included in the recent recommendations of the National Academy of Sciences (NAS, 2016), providing support via technology may be more cost-effective and easier to implement than offering financial incentives, motivational interviewing or workforce preparation to increase engagement and retention (Hall & Bierman, 2015). Given that 92% of low-income households own cell phones (Pew Research Center, 2017), the supports provided to

the families in this project would be inexpensive to adopt and sustain. A variety of free and inexpensive software packages (NotePager Pro was used in the current study) now exist that can be used to text participants from a computer, allowing interventionists to use a full keyboard and to schedule texts to be sent automatically.

Retaining at-risk mothers in intervention studies continues to be an issue for researchers and other practitioners, with many mothers receiving a limited amount of the intended interventions due to low engagement and high drop-out rates. For instance, Gershater-Molko, Lutzker, and Wesch (2003) had a retention rate (from baseline to intervention completion) of 45% for the complete SafeCare model compared to a 77% retention rate for the traditional PCI condition and 89% for the cell phone supported PCI condition in the current study. By limiting the number of sessions (focusing on one module, rather than all three SafeCare modules) and adding cell phone supports, retention rates nearly doubled (from 45% to 89%). With the retention of most families at 12-months post-intervention, we are able to make stronger assertions about the long term impact of the intervention on parenting and child behaviors.

Further, this has significant implications for clinical applications. Parent engagement and retention is an ongoing challenge for home-based interventions. With programs serving diverse populations of at-risk families, and providing services that differ in scope, intensity, and duration, there is a need for tools that support parent engagement, and the generalization and maintenance of new skills beyond the home visit. Text messaging is a cost-effective and time-efficient tool for increasing intervention dosage beyond the scope of a weekly home visit, and thus supporting parents in using key strategies in their daily interactions with their child. Further, text messaging shows promise as a tool that can be adapted to extend the reach of home visiting

interventions beyond the period of intense intervention services, thus improving maintenance of intervention impacts.

Limitations. One limitation of the current study is the lack of strong measures of potential mechanisms for change. We have evidence that both interventions (PCI and PCI-C) work but we cannot make strong assertions about how and why the phones boosted intervention effects or what aspect of PCI led to behavioral changes. Future research could remedy this limitation by including strong measures of potential mechanisms, such as a strengthened social network or a more positive therapeutic alliance with the interventionist. While the process of explaining how PCI and PCI-C may have influenced maternal depression was not examined in the current study, future research might assess the ways in which parenting interventions can lead to improvements in children's behavior which, in turn, reduces depression and subsequently improves parenting practices over time. A second limitation for analyzing the current study is the high rate of attrition during the intervention period. In future research we will clarify with participants that they can still complete assessments without completing the intervention visits, and include measures that allow us to conduct a more thorough evaluation of the factors that contribute to attendance, attrition, and engagement.

Summary. In short, this follow-up study provides four new important pieces of information regarding the long-term effects of the Parent-Child Interactions intervention: (1) both traditional and cell phone enhanced versions of PCI resulted in improved parenting skills 12 months after the end of the active period of intervention; (2) children's behavior (both observed and reported) still showed improvement at the 12 month follow-up for those in the PCI-C group; (3) maternal depression was reduced 12 months after the intervention for both intervention groups; and (4) the rate of attrition was much lower for the PCI-C group than the PCI group.

This set of findings add to the literature establishing PCI and SafeCare as evidence-based practices for home visiting and advances the science of intervention on preventing child maltreatment and children's challenging behaviors. We expect that greater understanding of the mechanisms and processes through which parenting interventions improve both positive parenting and children's outcomes will lead to a new generation of effective treatments to prevent maltreatment and promote children's healthy development.

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Table 1

Means and Standard Deviations for Child and Parent Outcomes Across Time and Between Intervention Groups

		Pre-test			Post-test			6-month			12-month		
		N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
PCI-C	PCI Skills	105	0.32	0.19	89	0.50	0.25	84	0.40	0.25	82	0.42	0.22
	Parenting	103	3.66	0.61	89	4.04	0.66	84	3.88	0.73	83	3.83	0.65
	Child Cooperation	105	4.24	0.55	89	4.50	0.46	84	4.56	0.44	83	4.61	0.44
	Child Externalizing	105	50.42	8.78	--	--	--	70	48.14	9.07	47	47.23	8.98
	Child Adaptive Skills	105	48.51	10.22	--	--	--	70	52.27	10.10	47	51.45	9.91
	Depression	102	9.78	7.78	86	7.45	6.05	78	5.46	5.57	81	6.08	5.99
PCI	PCI Skills	137	0.35	0.21	93	0.46	0.24	89	0.41	0.23	81	0.38	0.22
	Parenting	136	3.65	0.60	92	4.09	0.63	89	3.92	0.71	81	4.02	0.58
	Child Cooperation	136	4.24	0.59	93	4.55	0.52	89	4.53	0.54	81	4.55	0.39
	Child Externalizing	135	51.23	9.54	--	--	--	75	48.44	7.16	46	48.44	8.03
	Child Adaptive Skills	136	47.85	9.95	--	--	--	75	48.71	9.36	46	48.57	9.96
	Depression	131	10.07	7.69	93	7.24	6.10	85	7.20	8.21	79	6.94	6.86
WLC	PCI Skills	110	0.33	0.20	102	0.31	0.20	98	0.32	0.19	95	0.28	0.19
	Parenting	110	3.59	0.70	101	3.48	0.72	98	3.54	0.73	95	3.52	0.81
	Child Cooperation	109	4.26	0.60	102	4.36	0.54	98	4.28	0.61	95	4.43	0.53
	Child Externalizing	107	49.29	9.15	--	--	--	89	49.59	8.70	62	50.13	9.17
	Child Adaptive Skills	107	46.44	9.76	--	--	--	89	47.71	10.40	62	49.03	9.31
	Depression	105	8.94	7.69	97	7.66	6.56	93	7.68	7.86	93	6.91	7.79

Note: PCI-C = Parent-Child Interactions with Cellphone component; PCI = Parent-Child Interactions; WLC = Wait-List Control; BASC was not collected at Post-test

Table 2

Regression Results for Parenting and Child Outcomes at 12-Months Post-Test [N=371]

		Estimate (*SE*)	Cohen's d^1	*p*
PCI Skills	Pre-test	0.457 (*0.062*)	--	< .001
	PCI-C vs WLC	**0.139 (*0.029*)**	**0.680**	**< .001**
	PCI vs. WLC	**0.078 (*0.029*)**	**0.373**	**0.007**
	PCI-C vs. PCI	**0.061 (*0.030*)**	**0.278**	**0.041**
Parenting	Pre-test	0.557 (*0.058*)	--	< .001
	PCI-C vs WLC	**0.259 (*0.090*)**	**0.352**	**0.004**
	PCI vs. WLC	**0.403 (*0.090*)**	**0.581**	**< .001**
	PCI-C vs. PCI	-0.143 (*0.093*)	-0.235	0.124
Child Cooperative Behavior	Pre-test	0.137 (*0.049*)	--	0.005
	PCI-C vs WLC	**0.187 (*0.069*)**	**0.383**	**0.042**
	PCI vs. WLC	0.129 (*0.069*)	0.281	0.061
	PCI-C vs. PCI	0.058 (*0.071*)	0.141	0.414
Child Adaptive Skills	Pre-test	0.566 (*0.072*)	--	< .001
	PCI-C vs WLC	0.847 (*0.535*)	0.089	0.593
	PCI vs. WLC	-1.414 (*1.585*)	-0.148	0.372
	PCI-C vs. PCI	2.261 (*1.681*)	0.231	0.179
Child Externalizing Behaviors	Pre-test	0.543 (*0.092*)	--	< .001
	PCI-C vs WLC	**-18.735 (*5.464*)**	**--**	**0.001**
	PCI vs. WLC	-3.302 (*5.869*)	--	0.574
	PCI-C vs. PCI	**-15.434 (*7.018*)**	**--**	**0.028**
	Pre-test * PCI-C vs WLC	**0.302 (*0.106*)**	**--**	**0.004**
	Pre-test * PCI vs. WLC	0.028 (*0.114*)	--	0.807
	Pre-test * PCI-C vs. PCI	**0.275 (*0.134*)**	**--**	**0.041**

[1] Cohen, 1988; 0.2 = Small effect; 0.5 = Medium effect; 0.8 = Large effect

[2] Effect sizes not appropriate for models with interactions, since effect size varies depending on level of moderator (Pre-test, in this case).

Note. Group effects significant at *p* < 0.05 are in **bold**.

Table 3

Survival Analysis Results Related to Parent Attrition [N=371]

Group	Time-point	% drop-out	Estimate[1] (*SE*)	Odds Ratio[1]	*p*
PCI-C	**Pre-test**	**7.08%**	**-2.575** (*0.367*)	**0.076**	**< .001**
	Intervention Period	**14.16%**	**-1.716** (*0.272*)	**0.180**	**< .001**
	6-Month Follow-up	**4.42%**	**-3.056** (*0.512*)	**0.047**	**< .001**
	12-Month Follow-up	**.88 %**	**-3.726** (*0.716*)	**0.024**	**< .001**
PCI	Pre-test	3.52%	-0.736 (*0.585*)	0.479	0.208
	Intervention Period	**30.99%**	**0.934** (*0.328*)	**2.545**	**0.004**
	6-Month Follow-up	2.82%	-0.356 (*0.779*)	0.701	0.648
	12-Month Follow-up	**5.63 %**	**1.634** (*0.790*)	**5.123**	**0.039**

[1] PCI-C is baseline group, so PCI-C estimates represent average log (odds) and odds of dropout for PCI-C group while PCI estimates compare PCI log (odds) and odds of dropout to respective PCI-C estimates.

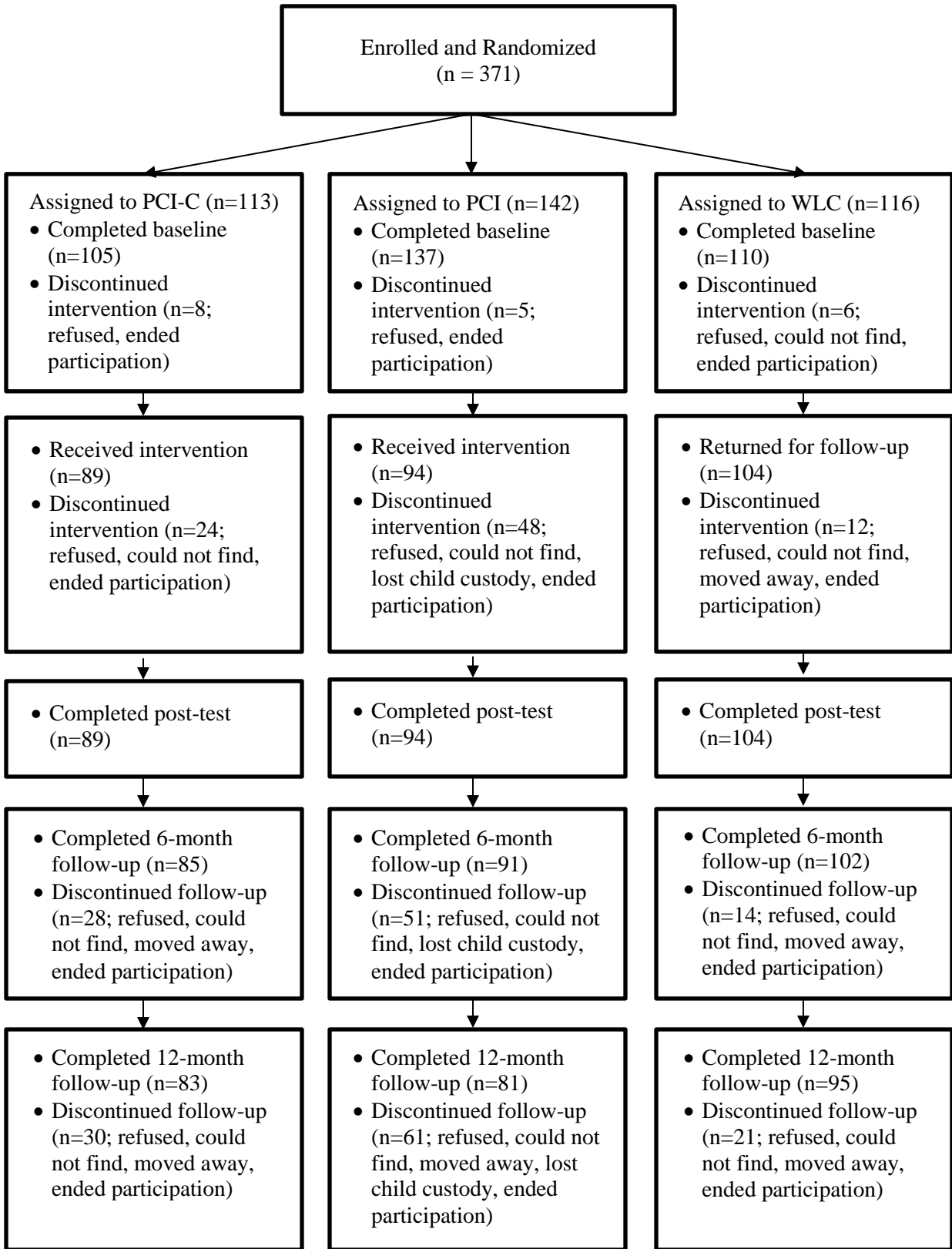Note. Estimates that are significant at $p < 0.05$ are in **bold**.

Figure 1. A summary of participant retention from enrollment to 12-month post-intervention follow-up.
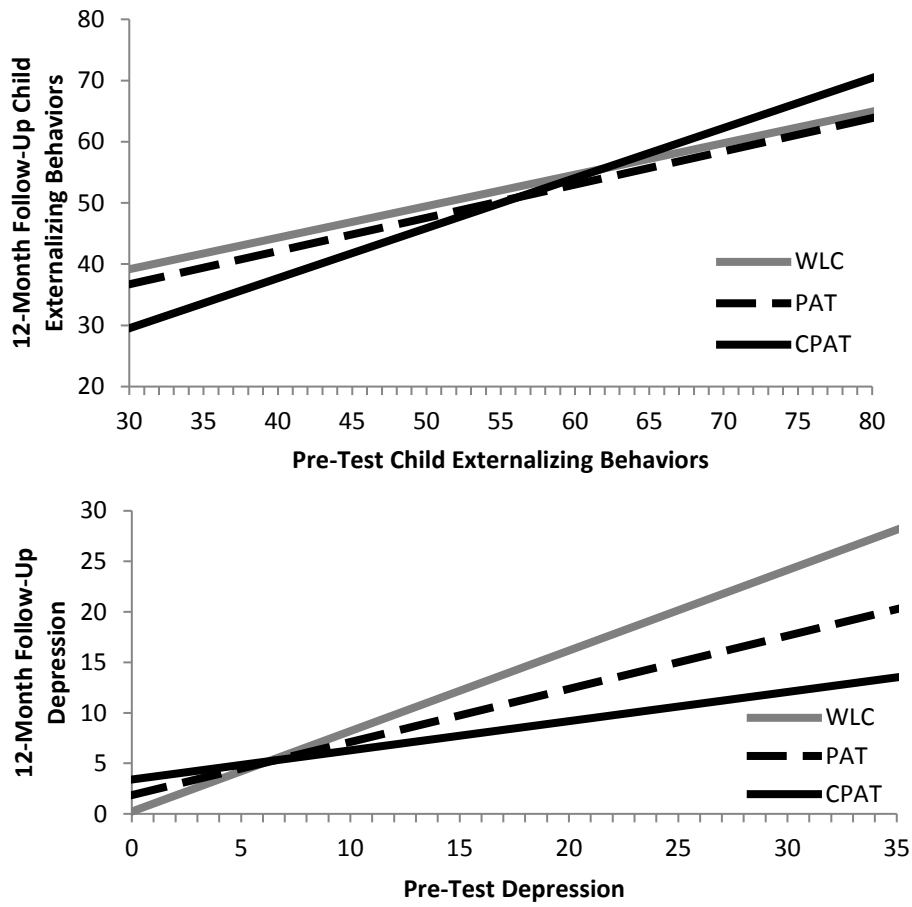
Figure 2. Interactions between group assignment and pre-test functioning in predicting children's externalizing behaviors and maternal depression at 12-month follow-up [N=371]