This pilot study examined changes in parenting skills and child behavior following participation in an online positive parenting skills program designed for young children with traumatic brain injury (TBI). Thirty-seven families with a child between 3 and 9 years of age who sustained a moderate to severe TBI were randomly assigned to one of two interventions: online parenting skills training ($n = 20$) or access to Internet resources on managing brain injury ($n = 17$). Parent–child interaction observations and parent ratings of child behavior were collected pre- and post-treatment. Generalized estimating equations and mixed models were used to examine changes in parenting skills and child behavior problems as well as the moderating role of family income on treatment response. Participants in the parenting skills group displayed significant improvements in observed positive parenting skills relative to participants in the Internet resource group. Income moderated improvements in parent ratings of child behavior, with participants in the low-income parenting skills group and high-income Internet resource group reporting the greatest improvements in behavior. This is the first randomized controlled trial examining online parenting skills training for families of young children with TBI. Improvements in positive parenting skills and child behavior support the utility of this intervention, particularly for families from lower socioeconomic backgrounds.

Keywords: TBI; online intervention; positive parenting; brain injury; randomized clinical trial

Each year in the United States, approximately 475,000 children between 0 and 14 years of age sustain a traumatic brain injury (TBI; Faul, Xu, Wald, & Coronado, 2010). These injuries can result in a variety of long-term negative effects, particularly changes in behavior (Schwartz et al., 2003) that are typically characterized by increases in externalizing problems, including impairments in inhibitory control and self-regulation as well as increased oppositionality (Chapman et al., 2010, Ganesalingam, Sanson, Anderson, & Yeates, 2006).
Beyond injury severity, social disadvantage/lower socioeconomic status (SES), chronic stress, parent psychological distress, and poor parent–child interactions have been shown to contribute to child behavior problems following TBI (Raj et al., 2013; Schwartz et al., 2003; Taylor et al., 2001). Although SES cannot be readily changed, other factors that are correlated with social disadvantage, such as parental responsiveness and disciplinary practices (Fairbanks et al., 2013; Micklewright, King, O’Toole, Henrich, & Floyd, 2012), can be modified through interventions and support. Addressing these factors may prevent escalating child mood and behavior problems after injury. A facilitative home environment, consistent and non-punitive disciplinary practices, and parental warmth and responsiveness toward a child with TBI are associated with greater recovery and better long-term outcomes, underscoring the importance of these factors (Micklewright et al., 2012; Wade et al., 2011).

Parenting skills programs, including the Incredible Years (Webster-Stratton, Reid, & Stoolmiller, 2008), Parent–Child Interaction Therapy (PCIT; Eyberg, 1988), and the Positive Parenting Program (Wiggins, Sofronoff, & Sanders, 2009), teach parents how to build a warm, responsive relationship with their child as well as strategies for consistent, non-punitive discipline. Some programs, such as PCIT, also incorporate live parent coaching. During coaching sessions, parents play with their child while wearing an earpiece, allowing the therapist to provide in vivo feedback and suggestions without the child hearing. Parenting programs that incorporate in-session practice result in greater gains in parenting skills, as well as greater reductions in child externalizing behavior problems, compared with programs that do not include in-session practice (Kaminski, Valle, Filene, & Boyle, 2008). Previous research on parenting programs has focused on families of children with or at-risk for developing disruptive behavior disorders such as oppositional defiant disorder (e.g., Thomas & Zimmer-Gembeck, 2007). Given that many children exhibit deficits in attention and inhibitory control, as well as increased aggression after TBI, similar parenting programs may benefit parents of children with TBI (Cohen, Heaton, Ginn, & Eyberg, 2012).

Research on behavioral interventions for young children with TBI is scant. A single, patient-choice trial (Woods, Catroppa, Giallo, Matthews, & Anderson, 2012) found improvements in parent-reported behavior problems following either in-person or telephone-delivered parenting skills training. Additionally, several intervention studies using cognitive-behavioral problem-solving therapy techniques with families of older children and adolescents with TBI have shown improvements in child and parent outcomes after intervention. Across several studies (Wade, Carey, & Wolfe, 2006; Wade et al., 2012; Wade et al., in press), investigators have reported greater improvements in child and caregiver outcomes among lower-income families. Wade and colleagues (2012) provided tentative evidence that lower-income families report both higher levels of behavior problems and lower levels of problem-solving skills prior to treatment. However, lower-income parents (i.e., those earning < $30,000 a year) in the intervention group of their study reported greater improvements in positive problem-solving orientation and reductions in depression compared with lower-income parents in the comparison group. Several explanations were posited for the finding of greater treatment efficacy among lower-income families, including skill deficits and limited access to resources and supports after injury (Wade et al., 2012). Indeed, Slomine et al. (2006) found that lower-income parents (i.e., those receiving Medicaid) of school-age children who had been hospitalized for a TBI reported greater unmet needs 3 and 12 months after TBI compared with wealthier families who had commercial insurance. Evidence that children from lower-income families experience poorer behavioral outcomes following TBI, but may benefit more from treatment when provided, underscores the need to examine the relationship of family income to treatment response and to identify strategies for engaging lower-income families.

Barriers to help seeking, such as transportation difficulties and lack of child care for siblings (Owens et al., 2002), that can impact participation in therapy programs may be particularly salient to lower-income families. Thus, more accessible treatments need to be established. Emerging technologies have made it possible to deliver education/therapy online (Newman, 2004) without decrements in adherence or satisfaction (Ruskin et al., 2004). By reducing barriers, online programs can reach clients that in-office programs cannot (Tate & Zabinski, 2004).

In this paper, we report findings from a pilot randomized clinical trial (RCT) comparing the efficacy of an online positive parenting skills intervention program focused on young children with TBI (Internet-based interacting together every day; recovery after childhood TBI; I-InTERACT) with access to Internet resources (Internet resource comparison; IRC) in increasing positive parenting behaviors and reducing child behavior problems. To our knowledge, this is the first program to implement a coaching–based parenting skills program over the Internet. This is also the first RCT of a behavioral intervention focused on young children with TBI. We examined...
changes in parenting skills and child behavior post-intervention and hypothesized that parents who received I-InTERACT would display a higher number of positive parenting behaviors and fewer undesirable parenting behaviors compared with parents assigned to the IRC group. Consistent with previous research, we also hypothesized that improvements in child behavior problems would be moderated by family income, with greatest reductions in child behavior problems occurring among lower-income families receiving I-InTERACT.

**Method**

**PARTICIPANTS AND RECRUITMENT**

The study was approved by the Institutional Review Board and is included on the national clinical trials Web site (clinicaltrials.gov; NCT01056146). All participating caregivers provided informed consent before enrolling. To participate, families had to have a child who was hospitalized for at least one night following an unintentional TBI. They also met the following criteria: (a) child was 3–9 years old at enrollment, (b) inpatient rehabilitation (if needed) was complete, and (c) child resided with his or her parent(s) or legal guardian for the study period. Additionally, families were required to speak English as the primary language at home. Families were excluded if the child had a history of psychiatric hospitalization prior to his or her injury or significant developmental disability/intellectual impairment not attributable to the TBI. Children who sustained a complicated mild to severe TBI were eligible...
regardless of their level of pre-study behavior problems, given our interest in both reducing current behavior problems and preventing future ones.

Thirty-seven families of children with TBI provided informed consent and were randomized to I-InTERACT (n = 20) or IRC (n = 17). See Figure 1 for a CONSORT diagram depicting screening, recruitment, and retention information. Glasgow Coma Scale (GCS) scores below 9, at or before hospital entry, were classified as severe TBIs (I-InTERACT n = 1, IRC n = 2). GCS scores between 9 and 12 (I-InTERACT n = 4, IRC n = 3) OR GCS scores between 13 and 15 accompanied by evidence of brain insult on computed tomography (CT) or magnetic resonance imaging (MRI) scans (I-InTERACT n = 10, IRC n = 7) were classified as moderate TBIs (GCS score missing for one child; Jennett & Bond, 1975). Due to lower hospital census than expected, recruitment criteria were broadened partway through the study to include children with a history of abusive head trauma (e.g., children who had inflicted injuries to their heads; I-InTERACT n = 5, IRC n = 4). All of the children with abusive head trauma were living in stable home situations, either with adoptive or biological parent(s). Seven participating families’ caregivers were not identified as the injury perpetrator. Two participating families’ caregivers could not be ruled out as the injury perpetrator. Children with low-grade gliomas (I-InTERACT n = 0, IRC n = 3) were also enrolled; however, given the small number of children recruited and their randomization to the control condition, they were removed from analyses.

Potential participants were identified by screening current and retrospective inpatient admissions at a tertiary-care children’s hospital and reviewing charts from relevant specialty clinics. Those who were identified received a letter from their physician describing the study. Subsequently, a research coordinator contacted families by telephone to provide further information about potential risks and benefits. Upon their verbal agreement to participate, families were randomized to receive I-InTERACT or access to Internet resources (IRC). To ensure that both gender and race were balanced within each treatment group, the randomization process included stratification according to these two factors (i.e., participants were randomized according to non-White female, White female, non-White male, and White male strata). The randomization scheme was generated using SAS by the medical center’s Division of Biostatistics and created using permuted block sizes for each of the randomizations. Group assignment was not concealed from the study coordinator, therapists, or participants. However, participants were not made aware of their group assignment until after written consent and baseline data were collected. Video coders remained naïve to condition (see below).

I-INTE-RACT PROGRAM

I-InTERACT is an Internet-based parenting skills program incorporating aspects of other evidence-based programs (particularly PCIT; Eyberg, 1988). The program teaches positive parenting skills and consistent discipline techniques through online didactics and live coaching. Given that children with TBI often fail to learn from consequences, the program also teaches antecedent behavior management strategies to set children up for success (Feeney & Ylvisaker, 1995). Additionally, the program includes didactic information on cognitive and behavioral sequelae of TBI and training in stress and anger management. Last, the program provides tailored didactic information to families experiencing specific ongoing problems via optional supplementary sessions (e.g., pain management).

Three therapists with master’s degrees in clinical psychology conducted the I-InTERACT program with families. The therapists completed training on the consequences of TBI and in-depth instruction on the delivery of the I-InTERACT program. They received a manual outlining the therapy protocol and conducted sessions with families utilizing checklists for each session. Therapists also participated in weekly meetings to review family progress and ensure treatment fidelity with an advanced supervising psychologist with more than 20 years of experience in pediatric TBI interventions.

To reduce barriers to participation, I-InTERACT was delivered online. It included 10 core sessions with up to 4 supplementary sessions. The first session was completed in the family’s home, to provide the therapist with an opportunity to build rapport and orient the family to the website and videoconferencing technology. Remaining sessions were conducted online. The goal was to complete one online session per week, although families often rescheduled (see below for mean time from baseline to post-treatment assessment). Each online session comprised two components: (a) a self-guided Web session incorporating demonstration videos and exercises pertaining to specific skills; and (b) a synchronous videoconference session with the therapist to review the Web session, role-play new skills with the therapist, and receive simultaneous feedback through a wireless earpiece during in vivo play with the child. Each family in the I-InTERACT group had a unique password-protected login and were able to complete Web sessions at any time. Videoconferencing was accomplished using Skype or Cisco Movi Client. Coaching during Sessions 2–6 focused on positive parenting skills. Coaching during
Sessions 7–9 focused on the use of consistent nonpunitive discipline techniques, including specific commands and time-out. Didactic and videoconference session content also included staying positive and coping with stress (Session 3), setting children up for success (Session 4), dealing with anger (Session 6), and cognitive problems associated with TBI (Session 8). House rules and behavior in public were covered in Session 9. After Session 9, families had the option of completing up to four supplemental Web modules and/or videoconference sessions (marital communication, parents and siblings, working with the school, pain management, and guilt and grief). Three families completed at least one additional Web module. Three families completed at least one additional videoconference session with a therapist. Families that chose not to complete additional sessions were contacted bimonthly to discuss how the I-InTERACT practice and principles were being used in the home (total of four contacts). The therapist and family completed core Session 10 in month six to review skills and boost program efficacy prior to termination. A table of the 10 core sessions can be found in Antonini et al. (2012). The full intervention protocol can be obtained from the last author.

Internet Resource Comparison (IRC) Group

Most studies examining the efficacy of specific parenting interventions similar to I-InTERACT have utilized wait-list or untreated control groups (e.g., Bagner & Eyberg, 2007; Bor, Sanders, & Markie-Dadds, 2002; McNeil, Eyberg, Eisenstadt, Newcomb, & Funderburk, 1991). Rather than utilizing similar methodology, families randomized to the comparison group in this study were provided with access to a study website that contained links to a variety of relevant Web-based resources (http://wadeprograms.org/i-interact). These resources represented a better-matched comparison to the Web-based resources provided by the I-InTERACT intervention and controlled for the nonspecific effects of Internet access. Resources included links to local, state, and national brain-injury associations and to sites specific to pediatric brain injury, such as the Center on Brain Injury Research and Training, Brain Injury Partners, and the National Database of Educational Resources on Traumatic Brain Injury. Content of these websites addressed mechanisms and sequelae of brain injury and provided interactive modules on parent advocacy with the schools, handling stress, and managing behavior problems following TBI. Families were encouraged to spend at least one hour each week accessing information from these sites and were asked to track the sites that they visited.

Procedure

Baseline visits were conducted from February 2009 to February 2011. Follow-up visits were conducted from August 2009 to October 2011. Families were naive to group status at enrollment. After obtaining written consent at the baseline home visit, the research coordinator administered measures documenting the child’s current behavior (see Measures section) and cognitive functioning (Woodcock Johnson–III Brief Intellectual Ability Test; Woodcock, McGrew, & Mather, 2001). The parent–child dyad was also videotaped playing together to assess parenting skills. At the end of the baseline assessment, parents received a packet that included their group assignment and written instructions regarding how to log on and access the I-InTERACT or IRC websites. They were loaned computers and Web cameras, if needed, and received $50 in compensation.

Follow-up assessments were conducted after treatment completion (I-InTERACT mean: 8.16 months, IRC mean: 8.26 months). The two groups did not significantly differ in the time between baseline and post-treatment assessments, t(31) = 0.18, p = .86. At this visit, families completed all of the measures they had completed at baseline, as well as post-treatment satisfaction surveys. The parent and child were also video recorded playing together. At the end of this visit, families received $50 in compensation and were reimbursed for 6 months of high-speed Internet service.

Measures

Dyadic Parent–Child Interaction Coding System (DPICS)

The DPICS (Eyberg, Nelson, Duke, & Boggs, 2005) was used to code recordings of parent–child interactions and determine changes in parenting skills. Each recording included two 5-minute segments with parents initially instructed to follow the lead of their child (i.e., child-directed play) and then to lead the play (i.e., parent-directed play). During the child-directed segment, coding focused on positive parent behaviors (“labeled” praises, reflective statements) and undesirable parent behaviors (questions, commands, criticisms). During the parent-directed segment, the same positive behaviors as in the child-directed segment were coded. The following variables were also calculated to assess child compliance and parent follow-through: child compliance (percentage of times that child complied with parent’s direct or indirect commands), parent positive response to compliance (percentage of times that parent gave child a labeled praise following compliance after a direct or indirect command), and parent response to non-compliance (percentage of times parent properly used discipline techniques following
non-compliance to a direct command). To reduce the number of dependent variables, we constructed composite measures of positive parenting behaviors (labeled praises, reflections) and negative parenting behaviors (commands, criticism) from the child-directed interactions. Resultant Cronbach’s alpha values of .84 and .81, respectively, indicated acceptable internal consistency. Questions were not significantly correlated with other negative parenting behaviors (r = .04–.11) and, thus, were examined separately.

Five individuals were trained to code the DPICS recordings (two graduate students and three full-time research assistants with bachelor’s degrees). A detailed coding and training manual was used to orient new raters and served as a reference for experienced coders (Boggs, Eyberg, & Reynolds, 1990; Eyberg et al., 2005). After reviewing the manual, new raters attended, observed, and practiced coding alongside independent coders. New coders also independently coded footage and later compared their scores with those of experienced coders. When a new coder consistently scored footage within 1 frequency point of an experienced coder, the new coder graduated to independent unchecked coding. Monthly group meetings were conducted to maintain reliability and prevent drift. Throughout, all coders remained unaware of treatment condition.

Ten percent of the recordings were randomly double coded to assess overall coder reliability. Intraclass correlation coefficients (ICCs) for the variables ranged from good to excellent (.60–.88; Rosner, 2006). Despite close agreement for almost all categories across participants, small coding differences greatly affected ICC values for the low-frequency categories (e.g., positive statements summary scores were examined in analyses.

**Child Behavior Checklist (CBCL)** Given previous research showing that CBCL (Achenbach & Rescorla, 2000, 2001) scores are sensitive to the effects of brain injury, the CBCL has been identified as a “core measure” of child psychiatric and psychological functioning for research studies on pediatric TBI (McCauley et al., 2012). Thus, this parent-rated scale was considered the primary measure of emotional/behavioral functioning in the current study. Depending on the age of their child, parents either completed the CBCL 1.5–5 (n = 21) or the CBCL 6–18 (n = 16). The Total Problems T score was used in analyses.

**Eyberg Child Behavior Inventory (ECBI)** The ECBI (Eyberg & Pincus, 1999) has been used in a variety of studies examining the efficacy of PCIT and, thus, was added to the current study as a secondary measure of behavioral functioning. It provides two summary T scores—a Total Intensity T score (“How often does this [behavior] occur with your child?”) and a Total Problems T score (“Is this [behavior] a problem for you?”). Both summary scores were examined in analyses.

**ANALYSES**

Across assessments (74 data points), two parent–child play interaction videotapes were missing due to lost videos/sound recording problems (one I-InTERACT, one IRC). Additionally, four participants dropped out of the study or were lost to follow-up (three I-InTERACT, one IRC). Only data from the primary parent/caregiver for each child were included in analyses. Group differences for demographic variables were assessed using t tests and chi-square tests.

**Primary Analyses**

Because the DPICS coding system generated count data, parenting skills data were analyzed using Generalized Estimating Equations (GEEs; SAS PROC GENMOD), to compare the relative risk (RR) between low- and high-income I-InTERACT and IRC groups at baseline and follow-up visits. Similarly to previous intervention trials for pediatric TBI (e.g., Slomine et al., 2006; Wade et al., 2006, 2012, in press), family income was dichotomized to minimize effects of extreme values. Family income levels ranged from below $10,000 to above $120,000. For analyses, families earning less than $30,000 were classified as “lower-income” families. Those earning $30,000 or more were “higher-income” families. This income split resulted in a relatively equal income group distribution for families in the intervention group. Power analyses indicated that a sample size of seven in each of the four groups (low- and high-income I-InTERACT and IRC groups) would afford 80% power to detect a 0.5 standard deviation effect size at the significance level p < 0.05.

The distribution of DPICS scores was not normal. Thus, separate GEE models (using Poisson distributions and zero-inflated Poisson distribution and log link functions) were computed for each combined DPICS variable. Within each model, group assignment (I-InTERACT or IRC) was the between-groups variable, time point (baseline, follow-up) and income were the within-group variables, and the full complement of interactions (Income × Visit, Group × Visit, Group × Income, and Group × Visit × Income) was included. Each model also included its baseline score as a covariate to control for parenting skills prior to intervention. Nonsignificant interactions were systematically trimmed; results presented here include the final, simplified models.
Mixed-models analysis (SAS PROC Mixed) was utilized to examine the effects of intervention and income on our primary parent rating of child behavior (CBCL Total Problems T score). The distribution of CBCL data was grossly normal. The mixed model was computed with the same variables, covariates, and interactions as described above. The Kenward–Roger degrees of freedom command was specified for each model to account for the missing data at various time points. The Toeplitz covariance structure was chosen to allow for unbalanced covariance matrices and factor in moving averages that result from repeated measures designs. Nonsignificant interactions were systematically trimmed.

Secondary Analyses

A multivariate repeated measures analysis of covariance (using SAS PROC GLM) was utilized to examine the effects of intervention and income on the variables from our secondary parenting rating measure (ECBI). The two variables at both time points (Total Problems T score and Total Intensity T score) were included as dependent variables. The distributions of these scores were grossly normal. The multivariate effect of the ECBI Variable × Group × Visit × Income interaction was examined.

Last, to examine the effect of treatment intensity on parenting skills, Pearson correlations were conducted between observed DPICS parenting behaviors at the follow-up visit for all I-InTERACT families and the number of sessions that parents completed.

Results

Demographics

Demographics for participants are summarized in Table 1. Groups were well matched and did not significantly differ on race, parental education, income, employment status, or computer ownership. Chi-square analyses did not result in significant differences for the types of injuries represented within the two groups. Groups were also well matched with regard to child cognitive ability as assessed by Brief Intellectual Ability (BIA) standard scores from the Woodcock Johnson–III Tests of Cognitive Abilities.1 Last, there were no significant group differences in reported time spent online for study-related didactic activities, χ²(3, N = 32) = 7.03, p = .07.

Although the program was designed to be completed in 6 months, not all families were able to complete treatment that time frame, due to canceled and rescheduled sessions. Three families assigned to I-InTERACT dropped out. Among those who completed the follow-up visit (n = 17), the average number of sessions completed was 8.76 (range: 1–14), with 76% completing 9 or more sessions. We found no significant differences in race, parent age, parent education, employment status, or computer ownership among dropouts, those completing ≤ 3 sessions, and those completing ≥ 9 sessions.

Primary Analyses

Changes in Parenting Skills and Compliance

There were no significant differences in observed parenting variables or child compliance at baseline (see Tables 2 and 3).

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1 Fifteen children (eight I-InTERACT, seven IRC) were unable to complete the Woodcock Johnson in the home due to severe attention/behavioral difficulties.

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Positive parenting behaviors (combined labeled praises and reflective statements). A significant Group × Time × Income interaction was identified. Parents in the lower-income I-InTERACT group were significantly more likely to provide positive statements post-intervention than parents in the lower-income IRC group ($RR = 14.07$, $p < .0001$). Parents in the higher-income I-InTERACT group were significantly more likely to provide positive statements post-intervention than parents in the higher-income IRC group ($RR = 3.29$, $p = .0001$).

Undesirable parenting behaviors (commands and criticisms). A significant effect of Time was identified. Parents in both groups were significantly less likely to provide undesirable statements post-intervention ($RR = 2.32$, $p = .0002$).

Questions. Analyses revealed a significant Group × Time interaction. Parents in the I-InTERACT groups were less likely to ask questions post-intervention than those in the IRC groups ($RR = 2.21$, $p = .03$).

Child compliance following direct commands. Only data from child participants who were given at least one direct command that they had the opportunity to comply with (i.e., sufficient time to respond, parent did not complete the action him- or herself) were included in these analyses (baseline: $n = 34$, follow-up: $n = 28$). There were no significant main effects or interactions.

Child compliance following indirect commands. Only data from child participants who were given at least one indirect command that they had the opportunity to comply with (i.e., sufficient time to respond, parent did not complete the action him- or herself) were included in these analyses (baseline: $n = 35$, follow-up: $n = 34$). There was a significant main effect of Time, indicating that children across groups were more compliant at the follow-up visit than at the baseline visit ($RR = .78$, $p = .017$).

Parent praise following child compliance. Values at baseline for both groups were zero. Results from a zero-inflated Poisson regression indicated a significant effect of Group post-intervention. Parents in the I-InTERACT groups had a higher percentage of labeled praises following compliance than parents in the IRC groups ($RR = 15.37$, $p < .009$).

Parent response to noncompliance. No parent in either group at any visit provided clear...
consequences to their child for noncompliance following a direct command.

**Changes in Parent Ratings of Child Behavior**

Groups were not significantly different at baseline in any of the child behavior ratings.

**CBCL.** There was a significant Group x Income x Time interaction for Total Problems T scores, $F(1, 38.8) = 9.68$, $p = .004$. Following intervention, children in the lower-income I-InTERACT group had lower T scores than children in the lower-income IRC group ($p = .001$). Children in the higher-income IRC group had lower T scores than those in the higher-income I-InTERACT group ($p = .04$). See Tables 4 and 5 and Figure 2.

**SECONDARY ANALYSES**

**Changes in Parent Ratings of Child Behavior**

**ECBI.** The multivariate effect was not significant. Post hoc univariate results were not interpreted.

**Relationships Between Number of Sessions Completed and Parenting Behavior**

Correlations indicated that the number of sessions that parents in the I-InTERACT groups (lower-income and higher-income) completed was

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Table 3

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Relative Risk</th>
<th>Lower RR</th>
<th>Upper RR</th>
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<th>$p$</th>
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<tr>
<td>Low-income I-InTERACT baseline visit</td>
<td>-0.22</td>
<td>0.80</td>
<td>0.38</td>
<td>1.64</td>
<td>-0.60</td>
<td>.55</td>
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<td>Low-income I-InTERACT follow-up visit</td>
<td>2.68</td>
<td>14.07</td>
<td>5.01</td>
<td>42.55</td>
<td>4.92</td>
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<td>High-income I-InTERACT baseline visit</td>
<td>0.45</td>
<td>1.57</td>
<td>0.82</td>
<td>2.99</td>
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<td>High-income I-InTERACT follow-up visit</td>
<td>1.19</td>
<td>3.29</td>
<td>1.79</td>
<td>6.02</td>
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<td><strong>Undesirable Statements</strong></td>
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<tr>
<td>Baseline visit</td>
<td>0.84</td>
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<td>3.59</td>
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<td>.0002</td>
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<td><strong>Questions</strong></td>
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<tr>
<td>I-InTERACT baseline visit</td>
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<td>0.96</td>
<td>0.17</td>
<td>1.09</td>
<td>-0.68</td>
<td>.50</td>
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<td>I-InTERACT follow-up visit</td>
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<td>2.21</td>
<td>1.09</td>
<td>4.39</td>
<td>2.19</td>
<td>.03</td>
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<td><strong>Child Compliance Following Indirect Commands</strong></td>
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<tr>
<td>Baseline visit</td>
<td>-0.25</td>
<td>0.78</td>
<td>0.63</td>
<td>0.96</td>
<td>-2.38</td>
<td>.017</td>
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<td><strong>Parent Positive Response to Compliance</strong></td>
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<tr>
<td>I-InTERACT follow-up visit</td>
<td>2.73</td>
<td>15.37</td>
<td>1.95</td>
<td>120.70</td>
<td>2.60</td>
<td>.009</td>
</tr>
</tbody>
</table>

Note. All models originally included the full complement of variables and interactions (group, visit, and income). Nonsignificant interactions were systematically trimmed. Results reported here reflect the trimmed models. Relative risks values for the I-InTERACT group were calculated using the IRC group as a comparison. I-InTERACT = Internet-based interacting together every day: recovery after childhood traumatic brain injury; RR = relative risk.

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Table 4

<table>
<thead>
<tr>
<th></th>
<th>I-InTERACT Group</th>
<th>Internet Resource Comparison Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Income</td>
<td>High Income</td>
</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>Posttreatment</td>
</tr>
<tr>
<td><strong>CBCL</strong></td>
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<td></td>
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<tr>
<td>Total Problems</td>
<td>52.80(10.35)</td>
<td>45.57(13.95)</td>
</tr>
<tr>
<td></td>
<td>49.50(6.67)</td>
<td>52.60(8.26)</td>
</tr>
<tr>
<td><strong>ECBI</strong></td>
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</tr>
<tr>
<td>Intensity</td>
<td>54.20(10.94)</td>
<td>48.86(11.39)</td>
</tr>
<tr>
<td>Problems</td>
<td>55.10(13.48)</td>
<td>48.57(11.07)</td>
</tr>
<tr>
<td></td>
<td>55.18(9.74)</td>
<td>50.73(11.48)</td>
</tr>
</tbody>
</table>

Note. I-InTERACT = Internet-based interacting together every day: recovery after childhood traumatic brain injury; CBCL = Child Behavior Checklist; ECBI = Eyberg Child Behavior Inventory.

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positively associated with the total number of labeled praises they provided during child-directed play ($r = .48, p = .05$) and parent-directed play ($r = .43, p = .09$), as well as the proportion of labeled praises they provided after their child followed an indirect command ($r = .47, p = .05$). Also, the number of sessions parents completed was negatively associated with the number of questions they asked during child-directed interaction ($r = -.56, p = .02$).

**Discussion**

This pilot study examined the efficacy of an innovative online parenting program to improve parenting skills and child behavior following TBI. Consistent with hypotheses, positive parenting skills improved in the I-InTERACT group relative to the IRC group, and these improvements were correlated with the number of sessions that parents completed. Observational codes indicated that parents in I-InTERACT, regardless of income level, provided more positive statements at the post-intervention visit. Undesirable statements significantly decreased in both groups between baseline and post-intervention follow-up visits. However, questions only decreased among parents who participated in the I-InTERACT program (both income levels).

Contrary to hypotheses, child compliance increased in both groups from pre- to post-intervention, and only following indirect commands. This finding suggests that parents in the IRC group may have also learned strategies for more positive interactions with their children via the Internet resources. However, parents in the I-InTERACT group were significantly more likely to praise their child following compliance than parents in the IRC group. These findings suggest that families receiving the I-InTERACT intervention provided more consistent follow-through for compliance, thereby reinforcing such behavior.

Similar findings were not found with respect to follow-through for noncompliance. No parent in either group provided appropriate consequences. There are several possible explanations for this lack of follow-through. Parents may have failed to fully learn these concepts and, if their child was largely compliant, may have had few opportunities to implement the time-out procedure with therapist support. Indeed, it was rare for children to exhibit noncompliance during coaching sessions and, consequently, many parents had no opportunity to be coached through the entire discipline sequence. Given that many children in this sample did not
have elevated behavior problems to begin with, greater emphasis was placed on positive parenting skills with relatively less focus on discipline strategies. An alternative explanation for the lack of follow-through after noncompliance is that parents may have felt unsure or uncomfortable about enforcing negative consequences while being videotaped.

Bivariate correlations support the notion that more sessions completed were associated with greater mastery of positive parenting skills, such as labeled praise, highlighting the potential need for more sessions emphasizing follow-through around noncompliance. Although it is also possible that more competent parents were more adherent, thus confounding session completion with parenting skills, this is unlikely given that the average number of labeled praises at baseline was zero across study groups and income levels. These findings suggest that none of the participating parents were routinely providing labeled praises prior to treatment. In PCIT, the average number of sessions is 13, although parents may take many more sessions than this to reach skill mastery (Bell & Eyberg, 2002). Unlike PCIT, our program did not require mastery of skills prior to moving on to certain aspects of the intervention. Participants in the current study who completed the intervention attended an average of nine core sessions, which may have been insufficient for parents to implement consistent follow-through for compliance and noncompliance.

Consistent with hypotheses and previous research (e.g., Slomine et al., 2006; Wade et al., 2006, 2012, in press), we found that income moderated the efficacy of the I-InTERACT intervention in reducing behavior problems on our primary outcome measure, the CBCL. Specifically, child behavior at follow-up only improved in the lower-income I-InTERACT group. Interestingly, the behavior of children in the higher-income IRC group also showed improvements from baseline. One possible reason for this may be related to the types of interventions we examined. In contrast to wait-list control groups that are often used for intervention comparison, both the I-InTERACT program and IRC provided access to specific information for parents regarding pediatric TBI and parenting. However, parents in the IRC group were required to access and understand this information on their own, rather than having it presented in specific didactic online sessions by a study therapist. Perhaps parents of lower SES are better able to access and integrate information when it is presented by a therapist rather than by self-initiated online research, which may have been more difficult to understand or implement. Conversely, parents of higher SES assigned to the IRC group may have been more comfortable accessing resources and implementing changes based on the Internet resources provided to them.

To our knowledge, our group is the first to examine the use of online coaching to teach positive parenting skills. Given that children who have sustained a TBI show higher rates of behavior problems after injury (Schwartz et al., 2003), this is a key population who may benefit from intervention. Studies such as this one are important in addressing the needs of children and families after TBI. To our knowledge, our study is the first to examine the impact of a Web-based parenting skills intervention designed specifically for parents of children who have sustained brain injuries. Not only did the program teach parents how to increase positive interactions while decreasing negative interactions, it also provided ways to help set children with TBI-related cognitive sequelae up for success (antecedent behavior management), discussed the impact of TBI on cognition and behavior, and included content on stress and anger management. Web-based videoconferencing technology allowed families without reliable transportation as well as those living in distant, rural settings to participate. Participants in both groups lived an average of 17 miles from the hospital with 14 of 37 families living at least 20 miles away. Undoubtedly, the intervention reached families that would not have been able to attend weekly in-office mental health services at an urban hospital. High levels of parental satisfaction (Antonini, Raj, Oberjohn, & Wade, 2012), coupled with increases in positive parenting behaviors, particularly contingent praise, support the potential viability of this approach for improving positive parenting skills among those who have difficulty attending office-based sessions.

This is one of only a handful of studies examining the efficacy of an intervention for young children with acquired brain injury (ABI; Woods et al., 2012). Many intervention studies focusing on ABI in young children have been case studies, including a recent study illustrating the use of PCIT with an 11-year-old boy who sustained a TBI (Cohen et al., 2012). As an RCT, the current study adds important information to the scant treatment literature and suggests directions for future research, including consideration of the timing and intensity of interventions, and the importance of looking at intervention change across different SES groups. Research examining the most effective components of this type of manualized parenting program for children with TBI will also be important to determine relative emphasis (parent skills vs. stress management and TBI education) and intensity. Additionally, research directly comparing
Web-based to face-to-face treatment is needed to establish the relative efficacy of these approaches.

In light of these findings, several study limitations should be taken into consideration. Due to our small sample size and extreme income levels, we chose to dichotomize our income variable. However, this dichotomous income variable combined a wide range of families into one variable and did not match the poverty level (Department of Health and Human Services, 2013). Thus, this variable may have affected our findings related to income. Additionally, the study’s small sample size precluded additional subsample analyses to further understand treatment effects (e.g., differences in treatment effects across ages). Due to our small sample size, we chose not to correct for multiple analyses. However, by doing so, there was an increased chance of Type I error. Therefore, replication of our intervention with a larger sample size is important. Study inclusion criteria did not require child participants to exhibit severe behavior problems, since we were interested in reducing existing problems and preventing new ones from developing. Thus, even though all of the children in the study had sustained a TBI, the majority did not have clinically elevated T scores on rating scales at baseline. It is possible that improvements may have been greater, particularly for the higher-income I-InTERACT group, if participants had displayed more behavior problems at the beginning of the study. Furthermore, the sample of children was quite heterogeneous with regard to type of injury (abusive and non-abusive TBIs) and time since injury. As such, treatment effects may have differed if the sample had only included children with the same injury characteristics. Additionally, follow-up assessments were completed only at the end of treatment. Thus, it is unclear whether treatment effects endured with time post-treatment. Although the DPICS coders remained unaware of treatment assignment, the study coordinator who collected the pre- and pos-tstudy parent-report questionnaires and recorded the DPICS play sessions was not naive to condition, which could have influenced study results. Last, we used a comparison condition that equated the groups for access to Web-based resources and information as well as nonspecific effects of Internet access, but did not equate the groups for therapist attention or intervention intensity. Although the current design is superior to previous uncontrolled studies or those in the general parenting skills literature that have utilized wait-list controls, it is limited in its ability to distinguish the effects of the parent skills training from the effects of therapist attention more broadly. Although the two groups were not significantly different, parents in the I-InTERACT group reported spending more time on TBI-related computer activities than the control group, which could have impacted some of the study’s results. Future studies of the intervention’s efficacy should include comparison treatments that are comparable with regard to therapist time and therapeutic intensity.

In spite of these limitations, the I-InTERACT program shows promise with regard to fostering positive parent–child relationships following TBI, particularly with families of lower SES. Although online interventions have increased for a variety of populations, this is the first, to our knowledge, to utilize direct coaching to assist in changing parenting skills. Results showing improvements in these positive parenting skills lend preliminary support for the use of computer and Internet technology to deliver one-on-one coaching in clinical practice. Unfortunately, online intervention programs used in clinical practice are limited to families with computers and Internet. However, the number of families that have access to these is quickly increasing. A national Pew survey conducted at the end of 2009 estimated that 74% of all American adults (18 years or older) use the Internet. In households making $30,000 or less per year, 60% of adults use the Internet; 42% access broadband Internet through connection in their home; and 46% access the Internet using a wireless laptop or handheld device (e.g., cell phone; Rainie, 2010). Free Web-conferencing technology (e.g., Skype) is easily downloadable onto computers of clinicians and families, and wireless headsets are relatively inexpensive. Thus, online interventions such as I-InTERACT have the ability to provide treatment for clients across income levels living far from specialty care.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

References


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