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Automated Parent-Training for Preschooler Immunization Pain Relief: A Randomized Controlled Trial

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Abstract

Objective To examine a computerized parent training program, "Bear Essentials," to improve parents' knowledge and coaching to help relieve preschoolers' immunization distress. **Method** In a randomized controlled trial, 90 parent–child dyads received Bear Essentials parent training plus distraction, distraction only, or control. Outcomes were parent knowledge, parent and child behavior, and child pain. **Results** Bear Essentials resulted in improved knowledge of the effects of parents' reassurance, provision of information, and apologizing on children's procedural distress. Trained parents also engaged in less reassurance and more distraction and encouragement of deep breathing. Children in Bear Essentials engaged in more distraction and deep breathing than children in other groups. There were no effects on measures of child distress or pain. **Conclusions** Results suggest that the interactive computer training program impacted parent knowledge, parent behavior, and child behavior as hypothesized, but modifications will be necessary to have more robust outcomes on child procedural distress.

Key words: computer applications/eHealth; pain; parents.

Children undergo a host of routine invasive medical procedures, with the most common being immunization injections. Current guidelines recommend roughly 49 doses of 14 vaccines by 6 years of age (Centers for Disease Control and Prevention, 2014). Although necessary to prevent diseases, the majority of children find immunization injections anxiety-provoking and painful, with data suggesting that 63% of children fear needles (Taddio et al., 2012). Growing evidence indicates that there can be lasting negative physiological and psychological effects of previous procedural pain (Noel, McMurtry, Chambers, & McGrath, 2010; Taddio, Ilersich, Ipp, Kikuta, & Shah, 2009; Taddio et al., 2012).

Given the frequency and brevity of immunization procedures, research has focused on nonpharmacological approaches for injection anxiety and pain management. A rich body of assessment work argues that parent behavior accounts for most of the variance in child medical distress (Cohen, Bernard, Greco, & McClellan, 2002; Frank, Blount, Smith, Manimala, & Martin, 1995; Palermo & Chambers, 2005); some parent behaviors appear beneficial and other parent behaviors might exacerbate or reinforce child distress (Blount et al., 1989; Manimala, Blount, & Cohen, 2000; Martin, Chorney, Cohen, & Kain, 2013).

Parent behaviors that reduce child distress and increase child coping include distracting, praising good behavior, using humor, and playing (Blount et al., 2009). Parent distraction in particular has been found to successfully lower child medical pain or distress and is the key ingredient in most pediatric procedural pain or distress management interventions (Birnie et al., 2014; Cohen, Cousins, & Martin, 2013; DeMore & Cohen, 2005; Schechter, Zempsky, Cohen, McGrath, McMurtry, & Bright, 2007; Uman et al., 2013). In addition, encouraging coping, such as engaging in deep breathing, has been shown to benefit children during stressful procedures (French, Painter, & Coury, 1994).

Parent behaviors that are positively correlated with children's procedural distress include reassuring, providing information, apologizing, and criticizing. The most frequent parent behavior directed toward children during medical events is reassurance (Blount et al., 1989). Additionally, findings from an experimental study indicate that parents' reassurance might cause or exacerbate some children's pain or distress behaviors (Manimala et al., 2000; McMurtry, Chambers, McGrath, & Asp, 2010), although this finding is not consistent (Gonzalez, Routh, & Armstrong, 1993; Martin et al., 2013).

At this point in time, data generally suggest that parents should maximize distraction, praise, humor, and play and minimize reassurance, information provision, apologies, and criticism to best assist their children during immunization injections. However, dissemination and implementation of this advice is challenging. Although individually training parents before pediatric procedures in distraction is effective (DeMore & Cohen, 2005; Piira, Hayes, & Goodenough, 2002; Uman et al., 2013) and sending parents training packages before surgery has been shown to be successful (Kain et al., 2007; Martin et al., 2011), these approaches might be time- and cost-prohibitive for a brief immunization (Cohen, Blount, & Panopoulos, 1997). The practical approach of training the medical staff to coach untrained parents is promising (Cohen, Blount, Cohen, Schaen, & Zaff, 1999; Cohen et al., 1997, 2002, 2006) but limited. Specifically, there is variability in staff behavior and low-quality control of the intervention; the medical staff might not have the time or interest to adequately devote to coaching; and parents will not explicitly learn evidence-based coaching behavior. A solution might reside in the burgeoning field of health technology, where computers or other electronic systems might provide pediatric interventions in a consistent and low-cost manner (Palermo & Wilson, 2009; Wu, Steele, Connelly, Palermo, & Ritterband, 2014).

The primary research aim of this study was to evaluate a time-efficient, automated computer program designed to teach parents to engage in evidence-based behavior during their preschooler's immunization injections. Given that pediatric pain relief was expected to result secondary to effective parent coaching, our primary hypothesis was that a parent computer training intervention would result in greater immediate and long-term parent knowledge about the impact of specific parent behavior on child procedural distress. Along with this aim, we further hypothesized that parents who received the computer training would engage in more distraction, praise, humor, and play and less reassurance, provision of information, apologizing, and criticism during their children's immunizations than untrained parents who were provided with a distraction approach (i.e., movies) or parents who received standard care. A secondary research hypothesis—but central clinical ambition—was that children in the parent training condition would display less distress and engage in more distraction and coping than children in the distraction condition, followed by children in the control condition. Additionally, we hypothesized that children in the parent training condition would self-report and be reported by parents

and nurses as experiencing lower pain than children in the distraction condition, followed by children in the control condition.

Method

To date, one other publication has resulted from the data with these participants. This study found that child anxiety mediated the relation between parent anxiety and child pain (Bearden, Feinstein, & Cohen, 2012); the prior study did not include analyses of the primary variables in the current investigation (i.e., parent knowledge, parent behavior, child behavior). The randomized clinical trial was prepared in accordance with guidelines enumerated in the Consolidated Standards of Reporting Trials statement (Altman et al., 2001; Stinson, McGrath, & Yamada, 2003).

Participants

To select an appropriate sample size, we used the effect sizes from a prior study comparing the impact of live training on parents' coping-promoting behavior (.83 effect size) and distress-promoting (.52 effect size) behavior during preschoolers' immunizations (Cohen et al., 1997). An analysis with power of .80 revealed that between 19 and 47 participants per group would be needed to detect a significant effect on parents' coping-promoting or distress-promoting behaviors, respectively, with a t test (GPOWER; Faul & Erdfelder, 1992). Thus, 90 participants (30 per group) were deemed sufficient for the current three-arm randomized controlled trial.

Inclusion criteria were that the participants consisted of a parent and his/her 4- to 6-year-old child presenting at an outpatient pediatric practice for preschool immunizations (i.e., Diptheria, Tetanus, Pertussis and Polio; Measles, Mumps, and Rubella, Varicella). Families were excluded if they were unable to complete measures due to being non-English speakers or the child having significant medical or developmental issues. In all, 113 families were assessed for eligibility, and 90 met inclusion criteria and agreed to participate. Parents included 78 mothers and 12 fathers, with ages ranging from 28 to 50 years ($M = 38$ years, $SD = 4.3$ years). Eighty-five (94.4%) parents identified as either married or in a common law relationship. Parents identified as White (83.3%), Asian/Pacific Islander (8.9%), Black (4.4%), or Mixed (2.2%), and ranged in annual income but were generally affluent (annual income ranged from \$38,400 to \$350,000, $M = \$127,688$, $SD = \$67,418$). Parent education level varied from 12 (graduated high school) to 25 years ($M = 16.8$ years, $SD = 2.4$ years).

Regarding the pediatric patients, 46 were female and 44 were male. The children were White (81%), Mixed (7.8%), Asian/Pacific Islander (5.6%), Black (4.4%), and one parent failed to indicate child's race. Children's ages ranged from 4 to 6.5 years ($M = 4.8$ years, $SD = 9.7$ months), and they received between one and four immunization injections each ($M = 2.19$; $SD = 1.01$). No pain management strategies (e.g., topical anesthetics) beyond the study behavioral interventions were provided.

Measures
Background Information
Demographic information for the parent (i.e., relation to child, age, gender, race, education level, total family income, marital status) and child (i.e., age, gender, and race) was assessed using a questionnaire.

Parent Procedural Behavior Knowledge
Parent behavioral knowledge at baseline, postprocedure, and at 3-month follow-up was gathered using the Parent Procedural Behavior

Knowledge Test, developed for this study. On the measure, parents were asked, "Please indicate whether you believe the following parent behaviors help or do not help children when they are upset during a medical procedure." There were eight behaviors listed (e.g., "Providing information," "Distracting"), and consistent with the literature (Blount et al., 2009), responses that suggested distracting, praising, using humor, and playing decrease child distress were considered correct. Responses suggesting that reassuring, providing information, apologizing, and criticizing do not decrease and might increase child distress were considered correct. Parents responded to the items using visual analog scales (VASs) with 100-mm horizontal line anchors of "*Decreases Child Distress*" (0) to "*Increases Child Distress*" (100). VASs were selected because they are commonly used in pediatric procedural distress studies, and it was determined that a consistent response format across all measures would be more efficient in a busy pediatric practice. In addition, the extant literature is not definitive in terms of whether parents' behaviors always lead to higher or lower distress, so the VAS allows for more variability in possible parent responses. Before analyses, responses for the four behaviors that decrease child distress were reverse-scored so that higher scores indicate greater knowledge for all eight behaviors.

Given that parents may have existing knowledge about the potential impact of some behaviors compared with other behaviors (e.g., parents likely know criticizing is not useful but might be unsure about the usefulness of providing information), we did not expect high internal consistency on the knowledge measure at baseline for any of the participating parents. However, we expected that following the training, the measure would be more internally consistent regarding knowledge for the participants in the treatment group. Data supported these expectations. The average baseline knowledge Cronbach's alpha score was .36 (.34–.40 across the three conditions). The Cronbach's alpha for the groups that did not receive the computer training (i.e., Distraction and Standard Care) ranged from .09 to .22 following the injection and from −.22 to .01 at 3-month follow-up. In contrast, the Cronbach's alpha for the knowledge measure for the parents who received the computer training was .78 following the injection and .73 at 3-month follow-up. These data provide initial support for the internal consistency of this novel measure.

Parent Procedural Behavior

Parent behavior during the immunization was recorded using a camcorder positioned on a tripod in the corner of the treatment room. The following eight behaviors were coded: distracting, praising, using humor, playing, reassuring, providing information, apologizing, and criticizing. These behaviors are commonly used in behavioral coding scales (Blount et al., 1989; Cohen, Bernard, McClellan, & MacLaren, 2005; Elliott, Jay, & Woody, 1987) and mapped onto the items assessed with the knowledge questionnaire. A coding manual was developed that operationally defined each behavior. For example, distracting was described as *Distracting behaviors that are intended to orient the child toward a specific distracting stimulus. Note: this may be the portable DVD player or could be another distraction in the room (e.g., a poster). Examples: "Who's the good guy?" "Have you seen this movie before?" Pointing to a poster on the wall*. In addition, parents' commanding to cope, physical comforting, and encouraging deep breathing were coded. The first two were selected because they are commonly coded in other pediatric behavioral distress studies (Blount et al., 1989; Cohen et al., 2005; Elliott et al., 1987). Encouraging deep breathing was included because it was demonstrated in the computer training program as a helpful parent coaching behavior.

Coding was consistent with prior studies (Manimala et al., 2000), with the number of occurrences of each target behavior in 5-s intervals divided by the total number of 5-s intervals in the procedure to produce a ratio of behavior. Initially, coders were trained to criteria using videotaped data from a prior preschooler immunization study. Once interrater agreement was achieved (i.e., Cohen's kappa of .80), coding of study data commenced. Consistent with previous studies in this area (Manimala et al., 2000), coding spanned from 3 min before cleaning of the skin until 3 min following removal of the needle or the family leaving the treatment room, whichever occurred first. Twenty percent of the data was coded by two coders to evaluate interrater agreement. Cohen's kappa for individual behavioral codes suggested strong agreement (range: .80–.90).

Child Procedural Behavior

To quantify children's response to treatment and distress, the following behaviors were selected from commonly coded behaviors in the literature (Blount et al., 1989; Cohen et al., 2005; Elliott et al., 1987): engaging in distraction, deep breathing, crying, screaming, and negative emoting. Coding was done as described above, and interrater agreement was strong for child procedural behaviors (Cohen's kappa range: .71–1.00).

Child Pain Ratings

Following the immunization procedure, children self-reported pain using the Children's Anxiety and Pain Scales (CAPS; Kuttner & LePage, 1989). Parents and nurses provided 100-mm VAS proxy reports of children's pain. These measures are widely used and are generally shown to be psychometrically sound for measuring preschooler immunization pain (Cohen, Lemanek, et al., 2008).

Procedure

Institutional approval was acquired before initiation of the study. Data collection was carried out by trained graduate research assistants (RAs) between July and October 2006, with follow-up data collected between September 2006 and January 2007, until all data were collected. RAs approached families after entering the medical facility. At that time, informed consent was obtained, background information was collected, and the baseline Parent Procedural Behavior Knowledge Test was completed. An RA blind to study conditions oversaw random assignment of participants to condition, which was completed as specified by a computer-generated random number table. Condition assignment remained concealed in a binder and was only revealed to the family following their agreement to participate.

For participants in all three conditions, videotaping began when the family entered the treatment room and ended 3 min after removal of the last needle or when the family exited the treatment room. At that time, the videotaping ended and children, parents, and nurses completed child pain measures. In addition, parents completed the postinjection Parent Procedural Behavior Knowledge Test. Parents were mailed the Parent Procedural Behavior Knowledge Test 90 days later with a cover letter requesting that it be completed and returned to the researchers. If after two mailings, parents failed to return it, they were called and asked to complete the measure via a phone interview. If they could not be reached, their follow-up data were not included.

Standard Care Control

In the standard care control (Control) condition, parents were provided treatment as usual in this pediatric medical setting, which did

not include any parent training around how to manage pediatric pain. Further, no movies or other systematic distractions were provided. However, parents and nurses likely engaged in idiosyncratic distraction and other natural techniques to manage children's distress during the procedure.

Distraction Only

In the distraction-only (Distraction) condition, after completion of the baseline knowledge questionnaire, parents were provided a laptop installed with predominately parent-led computer games to use for approximately 10 min while in the waiting room. Typically, the child joined or observed the parent using the laptop. This was done to control for the time and manner spent by families in the Training condition using the laptop in the waiting room. The family was allowed to use the laptop while waiting and it was collected after 10 min and before them being called to the treatment room. When entering the treatment room, the nurse made available a portable DVD movie player and a selection of age-appropriate movies to watch during the medical procedure. No direct training regarding optimal behavior was provided to the parents. This intervention is consistent with the protocol used in prior successful pediatric immunization distraction studies with a DVD movie player (Cohen and colleagues, 1999, 2002; MacLaren & Cohen, 2005).

Bear Essentials Parent Training Plus Distraction

After completing the baseline knowledge questionnaire, parents in the Bear Essentials parent training plus distraction (Parent Training)

condition received a laptop loaded with the "Bear Essentials" program, an approximately 10-min interactive animated computer program. Bear Essentials was developed for this study by Computers for People, a small educational software company. Informal focus groups and interviews with children, parents, clinicians, and researchers assisted in each phase of development (e.g., character creation, story sequence). The program displayed "Big Bear" taking "Little Bear" to a physician's visit for an immunization, which was followed by Big Bear attempting to soothe Little Bear with different tactics selected by the parent via buttons on the screen (e.g., distraction, criticism, reassurance; see Figure 1 for a screenshot). A narrator explained whether each parent behavior positively or negatively impacted child distress, which was also demonstrated by the animated bears (e.g., Little Bear watching with interest and a smile as Big Bear held up a picture book). The parent had to click the "Next" button to advance the program, which was only active when each specific behavioral module (e.g., reassuring) was complete; thus, parents could not fast-forward or skip screens. Typically, the child watched along as the parent completed the training program.

The computer program delineated the helpful qualities of distraction, praise, humor, and playing with the child. The program also indicated that reassurance, providing too much information, apologizing, and criticism might exacerbate child distress. It should be noted that efforts were made to adhere to the empirical evidence and thus some messages were not definitive (e.g., "Reassurance *might* heighten distress" rather than "Reassurance *heightens* distress"). In addition, the computer program was designed to teach

Figure 1. Screenshot from Bear Essentials program.

parents how to behave during different phases of the procedure based on findings from previous research (Blount, Piira, & Cohen, 2003; Cohen, MacLaren, & Lim, 2008). Specifically, providing brief information regarding the procedure, teaching coping skills, and choosing a distractor to use during the procedure are things that can be done preprocedurally. During the procedure, parents were encouraged to distract the child and encourage coping (e.g., deep breathing) and avoid negative behavior (e.g., reassurance, criticism). Finally, immediately following the procedure, parents were encouraged to praise their child.

Identical to the Distraction condition, the nurse provided a portable DVD player and movies to the families in the Parent Training condition to use during the medical procedure. The nurse was blind to whether the family was in the Distraction or Parent Training condition, and presented the DVD player and movies in a similar fashion across these conditions.

Results

Preliminary Analyses

The conditions did not differ on parent race, gender, marital status, income, education level, or number of injections. Pearson product moment correlations revealed a small but significant positive correlation between family income and baseline behavior procedural knowledge for distraction, $r(90) = .26$, $p = .03$. No other significant relations were found between preinjection behavioral procedural knowledge and family income, parent education level, parent age, or parent gender. Demographic characteristics were not associated with parent behavior or child behavior. Descriptive analyses were conducted to detail parent knowledge, parent behavior, child behavior, and child pain by condition (Tables I–IV).

Primary Analyses

Parent Knowledge

To examine parent knowledge, 3 (Condition: control, distraction, parent training) $\times$ 2 (Time: postinjection, 3-month follow-up) repeated-measures analyses of covariance were performed on the eight behaviors, controlling for baseline knowledge. Of the four encouraged behaviors, there were no significant main effects or interactions for parents' knowledge regarding the use of distraction, praise, humor, or play.

Of the four discouraged behaviors, there were no significant main effects or interactions for parents' knowledge of criticism. There was a significant Condition $\times$ Time interaction for reassurance knowledge, $F(2, 61) = 4.75$, $p = .01$, $\eta^2 = .14$. Post-hoc analyses indicated that at postprocedure, parents in the Parent Training condition reported higher scores than those in the Control condition and Distraction condition ($p < .05$), indicating greater knowledge that reassurance increases child distress. At the 3-month follow-up, parents in the Parent Training condition continued to report significantly higher scores than those in the Distraction condition ($p < .05$), but not than those in the Control condition ($p > .05$).

There was also a significant main effect of condition for providing information knowledge, $F(2, 61) = 8.97$, $p < .001$, $\eta^2 = .23$. At postprocedure and at the 3-month follow-up, parents in the Parent Training condition reported significantly higher scores than those in the Control or Distraction conditions, indicating knowledge that providing information increases distress (p values $< .05$).

Finally, there was a significant main effect of condition for apologizing knowledge, $F(2, 61) = 5.35$, $p = .01$, $\eta^2 = .15$.

At postprocedure and at the 3-month follow-up, parents in the Parent Training condition reported significantly higher scores than those in the Control or Distraction conditions, indicating greater knowledge that apologizing increases distress (p values $< .05$).

Parent Behavior

To examine parent behavior, a multivariate analysis of variance (MANOVA) was conducted for the parent behaviors codes. Using Pillai's trace, there was a significant effect of condition on parents' behaviors, $V = .70$, $F(30, 132) = 2.70$, $p < .001$, $\eta^2 = .38$. There was a main effect of condition on parents' distracting behavior, $F(2, 79) = 12.74$, $p < .001$, $\eta^2 = .24$. Follow-up analyses revealed that parents in the Parent Training condition engaged in distraction significantly more than those in the Control or Distraction conditions (p values $< .05$). There was a significant effect of condition on parents' encouragement of deep breathing, $F(2, 79) = 8.48$, $p = .001$, $\eta^2 = .18$. Parents in the Parent Training condition encouraged children to engage in deep breathing significantly more than parents in the Distraction and Control conditions (p values $< .05$). There was also a significant effect of condition on parents' use of commands to cope, $F(2, 79) = 5.47$, $p = .01$, $\eta^2 = .12$. Parents in the Control condition used more commands to cope than parents in the Distraction or Parent Training conditions (p values $< .05$). Finally, there was a main effect of condition on parents' reassuring behavior, $F(2, 79) = 4.63$, $p = .01$, $\eta^2 = .11$, with follow-up analyses revealing that parents in the Parent Training condition used reassurance significantly less often than those in the Control or Distraction conditions (p values $< .05$). Follow-up univariate ANOVAs revealed

Table I. Parent Procedural Knowledge Controlling for Baseline Knowledge

Knowledge	Control (M, SD)	Distraction (M, SD)	Training (M, SD)
Distracting			
Postprocedure	77.60 (24.21)	76.23 (22.15)	81.89 (27.34)
Follow-up	73.08 (22.98)	74.05 (19.95)	74.16 (28.95)
Praising			
Postprocedure	84.48 (15.82)$_a^x$	73.20 (25.37)$_b$	87.67 (12.10)$_a^x$
Follow-up	72.48 (23.16)^y	74.85 (20.21)	69.44 (24.23)^y
Using humor			
Postprocedure	77.42 (17.87)	69.76 (25.38)	74.89 (22.39)
Follow-up	72.08 (20.30)	74.00 (15.62)	76.37 (18.01)
Playing			
Postprocedure	77.38 (17.94)	68.90 (15.76)	74.74 (21.70)
Follow-up	77.71 (15.76)	72.57 (17.38)	81.42 (18.59)
Reassuring			
Postprocedure	11.32 (9.50)$_a$	25.52 (28.88)$_b^x$	42.68 (32.29)$_c^x$
Follow-up	14.36 (13.87)$_a$	14.52 (10.18)$_a^y$	25.63 (23.81)$_b^y$
Providing information			
Postprocedure	43.28 (29.43)$_a$	36.71 (20.05)$_a$	62.21 (31.63)$_b^x$
Follow-up	35.56 (29.00)$_a$	29.24 (21.14)$_a$	49.21 (33.76)$_b^y$
Apologizing			
Postprocedure	61.96 (25.80)$_a$	54.81 (23.22)$_a$	77.05 (21.83)$_b$
Follow-up	57.92 (26.70)$_a$	60.90 (20.28)$_a$	73.68 (20.89)$_b$
Criticizing			
Postprocedure	83.60 (24.40)	80.43 (31.56)^x	88.47 (14.20)
Follow-up	88.52 (18.22)	89.67 (8.94)^y	90.58 (8.47)

Note. Subscripts and superscripts indicate significant differences at $p \leq .05$. Means in the same row that do not share subscripts indicate significant differences. Means in the same column that do not share superscripts indicate significant differences. Higher response values infer higher knowledge.

non-significant treatment effects of condition for praising, using humor, playing, providing physical comfort, providing information, apologizing, or criticism.

Child Behavior

To examine child behavior, a MANOVA was conducted with the following behaviors: engagement in distraction, deep breathing, crying, screaming, and negative emotion. Using Pillai's trace, there was a significant effect of condition on the behaviors children engaged in during the injection procedure, $V = .75$, $F(36, 130) = 2.16$, $p = .001$, $\eta^2 = .38$. There was a significant effect of condition on children's engagement in distraction, $F(2, 81) = 22.99$, $p < .001$, $\eta^2 = .36$, with children in the Distraction and Parent Training conditions engaging in more distraction than children in the Control condition (p values $< .05$). There was also a significant effect of condition on children's use of deep breathing, $F(2, 81) = 3.87$, $p = .03$, $\eta^2 = .09$. Children in the Parent Training condition engaged in significantly more deep breathing than those in the Control or Distraction conditions (p values $< .05$). There were no significant treatment effects for children's crying, screaming, or negative emoting.

Child Pain

Univariate ANOVAs were conducted to examine differences between conditions in child, parent, and nurse ratings of child pain. There were no significant differences in child pain across child, $F(2, 85) = .39$, $p = .68$, $\eta^2 = .01$, parent, $F(2, 87) = 1.57$, $p = .20$, $\eta^2 = .04$, or nurse, $F(2, 87) = 1.25$, $p = .29$, $\eta^2 = .03$, ratings.

Discussion

The primary aims of the present study were to evaluate an interactive evidence-based computer parent training program designed to improve parents' knowledge and behavior in regard to assisting their children during distressing immunization injections. Secondary aims were to examine whether the parent training program led to improvements in child behavior or pain relief.

Parent Knowledge

Baseline knowledge scores suggested that parents generally understood that distraction, praise, humor, and play were behaviors that could effectively reduce their child's procedural distress. Similarly, parents across conditions appeared to know at baseline that

Table II. Ratios of Parent Procedural Behavior

Behavior	Control (M, SD)	Distraction (M, SD)	Training (M, SD)
Distracting	0.05 (0.08)a	0.06 (0.05)a	0.15 (0.11)b
Praising	0.03 (0.03)	0.03 (0.03)	0.03 (0.03)
Using humor	0.00 (0.01)	0.00 (0.01)	0.00 (0.00)
Playing	0.00 (0.01)	0.00 (0.00)	0.00 (0.00)
Encouraging deep breathing	0.00 (0.00)a	0.00 (0.00)a	0.02 (0.04)b
Commanding to cope	0.01 (0.02)b	0.00 (0.00)a	0.00 (0.01)a
Physical comfort	0.07 (0.08)	0.05 (0.08)	0.04 (0.04)
Reassuring	0.12 (0.09)a	0.10 (0.12)a	0.05 (0.06)b
Providing information	0.07 (0.05)	0.06 (0.05)	0.03 (0.04)
Apologizing	0.00 (0.01)	0.01 (0.01)	0.00 (0.01)
Criticizing	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Note. Subscripts indicate significant differences at $p \leq .05$. Means in the same row that do not share subscripts indicate significant differences.

apologizing and criticizing could increase their child's distress. Because of the high baseline scores with these behaviors, a ceiling effect might have constrained our ability to detect improvements in knowledge. Similarly, the statistically significant improvement in knowledge regarding the downside of apologizing for parents who received training might have had little clinical significance, given that parents across groups generally appeared to have this knowledge.

In contrast, baseline knowledge scores suggested that parents were generally not aware of the evidence that reassurance and providing excessive procedural information could heighten children's procedural distress. This is consistent with other research arguing that most parents believe reassurance is beneficial (McMurtry et al., 2010) and helps explain why reassurance is the most common parent behavior performed to soothe children in pain or distress (Blount et al., 1989; Cohen, Manimala, & Blount, 2000). The Bear Essentials training module successfully improved parents' knowledge about the potential downsides of reassurance. The training was also effective in increasing parents' knowledge regarding the potential negative effects of providing too much procedural information to their child. In addition, this knowledge gain was maintained 3 months following training. Given that the automated computer training lasted for fewer than 10 min and was conducted in a busy waiting room environment, these findings are especially encouraging.

Parent Behavior

The Bear Essentials training program resulted in parents using more distraction and also encouraging their children to engage in deep breathing. To our knowledge, this is the first time that a computerized training program has resulted in changes in parents' behavior during children's medical procedures. Prior research has demonstrated that person-to-person training in distraction is effective in behavior change, but it is costly (Chambers, Craig, & Bennett, 2002; Cohen et al., 1997; Manimala et al., 2000). The finding that parents who received training performed more distraction is

Table III. Ratios of Child Procedural Behavior

Behavior	Control (M, SD)	Distraction (M, SD)	Training (M, SD)
Engaging in distraction	0.04 (0.07)b	0.34 (0.25)a	0.36 (0.22)a
Deep breathing	0.00 (0.00)a	0.00 (0.00)a	0.01 (0.02)b
Crying	0.35 (0.31)	0.25 (0.24)	0.34 (0.30)
Screaming	0.04 (0.07)	0.06 (0.11)	0.05 (0.10)
Negative emoting	0.04 (0.06)	0.02 (0.05)	0.01 (0.02)

Note. Subscripts indicate significant differences at $p \leq .05$. Means in the same row that do not share subscripts indicate significant differences.

Table IV. Child Procedural Pain Ratings

Pain ratings	Control (M, SD)	Distraction (M, SD)	Training (M, SD)
Child self-report	3.38 (0.30)	3.43 (0.29)	3.72 (0.30)
Parent proxy report	49.87 (4.48)	53.73 (4.48)	61.23 (4.48)
Nurse proxy report	49.10 (4.04)	42.60 (4.04)	51.27 (4.04)

Note. There were no significant differences by condition. Self-report was on a 1–5 scale and parent- and nurse-proxy reports were on 0–100 scales, with higher scores representing high pain.

especially impressive, given that parents across conditions demonstrated high knowledge regarding the benefits of distraction.

Consistent with improvements in knowledge from training regarding the potential negative aspects of parents' reassurance, parents receiving computerized training engaged in fewer reassuring comments than parents in the other conditions. Data suggest that reassurance is the most common naturally occurring adult behavior during pediatric procedures (Blount et al., 1989), and researchers have repeatedly called for interventions to minimize parents' reassurance (McMurtry et al., 2010); our finding suggests that computer training might be an avenue for reducing parents' unhelpful behavior in the context of preschooler immunizations.

The lack of difference among the trained and untrained conditions in providing procedural information—despite the increase in knowledge—might be due to a limitation of the program. Specifically, the brief computer module did not detail what information to provide, and it is possible that parents might not have been aware of the optimal and developmentally appropriate ways of providing information to their children (Jaaniste, Hayes, & Von Baeyer, 2007; Welkom, Cohen, Joffe, & Bearden, 2009). Further, the low base rates of parent behavior made it difficult to discern group differences on these behaviors. In fact, there was a low base rate across all parent behavior. Unfortunately, this situation is common in this line of study, as parents are more reserved and tend to defer to the medical staff to lead the interactions during pediatric procedures (Cohen et al., 2000).

There was an unexpected finding that parents in the control condition engaged in more commands to cope than parents in the other conditions. This could have been due to the presence of a portable DVD player in the two treatment conditions, which might have given parents in those conditions the ability to direct attention to distraction instead of relying on commands for the child to cope with the immunization procedure.

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Children in the Distraction and the Parent Training groups engaged in more distraction than children in the Control condition. These promising findings are consistent with the literature that children are able to engage in distraction during a stressful medical event, especially if the parents have stimuli readily available to use (Cohen et al., 2013). Furthermore, consistent with the result that parents who received training engaged in more encouragement of deep breathing, children in the training condition also engaged in more deep breathing. This might be the first time research has demonstrated that an automated parent training leads to changes in parent behavior, which in turn leads to changes in child behavior.

These exciting findings are tempered by the lack of differences around child distress or pain. There are a number of potential explanations. For example, there is variability in the effectiveness of distraction based on a host of variables (Cohen et al., 2013; Leventhal, 1992), and although the training increased the quantity of distraction, the quality of distraction might have been suboptimal (Kleiber, McCarthy, Hanrahan, Meyers, & Weathers, 2007). In addition, given that the means were generally in the expected directions, power might explain null statistical results; however, a lack of clinical differences in children's pain and distress would likely have remained. Given the near ubiquity of portable digital devices in society, it is also possible that viewing movies in a medical practice is less novel and engaging to children than it was when some of the first movie distraction studies were conducted (Cohen et al., 1997; Kelley, Jarvie, Middlebrook, McNeer, & Drabman, 1984). It should

also be noted that children generally engaged in low rates of behavior beyond crying, which is unfortunately common with preschooler immunizations. In addition, there continues to be significant levels of child pain and distress even when interventions are shown to be effective (Uman, 2013). In short, our behavioral data and null results underscore the importance of continuing to investigate pediatric procedural distress management.

Several limitations in the current study should be noted. As is common with randomized controlled trials, the homogenous nature of the sample (e.g., age, ethnicity, income) limits the generalizability of the results. That said, given that this is the first attempt to evaluate computerized parent training for pediatric pain relief, it is important to emphasize internal over external validity. The brevity of the training program (less than 10 min) and lack of face-to-face individualized training were viewed as important in terms of practical concerns; however, overall the intervention did not demonstrate sufficiently robust results, especially in terms of child outcomes.

This study highlights a number of future directions. First, our data suggest that automated computer training—with modifications—should be further explored as a practical mode of intervention for busy pediatric settings. Possibly, focus groups and fine-grained behavioral coding might reveal the critical components that should be enhanced in future iterations of computerized training. Providing training online or via a home module might be a way to overcome some of the practical issues of in-clinic computerized training.

In sum, we developed and tested a brief computer program designed to train parents in evidence-based behavior that would reduce child distress during immunizations. This approach was designed to address some of the science–practice gaps in disseminating information about the best behaviors parents can engage in to help their children during medical procedures. Although the intervention improved parents' knowledge and behavior, which increased children's engagement in distraction and use of deep breathing, children's procedural distress and pain remained unchanged. Thus, we are encouraged to continue developing and refining automatized trainings to improve medical experiences for children. Specifically, we will focus on providing helpful, concrete behaviors that the parents can engage in, and may consider coupling parent training with age-appropriate computer training for children as well. We are confident that automated trainings can and will be useful in the future.

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