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Expanding the Reach of Preventive Interventions

Development of an Internet-Based Training for Parents of Infants

Edward G. Feil

Oregon Research Institute

Kathleen M. Baggett

University of Kansas

Betsy Davis

Lisa Sheeber

Oregon Research Institute

Susan Landry

University of Texas Health Science Center

Judith J. Carta

Jay Buzhardt

University of Kansas

There are major obstacles to the effective delivery of mental health services to poor families, particularly for those families in rural areas. The rise of Internet use, however, has created potentially new avenues for service delivery, which, when paired with the many recent advances in computer networking and multimedia technology, is fueling a demand for Internet delivery of mental health services. The authors report on the adaptation of a parenting program for delivery via the Internet, enhanced with participant-created videos of parent-infant interactions and weekly staff contact, which enable distal treatment providers to give feedback and make decisions informed by direct behavioral assessment. This Internet-based, parent-education intervention has the potential to promote healthy and protective parent-infant interactions in families who might not otherwise receive needed mental health services.

Keywords: *infant; parent training; Internet; computer; home-based*

Child maltreatment is one of our nation's most significant public-health problems (National Center for Injury Prevention and Control, 2004). Though it is difficult to arrive at firm prevalence rates, the Department of Health and Human Services (DHHS, 2005) indicates that in 2005 (the most recent year for which National Child Abuse and Neglect Data System summary statistics are available), 899,000 children in the United States and its territories were victims of abuse or neglect. This statistic very likely underestimates the true prevalence rate (DHHS, 2005; Goldman, Salus, Wolcott, & Kennedy, 2003). Infants and young children are particularly vulnerable. Children younger than 3 years of age are the most frequent victims of substantiated maltreatment

(Goldman et al., 2003; Wu et al., 2004), and more than 40% of maltreatment-related fatalities are infants younger than the age of 1 year (DHHS, 2005). Clearly, early intervention to prevent the maltreatment of infants and young children is an urgent concern.

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A growing body of literature indicates the effectiveness of early intervention in improving parent-child interactions and relationships (Gershater-Molko, Lutzker, & Wesch, 2003; Goldman et al., 2003; Hahn, Mercy, Bilukha, & Briss, 2005; Landry & Smith, 2005) and hence, potentially reducing the risk of maltreatment (Valle et al., 2004). Interventions that guide mothers to be warm, responsive, stimulating, and attentive to their infants show great promise (e.g., Landry & Smith, 2005; Olds et al., 2002; van den Boom, 1994, 1995). These early interventions also improve infant emotional, social, and cognitive behavior, as evidenced by less frequent crying and more interactive, self-soothing, and explorative behavior (e.g., Olds, 2003; Olds et al., 2002; Olds, Hill, O'Brien, Racine, & Moritz, 2003; Smith, Landry, & Swank, 2005; van den Boom, 1994, 1995; Willet, Ayoub, & Robinson, 1991). The effects of parent-training interventions on infant behavior are important, given evidence that infants with difficult temperaments—those who cry frequently and are difficult to soothe—are at greater risk for maltreatment (Goldman et al., 2003). They are also consistent with decades of research indicating that safe, stable, and nurturing parent-infant relationships are associated with positive developmental trajectories (Feliti et al., 1998; Kendall-Tackett, 2003; Repetti, Taylor, & Seeman, 2002).

It has been recommended that interventions to promote positive parenting form the foundation of child maltreatment prevention (Hammond, 2008). Recent reviews and meta-analyses examining predictors of outcome have found that the strongest intervention effects have emerged for behavioral programs and for programs delivered in the home, and that such programs have been shown to be superior to those focused on increasing support or promoting parent mental health (Baggett et al., 2008; Bakersman-Kranenburg, van IJzendoorn, & Juffer, 2003; MacLeod & Nelson, 2000). In particular, promising behavioral interventions have focused on improving parent-child interactions by increasing parental responsiveness and flexibility (e.g., Akai, Guttentag, Baggett, Noria, & Centers for the Prevention of Child Neglect, in press; Landry, Smith, & Guttentag, in press; Valle et al., 2004). Home visiting programs focused on enhancing the parenting of very young children have been shown to improve not only parenting skill but also child developmental outcomes during infancy and throughout the lifespan (Kitzman et al., 2000; Olds et al., 1998; Ramey & Campbell, 1991). With regard to the prevention of maltreatment, the effects on incidence rates appear to be statistically significant and enduring (Olds et al., 2002).

Barriers to Service Delivery and Utilization

Given the documented effectiveness of early interventions, it is extremely unfortunate that access is severely limited for many high-need families (Connell, Sanders, & Markie-Dadds, 1997; Elder & Conger, 2000; Olds, 2003; Sanders, 1997, 1999). Barriers to service delivery and utilization, particularly in rural areas, often result in low-income parents having limited access to preventive mental health services in general and parenting interventions in particular (e.g., Connell et al., 1997; Elder & Conger, 2000; Franke-Ogg & Pritchard, 1989; Friedrichsen & Stamm, 2003; Gale & Deprez, 2003; Nordal, Copans, & Stamm, 2003; Olds, 2003; Sanders, 1997, 1999; Sheeber, Biglan, Metzler, & Taylor, 2002). Major obstacles to accessing services include the lack of medical coverage, absence of public (or reliable private) transportation, lack of child care, and limited flexibility in work schedules (Connell et al., 1997; DeLeon, Wakefield, & Hagglund, 2003; Nordal et al., 2003; Organista, Muñoz, & Gonzalez, 1994; Stamm, 2003). These barriers differentially affect women, minorities, and the poor (Connell et al., 1997; National Institute of Mental Health [NIMH], 2003; U.S. Census Bureau, 2002; Weisman & Jensen, 2002). These circumstances are worsening as the safety net for disadvantaged persons is weakened by reduced state resources (Wachino, Schneider, & Leighton, 2005). Services for families with infants are limited, as well, by the scarcity of professionals with expertise in evidence-based infant mental health practices (Zeanah, Stafford, & Zeanah, 2005).

Psychological barriers to mental health service utilization also pose significant difficulties for some families. In particular, concerns about confidentiality, dual relationships, and the stigma associated with seeking psychological services are especially acute in sparsely populated and remote communities (Cellucci, Vik, & Nirenberg, 2003; Roberts, Battaglia, & Epstein, 1999). It is therefore critically important that empirically supported interventions be adapted for nontraditional delivery systems in order to overcome barriers to treatment provision and utilization (Hollon et al., 2002; NIMH, 2000, 2003).

Feasibility of Interactive Computer-Mediated Interventions

Computer-mediated interventions and assessments have become feasible due to the steadily increasing penetration of computer and Internet access within American households. The number of households with computers increased from 8% to more than 60% between

1984 and 2003. Furthermore, the rate of Internet access and usage tripled, from 18% to more than 54%, from 1997 to 2003 (Day, Janus, & Davis, 2005). Currently, 73% of all American adults are using the Internet (Madden, 2006). This is an increase of 7% in only 1 year (from 133 million in January 2005 to 147 million in February 2006). This rapid growth illustrates the expansion of Internet use to more mainstream users who resemble the average American. Moreover, Internet use is rapidly increasing across key demographic thresholds. Particularly relevant to this report is evidence that women continue to be the fastest growing segment on the Internet, now constituting more than half of the U.S. online population (Fallows, 2005; Feil, Noell, Lichtenstein, Boles, & McKay, 2003; Nielsen Netratings, 2002). As well, though the digital divide still exists, with less Internet access among those at lower income levels and those living in rural areas, access continues to improve among these groups. Currently, 52% of homes in rural areas (Bell, Reddy, & Rainie, 2004) and 38% of homes with incomes less than \$25,000 per year (Day et al., 2005) report having access to the Internet. In our work with Head Start families between 2002 and 2004, we found that 41% had home Internet access (Feil et al., 2005). Currently, in a small efficacy study recruiting low-income mothers of infants, we are finding that a majority of families (69%) have Internet access at home. In particular, of the 29 families recruited in 2007 and 2008, 12 had cable-Internet access (41%), 5 had DSL (17%), and 3 had dial-up Internet service (10%). Therefore, we are finding that this population (i.e., young adult women in low-income homes) is technologically savvy, experienced with computers, and connected to the Internet. Consequently, a target population of mothers for an Internet-based intervention can be reached via a variety of sources (e.g., flyers at clinics as well as Internet-based posting, such as <http://www.craigslist.org>).

Interactive Computer Mediated Interventions for Parenting and Support

Telemedicine, and telepsychiatry technologies in particular, have extended the reach of mental health and pediatric interventions to families in rural areas. Such technology, which commonly integrates live video with telephone consultation, has been used to deliver interventions that provide support to parents of very low birth weight newborns living in rural and remote areas (Tan & Lai, 2007), as well as to parents whose children are receiving psychiatric care (McGinty, Saeed, Simmons, & Yildirim, 2006). Although telemedicine has generally used highly expensive video monitors, audio, and teleconferencing systems (McGinty et al., 2006), much more

affordable technologies, allowing for remote communication, are now available. For example, applications of interactive, computer-mediated interventions that rely on interactive computer programs, web cameras, or built-in eyeball cameras have dropped dramatically in price during the past 5 years.

Through the use of recent advances in multimedia technology and the rise of computer networking via the Internet, there now exists an opportunity to provide services remotely to families with limited access to traditional services (e.g., Deprey & Noell, 1997; Dunham et al., 1998; Feil, Glasgow, Boles, & McKay, 2000; Feil, Severson, Taylor, & Boles, 2000; Gordon, 2000; Irvine, Beauchamp, Phillips, Ary, & Hammond, 2002; MacKenzie & Hilgedick, 1994, 1998, 1999). Research in the application of interactive computer-mediated interventions for parenting support and information has been conducted on six programs, each of which report promising results (Dunham et al., 1998; MacKenzie & Hilgedick, 1994; Gordon, 2000; Irvine et al., 2002; McCullough, 2001; Munneke, 2001). The networks ranged in complexity from simple networked terminals and personal computers with animated graphic interfaces to the remote transmission of video. Dunham et al. provided online support and information to single mothers of young infants and found that young mothers who were socially isolated were likely to spend more time online. MacKenzie and Hilgedick developed a Computer-Assisted Parenting Program (CAPP) to provide four sessions of behavioral parent training and found their computer program positively affected parental involvement and limit-setting. Gordon and colleagues (Cefai, 2005; Kacir & Gordon, 1999; Lagges & Gordon, 1999; O'Neill & Woodward, 2002; Segal, Chen, Gordon, Kacir, & Glylys, 2003) found that an interactive CD-ROM parent-training program was effective at reducing child problem behaviors, improving family functioning, reducing maternal depression, improving parent knowledge of positive parenting skills, and increasing parent use of such skills. Munneke's adjunctive computer-based parent-training program resulted in a decrease in child noncompliance following the intervention. Irvine et al. developed a multimedia program and found that parents in the experimental condition showed significant improvements in self-reported parenting behaviors, such as a decreased likelihood to use harsh disciplinary measures.

In light of this growing access, we present on the development of Infant Net, an interactive Internet-delivered program aimed at improving early parenting and thereby reducing the risk for child maltreatment among mothers of young infants. We also present results from a preliminary feasibility study of important technological

aspects related to program development. Current efforts are under way to conduct an initial examination of the full, interactive Infant Net program, with results forthcoming within the next year. In the current report, we focus on the use of remote technology to improve access to intervention, facilitate mother engagement, and monitor treatment progress. The project is based on an existing empirically supported infant parenting program for delivery via the Internet, enhanced with participant-created videos of parent-infant interactions and weekly staff contact. The project uses an eyeball computer camera to record the videos that enable the treatment providers, referred to as Parent Coaches, to benefit from objective data in providing feedback and making intervention decisions. This Internet-based parent-education intervention has the potential to promote adaptive parent-infant interactions and infant social-emotional development, particularly within families residing in distal areas.

Curriculum Description and Adaptations

Curriculum Selection and Description

Our first priority in selecting a program was demonstrated effectiveness in improving early parenting and child outcomes. The Playing and Learning Strategies program (PALS; Landry & Smith, 1996; Landry, Smith, Swank, Assel, & Vellet, 2001; Smith, Landry, & Swank, 2000) is one of the most promising early intervention programs for teaching effective parent-infant interaction strategies. The PALS curriculum targets parents' ability to interact with their infants using behaviors that have been found to support optimal social, emotional, and cognitive development. In a recent NIH-funded, randomized clinical trial, mother and infant dyads receiving the PALS intervention were compared to dyads assigned to an attention-control condition. Mothers were 27 years old and completed 12.6 years of schooling on average. The sample was 29% African American, 31% Hispanic, and 36% Caucasian. Relative to mothers in the control condition, mothers participating in the intervention showed significantly greater improvements in reading their infants' visual, vocal, and behavioral cues, providing rich language stimulation, expanding on their infants' current focus of interest, and responding to their infants in a warm and contingent manner (Smith, Landry, & Swank, 2005). These mothers also decreased their physical intrusiveness and their redirection of children's focus of attention, while use of these behaviors remained stable or increased among mothers in the control condition. Infants whose mothers received the PALS intervention

showed a significant increase in independent play, greater compliance with maternal requests, better regulation of behavior and emotions, as well as greater improvement in coordinated focal and behavioral responses with their mothers, relative to infants in the control condition (Smith et al., 2005).

The PALS program had several other features that made it especially appropriate for adaptation to a computer-based self-administration intervention for the prevention of child maltreatment. First, the manualized nature of the program provided a strong initial structure and content. Second, the videos that provide examples of the PALS principles are easily delivered over the Internet. Third, at 10 sessions, the intervention is sufficiently brief to make participant retention feasible.

In the standard PALS intervention, sessions are implemented by trained facilitators, referred to as coaches, who build supportive one-on-one relationships with the child's caregiver. Coaches use videos to demonstrate key principles and behaviors. Parents learn to recognize their infants' early forms of intentional communication and to respond contingently and sensitively to their babies' signals. The PALS program consists of 10 home-based sessions which target reading infant signals, responding with warm and sensitive behaviors, maintaining infants' focus of attention, watching for opportunities to introduce an object or social game, using rich verbal content in combination with physical demonstrations, and incorporating the use of this constellation of behaviors in everyday activities such as dressing and feeding. The targeted behaviors were chosen based on extensive evidence that they support infants' immature abilities in signaling interest, shifting attention, and organizing behaviors (Landry et al., 2001). Each PALS session includes the following elements: (a) mother and coach discuss the mother's experience using targeted behaviors during the past week, (b) coach describes the next targeted behavior, (c) coach and mother watch and discuss the educational videotape of mothers from a range of ethnic backgrounds demonstrating the target skills, (d) mother videotapes interactions with her child in situations she has selected (e.g., toy play, feeding, bathing) and coach reviews this videotape with mother to provide positive and corrective feedback, and (e) mother and coach discuss how to integrate targeted behaviors into everyday activities during the coming week. The coach works with the mom by providing corrective information, which is individualized to each mother's need and can include revisiting content (web pages), reviewing video, and further probing with video to ensure that mom has mastered the content. These sessions typically last for about 90 minutes.

Figure 1
Screen Shot of Infant Net's Play and Learning Series Page

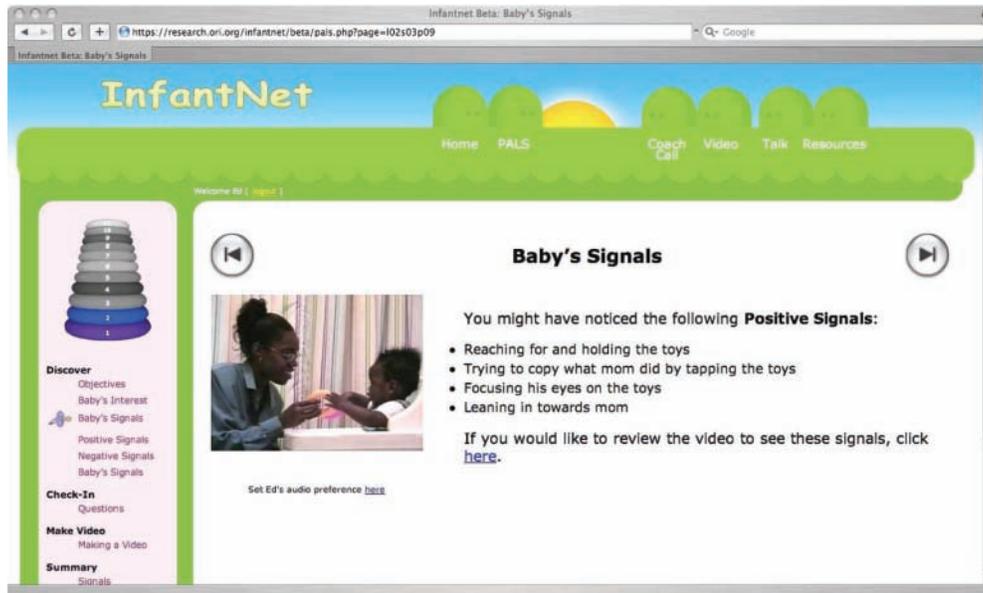
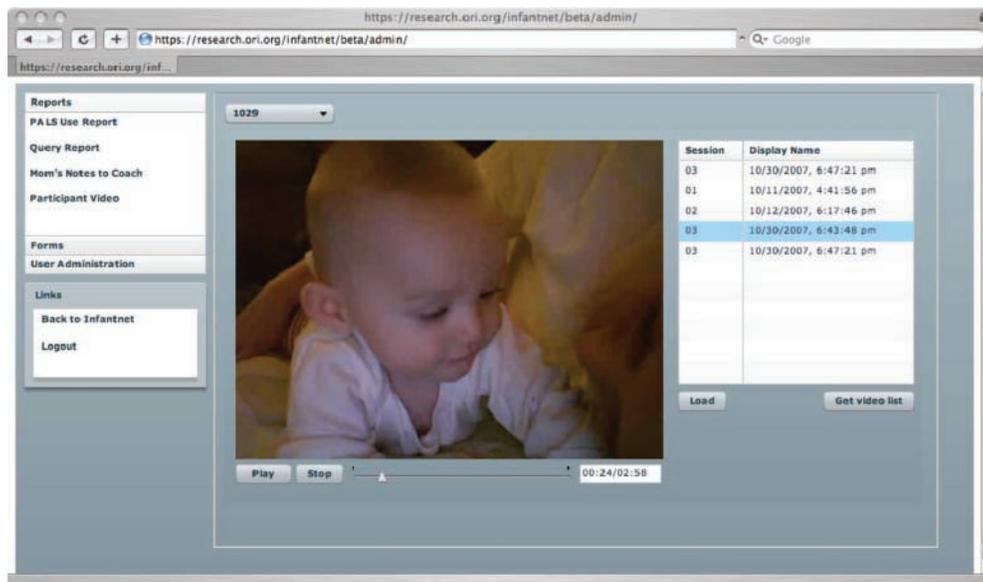


Figure 2
Infant Net Administrator Page With Participant Video



Adaptations for Internet Delivery

Adaptations of existing evidence-based interventions, aimed at increasing access by underserved populations, must maintain the effective elements of those programs. As such, the program content and length was retained within

our technological adaptation. The goals of our adaptation were not only to increase access to the parenting intervention but also to support: (a) successful and efficient learning through a focus on the principles of effective instructional design, (b) parent engagement through the multimedia and interactive nature of the program, and (c) data-based,

individualized intervention through the use of a continuous progress-monitoring mechanism embedded into the intervention delivery system.

To achieve these goals, the Internet-delivered intervention was designed to incorporate four primary components: (a) a course for self-regulated learning of parenting skills that incorporated dynamic multimedia presentations and interactive queries to facilitate knowledge acquisition and promote engagement (see Figure 1); (b) a mechanism to record remotely and transfer videos of parent-infant interactions captured through a computer eyeball, to encourage practice and facilitate discussion with the coach (see Figure 2); (c) an electronic system for professional and peer support designed to facilitate learning and promote engagement; and (d) an online tracking system of participant knowledge acquisition and treatment engagement to facilitate progress monitoring as well as supervision of coaches (see Figure 2).

Though, as described, the PALS intervention was well suited for computer-delivery, several modifications were required. First, the protection of data and confidentiality over the Internet required the use of encryption technologies for all data collection and progress-monitoring activities. We used VeriSign SSL, the same protocol as used for e-commerce. The website was accessible via the Internet with username and password protection. Second, the adaptation for an Internet-delivered multimedia intervention involved editing the intervention manual into a series of text pages (with audio narrative reading the page). The editing condensed the coach's interactive probing to the end of the session for inclusion in the weekly phone call. Third, the video material needed to transcoded into a browser-ready delivery format; we used Quicktime (.mov) format. Fourth, the system required programming an automated video transfer protocol for the observations of mother-infant interactions. Fifth, we created a graphic user interface and database programming for tracking. Lastly, the adaptation required the addition of a brief (1 hour) computer and program orientation for participants.

Self-regulated online learning of parenting skills. An important contributor to engagement with any educational program is the extent to which participants feel successful in learning the content that is being presented to them. To promote successful long-distance learning and maternal engagement with the program, careful attention was paid to principals of instructional design (Kameenui & Carnine, 2001) in adapting the PALS program to the computer. One key concern was to ensure that the literacy demands of the program were not prohibitive, and did not overwhelm participants' cognitive

resources needed for learning program content. For this reason, all text elements in the program have optional narration to reduce decoding demands. As well, progression through the website is menu-driven using a mouse and icons, which minimize the need for keyboarding or written language skills. To reduce the cognitive load on mothers and improve comprehension, session material is organized into meaningful chunks of information. The chunks, or main ideas within each session, are listed in a menu that is always in view such that with a click of the mouse, the mother can review any idea. This aspect is critically important in computer-delivered intervention because, unlike in a traditional treatment setting, the coach is not immediately or proximally available to provide in-the-moment clarifications. In addition, because program content builds upon itself, with base skills (e.g., recognizing baby's signals) taught and practiced before being integrated into more complex activities (e.g., introducing new toys and activities), program sessions are completed in a linear fashion. This structure reduces the demands on mothers as they move to subsequent, more complex learning tasks. Once mothers have completed a session, they can go back and review previously learned material across these sessions in a nonlinear format. Once again, a visual cue of session completion is always in view such that, with a click of the mouse, previously viewed sessions can be accessed quickly.

Periodically during the self-paced portion of each session, mothers are asked questions to promote the progressive learning of material. These questions can take multiple forms, either phrased as thought questions for the mother or as more direct assessments of content acquisition. To provide authentic and varied practice in critical program skills, the questions are paired with videos of mothers and their infants either displaying or not displaying the skill. Questions take the general form of, What did you notice this mother doing? or What could this mother have done differently? This type of example/nonexample discrimination training is critical to helping participants recognize and learn program skills. For these types of questions, mothers respond with check-box type responses (i.e., multiple answers are allowed). After responding to a query, mothers are given immediate feedback on possible answers to the questions and are then given an opportunity, through a simple one-click review prompt, to view the video demonstrating the important idea again.

Weekly computer-administered video recorded observation. After each session's content presentation and assessment, mothers are asked to record a video of themselves with their infant practicing the skills taught during

that session (see Figure 2). Explicit descriptions of the activities to be undertaken are given before each recording, including the provision of words and behaviors that mothers can use with their infant during the interaction (e.g., for the pat-a-cake activity, "Some words you can use with your baby during this activity: pat, clap, roll, hands, giggle, smile, laugh."). This prompt provides mothers with a foundation for success in displaying appropriate skills if such skills have been learned. Utilizing a remote computer-assisted observation system, mothers are videotaped for 5 minutes via a computer eyeball camera while they perform interactive activities with their infants. These video cameras are located above the computer screen as part of the computer. Once recorded, the video is sent by an automated application via a secure Internet connection to a web server for review by the coach and clinical supervisors. Videos are reviewed on a weekly basis with mothers to generate parent reflection, provide concrete reinforcement, and build motivation for explicit behavioral practice and homework contracting. In this way, coaches can give explicit formative feedback to mothers about where changes are, or are not, occurring, the latter signaling the coach to identify and address potential barriers to change.

Weekly parent-coach contacts. The Infant Net program makes use of coaches as a critical element to learning and keeping mothers engaged (Tate, Jackvony, & Wing, 2003). Coaches have weekly scheduled review sessions over the phone with each mother after the mother has completed a session. During the weekly phone call, the mother and coach review the past week's material and coview the parent-infant practice video with the coach providing both positive and corrective feedback. Because home practice is such an important component of the intervention, mothers are encouraged to describe the skills practiced during the week and are reinforced for concrete descriptions. When mothers report that they did not practice the skills taught, or their statements and behavior suggest that they were not able to engage in home practice, barriers and challenges are discussed for the purpose of problem-solving, key skills are quickly reviewed, and parents are prompted to practice the skills during a brief interaction with their child at the beginning of the session. Coaches also use this opportunity to encourage mothers to talk about and practice using these new skills during daily routines with their infant, an important aspect in the generalization of skills to be learned.

Social support. As social isolation has been identified as a risk factor in child maltreatment, it is important, in

adapting programs into a technological format, to include components relevant to strengthening access to sources of support. Creating a virtual community within technological interventions may be one way to eliminate some of the isolation felt by rural parents as well as to promote learning and engagement (Guterman, 1997). In addition to the ongoing contact with a coach, the Infant Net program includes an electronic bulletin board to communicate with peers and professional program staff. The bulletin board takes advantage of the Internet technology to approximate the group support thought to be a beneficial component of traditional parenting groups (Webster-Stratton, 1984). The bulletin board has the additional advantage of being available 24 hours a day, though we also establish "meeting times" to facilitate group interaction with professional oversight.

The first time a mother logs on to the bulletin board, she receives a welcome message from her coach and a list of ground rules for safe and respectful participation. This gives mothers some guidance on interacting with each other and sets the stage for open and supportive communication. Group members communicate by reading and replying to each others' messages. Each message features the mother's log-on name, the date, and a subject title. Mothers choose whether to use a variant of their own names (e.g., first name, last initial) or an "alias" (e.g., "countrygirl") as a log-on name. In this way, mothers have control over how anonymous they choose to be while interacting. Group members are able to read messages in a variety of ways. They can elect to read some or all the messages since their last log-on or follow a "thread" on a topic of particular interest. They may then choose to join in the discussions that are of interest to them. Content of the message areas are recorded in activity logs and available to coaches for weekly discussion with mothers. One limitation in the current version of the Infant Net website is that it does not yet have the capability to provide audio versions of web postings. Hence, access to this component of the intervention is limited to those with at least basic literacy.

Administrative tracking system. Online monitoring of participant activities and clinical supervision is also a critical component of user safety, learning, support, and engagement. The Infant Net program utilizes an automated and secure feedback system that dynamically generates displays of the intervention process for coaching support staff and supervisors. The program-tracking feature allows the clinical staff to track where each mother is in the program, as well as how often they have logged in, how many sessions and assessments have been completed, and the level of skill acquisition they are obtaining. This secure component of the website is divided into

two sections: Reports and Forms (see Figure 2). Reports include computer use, query responses, personal notes to the coach, and videos. Forms provide clinical staff with online methods for data entry.

Treatment Fidelity

Treatment fidelity was established and maintained in the following ways: (a) use of detailed, scripted parenting coach manuals; (b) parent videos used in each session to target specific parenting skills; (c) video-recorded session practice by coaches in which coaches met treatment fidelity criterion prior to implementation with study families; and (d) video-recorded or live observational probes of coach implementation of intervention sessions by a PhD-level supervisor, and the use of a treatment fidelity checklist completed by the coach and supervisor following supervised sessions. In addition, monthly individual and group supervision are used to view video recorded parent-child skill practice during sessions for the purpose of treatment planning that emphasizes individualizing intervention within parameters of the treatment protocol.

Internet-based supervision can significantly enhance fidelity. Staff are required to enter when and how they contacted families, whether in person or by phone, on a secure website, which is automatically viewable by the supervisor. As a result, the supervisor can monitor family progress and coach efforts on a daily basis without having to wait until the next individual supervision session.

Preliminary Studies of Prototype and Observational System

Formative Testing of Infant Net Prototype Program

We conducted a small set of case studies to test the feasibility of a web-based prototype of the PALS training program. The case studies focused solely on the web-based application of the training program without coaches. In this initial assessment, our goal was to: (a) administer the program in a home setting with a small sample, (b) obtain participation and observational data via Internet, and (c) collect usability, knowledge acquisition, and satisfaction measures. A web-based version of the first three PALS sessions (i.e., Introduction, Signals, and Responding) was used for this testing. Participants were 3 adolescent girls, aged 15 to 17, who were pregnant, living in foster group home care, and involved with the local juvenile justice system. Consent to participate was obtained from their legal guardians, with the girls

providing assent. We chose the foster group home based on our existing working relationship. As the purpose of this pilot was to test initial feasibility and social validity of a web-based prototype of the program, we selected this sample because they had very low social support, as a condition of being placed in a group foster home, they were from low SES backgrounds, and they had limited education. Each of these factors, especially when combined, was recognized as a potential barrier that we expected to find in our future target audience. Participants were approached by program staff and asked if they were interested in participating. If prospective teens were interested, a member of the research staff contacted them to explain the project and obtain assent in person.

A laptop computer with an eyeball camera and access to the project website was placed in the home for the duration of the pilot study. The case studies included four components, completed during a 2-week period:

1. Preassessment to obtain demographic information, participant's prior experience with computers, and participant knowledge of infant signals and responsive parenting behavior.
2. Program and computer-use instruction that lasted approximately 1 hour.
3. Appraisal of the participants' independent completion of the PALS Session 3 (Responding), which included completion of the interactive web session and videotaping of "mother" with a doll in an analogue activity to demonstrate and label different types of infant signals and to demonstrate appropriate sensitivity behaviors in response to those signals. We were interested primarily in assessing the participants' ability to self-record video of themselves interacting, which required positioning themselves and the doll with close view of their faces and speaking loudly enough for audio to be recorded. In addition, although the dolls obviously did not present cues, they did serve as props for participants to demonstrate a talk-aloud procedure involving labeling of positive and negative signals and demonstrating how they would respond to those signals.
4. Postassessment of knowledge of infant signals and responsive parenting behaviors as well as satisfaction with the Infant Net website. Postassessment consisted of fill-in-the-blank, multiple-choice, and true-false questions pertaining to infant signals and discrimination of sensitivity and responsiveness behaviors.

During the study, research staff observed participants while they completed the sessions. Research staff

tracked the amount of time participants spent in each section and recorded qualitative notes regarding participant errors that were made in response to content questions, difficulties that participants encountered as they attempted to progress through the program (including creating and sending their video), and questions that participants raised.

Results showed that postassessment knowledge regarding both infant signals and responsive parenting behaviors increased by 30% to 40% from preassessment (60% to 100% for Participant 1, 50% to 80% for Participant 2, and 50% to 90% for Participant 3). Direct observations of participant engagement with the website showed that the 3 participants, who had no prior experience with the system, were able to complete the didactic portion of each online training session and start the digital video recording in a reasonable amount of time (27, 25, and 17 minutes) with minimal assistance. Participant 1 needed assistance on two occasions (once in progressing through the didactic portion of the tutorial and in checking to verify that her image was appearing correctly on the computer monitor), Participant 2 needed assistance once (to press the start button to record video and verify that video was being recorded), and Participant 3 needed no assistance. In addition, 2 of the 3 participants completed independent homework (Phase 3 of the pilot: completion of PALS Session 3 and self-videotaping with successful video transfer to the Infant Net website). One participant did not complete the homework assignment. To determine whether this participant had simply not followed through with homework or whether she was actually unable to carry out the tasks, she was asked to complete the tasks without help from an observer just prior to postassessment. She was observed to complete each task, including successful video transfer, without instruction by the observer. Finally, participants completed a 7-item questionnaire, based on a 5-point Likert scale, to assess perceptions of usability and overall satisfaction with the system. The Likert Scale ranged from 1 (*very difficult* or *very dissatisfied*) to 5 (*very easy* or *very satisfied*). The mean satisfaction rating for each participant ranged from 4.7 to 5 across all survey items. These results provide preliminary support for the usability of and satisfaction with the future web-based portion of the Infant Net program.

Feasibility Testing of Parent-Infant Interaction Observation System for Progress Monitoring

In our previous studies, video-recorded free-play interactions, in which parents practiced key session skills, were

used to rate parent and child behaviors. However, it was unclear whether the quality of video streamed over the Internet would be adequate for observational ratings. Hence, we conducted a small test to compare observations gathered using the remote Internet-based streaming video approach with those gathered directly in the home using digital camcorders. Ten 4-minute segments were recorded simultaneously using the two approaches. The tapes were coded using the Indicator of Parent-Child Interaction developed at the University of Kansas (Baggett & Carta, 2006; Baggett, Carta, & Horn, 2003). Each interaction session resulted in two videos produced—one from streaming video and one from a traditional camcorder. Two masters'-level research staff, who had previously demonstrated mastery of the coding system as assessed by interobserver agreement of ratings of traditionally recorded videotaped interactions, independently rated the traditional and streaming videos. Each coder independently viewed and rated the same interaction session (i.e., one coder viewed the streaming video while the other coder viewed the traditional video of the same session). Each coder scored five traditional videos as well as five streaming videos. Interobserver agreement across the two methods was high, that is, percentage agreements were: caregiver behavior ($M = 92%$, Range = 75% to 100%), child behavior ($M = 91%$, Range = 83% to 100%), and overall interaction ($M = 92%$, Range = 86% to 100%). These scores compare to interobserver agreement scores gathered on this measure when observations are coded either in vivo or from video recordings (Baggett, 2003).

Conclusion

As noted, increasing attention has been paid to the need to develop nontraditional approaches to service delivery to overcome barriers to treatment utilization (NIMH, 2003). The steadily increasing penetration of home computer and Internet usage within vulnerable populations, paired with dwindling availability of state resources to support families at risk for child maltreatment, renders remote delivery of intervention services via the Internet a potentially valuable way of addressing this need. Potential cost reductions associated with transferring in-home programs such as PALS to the Internet stem from eliminating the need for service providers to physically travel to distal areas on a weekly basis, allowing one coach to work with multiple families in a single day. This benefit is even larger for infancy-based interventions given the scarcity professionals trained in infant mental health (Zeanah et al., 2005).

To ensure the delivery of effective services using technological media, however, significant attention must be paid to the message being delivered (Davis, Caros, & Carnine, 2006). Clearly, the transfer to Internet delivery must be made only when the effectiveness of the program in its original format has been demonstrated. The PALS program lends itself to computer administration with its manualized content and its heavy reliance on video vignettes with examples of target behavior. The instructional elements of the original program then need to be considered relative to their appropriateness for self-directed learning. In the instance of the PALS program, we were concerned that losing the in-person interactions between the coach and the mother, which provide opportunity for explanation and clarification, could substantially weaken the participants' ability to engage with and understand the material. We thus paid close attention to four important principles of instructional design (Kameenui & Carnine, 2001): (a) initial skill, wherein instruction must take place in a format that matches the skill level of the learner; (b) judicious review, wherein previous material is reviewed at the beginning of each new session, new material is reviewed and assessed on a frequent basis throughout a session, and varied examples are used to promote generalization; (c) conspicuous and integrated strategies, in which the component steps of each skill are explicitly presented and skills are learned in a linear format, with foundation skills learned to mastery first before they are integrated in subsequent sessions; and (d) mediated scaffolding, wherein appropriate guidance, modeling, and feedback are provided to the learner which are faded as mastery is achieved.

Skill level and using conspicuous strategies are critical considerations for participants with lower decoding and comprehension skills. Instruction must take place at a level whereby learners are not taught above their skill level lest learning and motivation be reduced. When an in-home coach is present, instruction can be constantly modified to fit the learner. Via computer, such ongoing adjustments in the initial presentation cannot be made. Thus, in the Infant Net program, chunking information into small, meaningful segments, placing these segments in a linear format, and reducing multisyllabic words and sentence length were all strategies used to provide a clearer and more easily absorbed learning task. Judicious review is accomplished with the strategic integration of examples and nonexamples of skills, with opportunity to efficiently review video examples of these skills. Returning to previous material for review can be accomplished with one-click access to reduce cognitive load and frustration, which can

interfere with learning. Scaffolding is provided via immediate feedback from the computer program as well as by the coach facilitator in weekly phone contact. The findings of our pilot case studies suggest that attention to these instructional design principles resulted in a program that has the potential not only to reach and engage remote families, but also to provide them with the material via a meaningful and effective service delivery mechanism.

Although the introduction of interactive Internet-based interventions into the fields of child development and parenting education has many benefits, potential issues concerning outdated equipment and absence of such technology for many rural families require further attention. The digital divide has been reduced but is still a factor for many communities. These communities may only have limited Internet access (i.e., dial-up) and outdated equipment, making interventions described herein unfeasible. Yet once one examines the cost of home-visiting interventionists (including travel time and no-show visits), the costs of Internet access as well as computer equipment seem to be relatively less. For example, on average, the cost of a computer at \$1,500 that is used for a year or more can serve multiple families. This cost, combined with the cost of 5 months of Internet access, is less than \$300 per family to complete an intervention. The Internet-delivered intervention substantially reduces the amount of staff time for delivery and eliminates home visits. On average, home-visiting programs with low-income families report that approximately half of home visits must be rescheduled due to missed appointments. The costs involved in delivering the traditional PALS program include: (a) personnel time to travel to and from 15 home visits per family, (b) mileage reimbursement, and (c) personnel time to conduct home visits that last at least an hour. These costs are substantial in comparison with the cost of personnel time required to conduct phone consults that last 30 minutes on average per week per family. In addition, this remote technology intervention dramatically reduces the cost of supervisory personnel time by eliminating the need to travel. Therefore, we conclude that a societal push to increase the use of interactive Internet-based interventions will result in the realization of cost savings, and will also aid in reaching these communities with broadband Internet access and up-to-date equipment.

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- Edward G. Feil**, PhD, is a senior scientist at Oregon Research Institute. His research interest includes child behavior problems, home and school interventions, and interactive technologies.
- Kathleen M. Baggett**, PhD, is an assistant research professor at Juniper Gardens Children's Project. She holds faculty appointments in the Department of Applied Behavioral Science at the University of Kansas and in the Department of Pediatrics at the University of Kansas Medical School. Her research focuses on early childhood social-emotional health promotion and child maltreatment prevention.
- Betsy Davis**, PhD, is an associate scientist at Oregon Research Institute. Her research focuses on educational psychology, research methodology and statistics, family process and intervention implementation related to child and adolescent behavioral and educational difficulties.
- Lisa Sheeber**, PhD, is a senior scientist at Oregon Research Institute. Her research focuses on family processes associated with child development and psychopathology.
- Susan Landry**, PhD, is the director of Texas Health Science Center's Children's Learning Institute. Dr. Landry's research focuses on environmental factors that promote early cognitive growth and development.
- Judith J. Carta**, PhD, is a professor of special education at the University of Kansas and a senior scientist with the Juniper Gardens Children's Project in the Institute for Life-Span Studies. She is the principal investigator of the CDC-funded Cellular-Phone Technology Based Parenting Project and the IES-funded Center for Response to Intervention in Early Childhood. Her research focuses on developing evidence-based practices in parenting, early literacy, language and social-emotional competence and measures for monitoring progress in early intervention programs.
- Jay Buzhardt**, PhD, is an assistant research professor at the Juniper Gardens Children's Project, University of Kansas and the vice president of Instructional Technology at Integrated Behavioral Technologies in Tonganoxie, KS. His research interests focus on developing and testing technologies designed to improve the outcomes of children with or at risk for developmental delays.