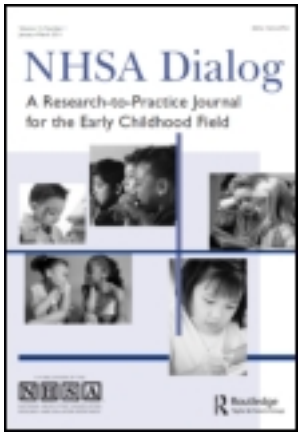

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Effects of Web-Based Support on Early Head Start Home Visitors' Use of Evidence-Based Intervention Decision Making and Growth in Children's Expressive Communication

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Effects of Web-Based Support on Early Head Start Home Visitors' Use of Evidence-Based Intervention Decision Making and Growth in Children's Expressive Communication

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We investigated Early Head Start home visitors' use of evidence-based practices and the efficacy of a web-based system to support these practices. Home visitors learned to use 3 evidence-based practices: (a) frequent assessment of children's early communication for screening and progress monitoring, (b) 2 home-based language-promoting interventions, and (c) data-based decision making in the use of the language-promoting intervention strategies. Two conditions were compared in a randomized control trial. Condition A involved the use of an online data collection system, training in data-based intervention decision making, and training in the evidenced-based language interventions. Condition B was the same as A plus additional web-based support (MOD: Making Online Decisions) linked to the children's expressive communication data. Results indicated that the expressive communication of children receiving MOD support grew significantly more than for children whose home visitors did not receive MOD support. Home visitors in both groups increased their monitoring of children in need of intervention. The dosage of the MOD intervention that children received varied within the group, and MOD home visitors reported high levels of implementation fidelity and satisfaction with the MOD system. Future research and implications for early intervention and home-visiting practices are discussed.

Keywords: language/speech, family support, developmental delay, educational media tools, home environment

The goal of many early childhood programs is to improve children's school readiness and to decrease the impact of deficits in early language and communication skills on future developmental and academic outcomes. Early intervention services to promote children's cognitive and language development in early childhood programs (e.g., Early Head Start, Part C of the Individuals with Disabilities Education Act [IDEA]) usually involve some form of home visitation (Astuto & Allen, 2009). Home visiting models over the past 20 years also

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have been promoted as a prevention component for child abuse and neglect (U.S. Advisory Board on Child Abuse and Neglect, 1991) and as a means for improving parental education and access to community-based support networks (American Academy of Pediatrics, 1998).

Specific practices used in home visiting programs vary widely, however, and most lack evidence of effectiveness (Kahn & Moore, 2010). Olds, Sadler, and Kitzman (2007) reported that home visiting programs are most effective (a) when they are implemented by a recognized professional (e.g., pediatric nurse or other licensed early childhood professional) rather than a paraprofessional and with families who have little to no reported domestic violence, (b) when home visitors use an evidence-based curriculum or framework at a high level of fidelity, and (c) when services begin within the child's first year of life. Olds et al. and others have reported that simply providing services in the home within the family context do not guarantee better outcomes (Astuto & Allen, 2009; Boyd, Odom, Humphreys, & Sam, 2010; Raikes et al., 2006; Sweet & Applebaum, 2004).

Fortunately, home visitation programs using evidence-based practices appear to be on the increase. For example, the Obama administration proposed the allocation of $1.5 billion for grants that support evidence-based early childhood home visitation programs (Office of Management and Budget, 2010). Needed in evidence-based home visiting programs are practices that work according to rigorous research findings as well as an infrastructure that supports evidence-based decision making. Home visitors need to decide what evidence-based practices to use, when and with which children/families to use them, how best to monitor progress, and what to do when children do not respond to the intervention. Home visiting practices that provide support for the individualization of children's needs and that are supported by evidence from randomized controlled trials (RCTs) are increasingly in demand (Olds et al., 2007).

Early childhood service providers, many of whom conduct home visits, need guidance, practices, and tools to support these efforts. Evidence-based decision making requires at least three basic components: (a) a system of measurement producing a rich source of frequently updated information on outcomes of interest, (b) benchmarks for evaluating each child's progress that guide decisions about risk and need for a change in intervention, and (c) support for choosing appropriate alternative interventions.

Although implementing evidence-based practice is challenging, strategies are emerging to support the use of these practices in educational settings. For example, Roehrig, Duggar, Moats, Glover, and Mincey (2008) reported that kindergarten and first-grade teachers using a web-based progress monitoring system to inform changes in the literacy instruction of individual children were hindered in their efforts because of lack of time and classroom management challenges. Their efforts were supported by access to coaches who helped them interpret child data and guide their instructional decisions. Boat et al. (2009) found that preschool teachers who received ongoing data-based feedback about their implementation of evidence-based practices demonstrated more effective use of these practices than teachers who did not receive this support. Linas, Carta, and Greenwood (2010) reported that data-based decision making in early childhood is challenged by lack of resources, professional development, knowledge, evidence-based intervention practices, and administrative support. Early childhood service providers have reported limited expertise in the use and interpretation of data to inform intervention strategies (Hojnoski, Caskie, Gischlar, Key, & Barry, 2009; Sandall, Schwartz, & LaCroix, 2004), presumably due to a combination

of preservice and in-service training opportunities and lack of infrastructure. We have encountered similar barriers when early childhood practitioners attempted to implement evidence-based practice without supports (Buzhardt et al., 2008).

The field of medicine has used technology to support data-based decision making to improve the effectiveness and efficiency of medical recommendations. Over 100 controlled clinical trials have investigated medical professionals' use of computer-based clinical decision support systems (CDSSs; Garg et al., 2005). Using practitioner-provided data (e.g., patient responses to physician questions, data from diagnostic tests, patient demographics, etc.), the range of clinical recommendations provided by CDSSs include prescriptions, additional diagnostic tests, and drug dosages. The use of CDSSs has been shown to improve practitioners' decision making when it provides the practitioner with regular decision-making prompts, can be easily integrated into the practitioners' regular activities, and is supported by upper level administrative staff (Garg et al., 2005; Hunt, Haynes, Hanna, & Smith, 1998; Kawamoto & Lobach, 2003).

Similar computer-based decision-making tools are emerging in educational practice. Reporting results of a cluster randomized field trial, Connor et al. (2009) concluded that a web-based decision-making tool improved the precision of first-grade teachers' individualized literacy instruction relative to teachers who did not use the tool. Furthermore, they reported that students who received instruction informed by the tool had stronger growth on literacy outcomes. Other computer-based tools that support evidence-based decision making and individualized instruction for elementary general and special education are at various stages of development and use. These tools include DDtrac (Gregg, 2009), which supports special education interventionists' goal setting and assessment of educational and social intervention effectiveness for children with disabilities, and AIMSWeb (2010) and iSTEEP (Chun & Witt, 2008), which support progress monitoring, data analysis, and goal setting for K–12 response-to-intervention implementation in literacy and math instruction. However, we are unaware of similar tools for practitioners providing infant and toddler services. Thus, to advance knowledge of how web-based tools can support home visitors' implementation of evidence-based practice and improve infant and toddler outcomes, we addressed four questions.

RESEARCH QUESTIONS

1. What was the impact of the web-based Making Online Decisions (MOD) support tool on growth in infants' and toddlers' language outcomes compared with no MOD support (NonMOD) as measured by the Early Communication Indicator (ECI)?
2. Did the MOD produce better home visitor ECI implementation performance compared with a NonMOD condition as measured by website data records?
3. What was the dosage and fidelity of implementation performance measured by website records and as reported by the MOD home visitors?
4. What was the home visitors' self-reported satisfaction with the MOD?

METHODS

Overview

This study was built on several evidence-based components developed previously and one newly developed component (Buzhardt et al., 2010). The previously developed components included

the language-promoting interventions (Crowe, 2002; Walker, Small, Bigelow, Kirk, &Harjusola-Webb, 2004), the ECI (Greenwood, Carta, Walker, Hughes, & Weathers, 2006; Greenwood, Walker, & Buzhardt, 2010; Walker, Carta, Greenwood, & Buzhardt, 2008), and web support for Infant and Toddler Individual Growth and Development Indicators (IGDIs; www.igdi.ku.edu; Buzhardt & Walker, 2010). The Early Head Start (EHS) programs participating in this study had previously adopted the ECI as part of their progress monitoring and accountability efforts. All home visitors in these programs used the ECI to assess their children's communication proficiency on a quarterly basis. Use of the ECI was guided by information provided through the website intervention manuals, data forms, and an online data management system. Each program had an online password-protected account to manage user accounts, enter and manage data, and generate summary reports. The authors provided programs with annual training on the use of the ECI and its role in evidence-based decision making. This ongoing training helped support retraining of staff and helped sustain implementation. Overall, this provided the context for the current study wherein an additional web-based component, the MOD tool was used to further support sustained use of the ECI for data-based intervention decision making.

Participants

Forty-eight home visitors and 132 children from five Kansas EHS programs participated in this study. Eight of these children were excluded from the analysis (see "Children" later) resulting in a final total of 124 children. None of the participants received direct payments for their participation. However, programs received $1,000 annually to compensate for the additional administrative efforts required to manage and coordinate tasks and materials between experimental versus comparison home visitors.

Early Head Start. One local EHS program and four distant programs (range of 119 to 337 miles [192 to 542 km] from the researchers) in Kansas participated. These programs were part of a larger group of 11 Kansas EHS programs using the ECI and the website to monitor the early communication skills of their infants and toddlers. The EHS programs provided community-based home visitation services for low-income families and their children from pregnancy up to 36 months of age. EHS policies require that 10% of the families served by EHS programs have a child with a disability (i.e., with an Individualized Family Service Plan [IFSP]). During the current study, all participating programs provided weekly home-based services to families. Among other requirements, EHS programs using home visiting "provide one home visit per week per family (a minimum of 32 home visits per year) lasting for a minimum of 1 and a half hours each ... maintain an average caseload of 10 to 12 families per home visitor with a maximum of 12 families for any individual home visitor" (Head Start Program Performance Standards, 2008).

Early Childhood Service Providers (Home Visitors). All home visitors who met the inclusionary criteria in the five programs agreed to participate, resulting in a total of 48 home visitors. All home visitors were female. Inclusionary criteria required maintenance of a caseload of at least one child in which they are the primary service provider. Substitutes for absent home visitors or those on extended leave were ineligible. Home visitors' reported levels of early childhood training were as follows: 41.2% reported some early childhood training beyond high

school but no degree, 23.5% had a Child Development associate's degree, 8.8% had an associate's degree, 22.1% had a bachelor's degree, 1.5% had a master's degree, and 1.5% reported "Other."

Children. Based on the quarterly ECI screenings of the 659 children in the five programs, 132 (20%) were identified as performing below benchmark (at least −1 *SD* below ECI age norm) and became eligible for participation in the study. To be included in the data analysis, children needed to have at least one ECI before and one after benchmark eligibility. Eight children were eliminated due to insufficient data, leaving 124 children (i.e., NonMOD group [$n = 61$] vs. the MOD group [$n = 63$]). The mean number of eligible children per program was 25 ranging from five to 66.

The gender of the children was 57% male, 43% female, and their mean age at benchmark eligibility was 16.8 months ($SD = 9.2$). Twenty-eight percent had an IFSP and received Part C services through IDEA. English was the primary home language for 71% of children, 23.4% Spanish, and 5.6% other (e.g., Somali, Barundi, Mande, Laotian, etc.). Comparisons of gender, home language, age, and IFSP variables indicated no significant differences between experimental groups on these variables.

General Procedures for All Home Visitors

An annual training for program staff for both groups was provided in the use of the website, the administration and scoring of the ECI, and intervention decision making. In addition, detailed information on these components was posted on the website and available to all for download. Using a trainer-of-trainers approach, staff attending these trainings could, in turn, train other local program staff in the use of the ECI and tools on the website.

Website Data Management System. Each program received a unique account within the online IGDI data system where local staff entered ECI data, generated progress-monitoring graphs for individual children and program-wide reports, and managed home visitors' user accounts and certification status. Figure 1 shows an example of one type of progress-monitoring graph that home visitors could generate from the data system at any time.

Using the program management tools in the IGDI online data system, state directors enrolled local program directors. Local directors enrolled their program staff so that they could add children and their assessment data to the data system. Local directors typically assigned a staff member to coordinate ECI administration and coding activities.

ECI Administration and Scoring. Administration and scoring of the ECI required completion of a certification process, which included training in how to administer the ECI and code its four key skill elements (i.e., Gestures, Vocalizations, Single and Multiple Word Utterances). To certify as a coder, a home visitor was required to code a pair of certification videos to a reliability criterion of 85% agreement compared with a mastery standard. To certify for administration fidelity, the home visitor was required to administer the ECI and be evaluated by a certified assessor. Trainees either videotaped themselves administering the ECI or they were observed administering it live. Administration certification was achieved if the trainee completed 13 or more of 16 administration steps correctly.

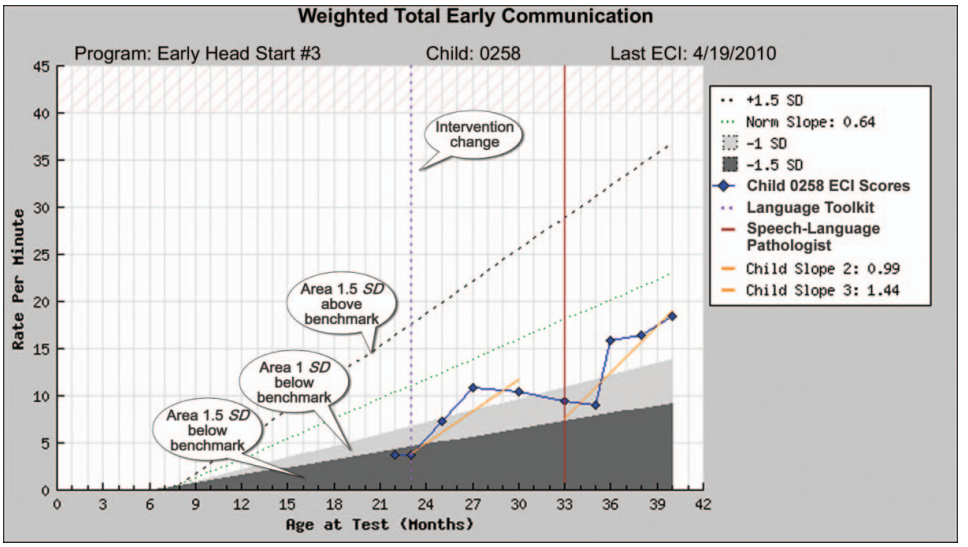

FIGURE 1 An individual child's ECI total communication performance over time generated by the IGDI online data system (with added explanatory bubbles; color figure available online).

Throughout the course of the study, home visitors administered a total of 2,907 ECIs to children on their caseload regardless of whether they were performing above or below benchmark as part of the universal screening and progress-monitoring component. The total number of ECI administrations to children identified as falling below benchmark, and thus part of this study, was 1,547 and by groups 701 (44%) for the NonMOD group compared with 846 (56%) for the MOD group.

Decision Making, Benchmarks, and Interventions. Home visitors in both groups received a didactic training session in the use of the ECI for data-based decision making. ECI benchmarks for deciding when a child was not making expected progress were discussed and materials provided. Trainees had access to two intervention manuals, the *Strategies for Promoting Communication and Language of Infants and Toddlers Manual* (Walker et al., 2004) and the *Language Intervention Toolkit* (Crowe, 2002) in hard copy and via the IGDI website.

Design

An RCT was used. The primary advantage of this experimental design is that it controls for most rival hypotheses to internal and external validity (Shadish, Cook, & Campbell, 2002). Participants were randomized to either the comparison (NonMOD) or the experimental condition (MOD) groups. Randomization was used to address two issues. The first was clustering of children within home visitors. Thus, home visitors were randomized, not children. This produced a MOD group with $n = 26$ and a NonMOD group with $n = 22$ home visitors each. The second was

to control for program differences by randomizing home visitors to conditions within programs rather than randomizing at the program level.

All consenting home visitors were told that they could withdraw from the study at any time. None withdrew from the study; however, attrition occurred as a result of staff turnover and job reassignments within programs over time. The attrition rates were 16.7% of NonMOD home visitors and 14.8% for the MOD home visitors who either left employment or were reassigned to a different position within the program that did not require them to maintain a caseload. When new staff members were hired to replace former home visitors, the new home visitors were assigned to the former home visitor's condition (i.e., NonMOD vs. MOD) and trained accordingly. This accommodated naturally occurring staff turnover while maintaining the integrity of the randomization.

NonMOD Condition. Home visitors in the NonMOD condition remained engaged in the procedures as previously described. They administered, scored, and entered ECI assessments into the IGDI online data system as usual. They reviewed children's progress charts (see Figure 1) and made decisions regarding eligibility and interventions. They made home visits, conducted the standard home-based intervention, and had access to the language intervention manuals.

MOD Condition. In addition to the NonMOD tools and procedures, the MOD home visitors had additional online support linked to the IGDI data system. The MOD was used to provide home visitors a structured, child-by-child approach for conducting individual, evidence-based decision making. MOD decision making began for a child as soon as the first below benchmark data point was added to the online data system for that child (see Figure 1).

Through a series of MOD-generated questions within the online data system and responses by the home visitor, details of the five steps were navigated and decisions made that informed subsequent steps in the decision-making process (Tilly, 2002, 2008). These steps were (a) Is there a problem? (b) What is causing the problem? (c) What intervention should be used? (d) Is it being done? and (e) Is the intervention working? The decision-making process was cyclical in that failing to accelerate a child's outcomes after the first five steps resulted in a repeat of the cycle with a modified intervention (Buzhardt et al., 2010). With each log-in, the MOD displayed a message to the home visitor reminding her of the next steps that needed to be completed for individual children on her caseload. Management tools and reports were integrated into the MOD system to allow coordinators/directors to monitor staff progress through the MOD, including completed steps and upcoming tasks.

Eligibility Recommendations. The recommendation that a child was at risk due to low performance and would likely benefit from a more intensive home language environment to promote language development was based on the ECI total communication score. Age-based benchmarks were linked to a normative study of 1,486 children (Greenwood et al., 2008; Greenwood et al., 2006). The cut points for ECI total communication were set at −1.0 standard deviation below the mean at each month of age. Whenever a MOD home visitor entered an ECI that fell at or below this level, the first step of the MOD was immediately initiated for only the MOD home visitors. In this first step, the home visitor validated below benchmark performance on the ECI by ruling out any unusual influences for that particular administration as well as any clinical mitigating circumstances (i.e., medical conditions, illness, family circumstances, etc.) that might account for

the low score. The MOD recommended conducting another ECI 2 weeks later if the assessment was considered invalid. Ruling out these factors then led to next steps in the decision-making process.

MOD Language Intervention Recommendations. The intervention recommendations were based on the language intervention literature, including milieu teaching (e.g., Hart & Rogers-Warren, 1978; Peterson, Carta, & Greenwood, 2005; Warren & Walker, 2005), prelinguistic Milieu Teaching (e.g., Warren et al., 2008; Warren, Yoder, Gazdag, Kim, & Jones, 1993), and responsive interaction (e.g., Tannock & Girolametto, 1992; Trent-Stainbrook, Kaiser, & Frey, 2007). The recommendations for specific strategies used in the present study were generated from two different manuals, one organized by type of strategy and developmental level, the other by developmental level and routine.

Strategies for Promoting Communication and Language of Infants and Toddlers Manual (Walker et al., 2004) was organized by specific language-promoting strategies (e.g., arranging the environment, following the child's lead, commenting and labeling, etc.). The manual encourages early educators and parents to embed the strategies across multiple routines (e.g., meals, play, book reading) to build intensity and to use the examples provided in the manual sections as suggestions for how to make facilitating communication and language goals more intentional. *The Language Intervention Toolkit* (Crowe, 2002) was organized by developmental levels and situations/activities in which the strategies may be used to establish joint attention, use turn taking, match utterance complexity, and be responsive. Parent handouts and suggestions for caregivers included specific activities that may be implemented across routines to support infant and toddler communication and early literacy. MOD-recommended strategies from both intervention manuals were printed out by home visitors and shared with parents during each home visit following the start of the intervention for the MOD group. The information was available in English or Spanish.

MOD-recommended strategies were those most appropriate given performance parameters for each of the ECI key skill elements. For example, a child whose rate of vocalizations was below the norm for his or her age received recommendations from sections of these manuals designed to encourage sounds. Each time a new ECI was entered for the child, the MOD recommendations automatically adapted to the child's current performance level, and the home visitor again selected from among strategy recommendations that she decided were the most appropriate for the child and the family's ability to implement. NonMOD home visitors had access to the manuals but not specific recommendations individualized to a child's performance.

MOD Recommendations About a Child's Progress. Three criteria of a child's ECI total communication performance were used to evaluate a child's progress and recommend next steps. These criteria were (a) the difference between the child's ECI score prior to intervention versus latest score, (b) the slope before versus after intervention, and (c) whether or not the child's slope forecast that he or she would be above benchmark 6 months in the future. These recommendations commenced after three ECI data points had been entered following onset of the intervention. MOD recommendations ranged from discontinuing more frequent progress monitoring and completion of fidelity checklists (part of the MOD process) for children making suitable progress to continuing these tasks and exploring additional interventions for children not showing progress.

MOD Training. In addition to the standard ECI training/retraining and certification that all home visitors received, the home visitors randomized to the MOD condition attended a 2-hr workshop conducted by the researchers in which they described the purpose of the MOD, demonstrated how to use it, and reviewed case examples of MOD activities. They also discussed issues related to randomization, including what randomization entails and the importance of limiting discussions of MOD-specific activities with their NonMOD colleagues. In cases where MOD home visitors were replaced by new staff, the local program coordinator reviewed the MOD procedures with the new hire. However, when one program experienced a sudden turnover in personnel in both conditions, the researchers conducted an additional training for new staff.

For 3 months following MOD implementation, the researchers contacted the program coordinator/director monthly to query him or her about any potential implementation issues and to answer questions. As part of an existing partnership with these programs, the researchers were also available via phone or e-mail to troubleshoot technical or implementation problems at any time for home visitors in both conditions.

Measurement

The Early Communication Indicator (ECI). The ECI is a 6-min play-based observational recording of infants' and toddlers' expressive communication during a standard play session with a familiar adult appropriate for administration in homes and childcare settings (Walker & Carta, 2010). It is an adaptive measure of individual progress designed to be administered quarterly for screening and more frequently (e.g., monthly) to monitor the child's response to intervention. All home visitors were encouraged to administer the ECI monthly for all children who performed below benchmark.

The original 5-year ECI development and validation effort (Greenwood et al., 2006; Greenwood & Walker, 2010) involved (a) a national survey of parents of children with special needs and professionals in early childhood and early childhood special education that socially validated expressive communication as an important general outcome of early intervention for young children (Priest et al., 2001); (b) studies documenting the psychometric properties and feasibility of the ECI, including sensitivity to growth over time (Greenwood et al., 2006; Luze et al., 2001); (c) studies showing sensitivity to short-term early interventions (Greenwood, Dunn, Ward, & Luze, 2003; Harjusola-Webb, 2006; Kirk, 2006; Kosanic, 2000; Murray, 2002; Small, 2004); and (d) an infant/toddler website to support scalability (Carta, Greenwood, Walker, & Buzhardt, 2010).The validity of the ECI total communication score was based on concurrent validity correlations of .62 and .55 on the Preschool Language Scale III and a parent rating scale, respectively (Luze et al., 2001).

Four key communication skills are recorded by an observer in the course of the 6-min interaction with an adult play partner during an ECI assessment. These skills are Gestures, Vocalizations, and Single Word and Multiple Word Utterances (Greenwood et al., 2006). Gestures are defined as physical movements made by the child in an attempt to communicate with the partner and include pointing, taking, and giving. Single words are either single voiced or signed words (i.e., sign language) by the child that are recognized and readily understood by the coder. Multiple word utterances are simply two or more different voiced or signed words by the child that fit together in a meaningful way to approximate a statement and are readily understood by the coder

(Walker & Carta, 2010). The frequency of occurrence of each key skill element is recorded on a paper and pencil data sheet over the 6-min assessment. These data are entered into the IGDI online data system, which automatically calculates scores and updates the child's progress charts (e.g., Figure 1). Scores are the rate per minute for each key skill (frequency/6 min).

Website ECI Implementation Records. Implementation information was available from the web-based data management system. For example, we calculated an index of ECI administration frequency to determine if home visitors increased the frequency of their assessments for children who fell below benchmark as they were encouraged to do. The index was based on the number of days separating adjacent ECI administrations by differencing the dates of administration. A monthly assessment was defined as any assessment that occurred within 8 to 45 days of the prior assessment, a quarterly assessment by a separation of 90 or more days. Midrange separation between the two was equal to or greater than 46 days but less than 90 days. For the MOD group, records were available indicating each child's history through the decision-making process. Thus, we were able to examine dosage in terms of the number of children experiencing each of the five MOD decision-making steps during the study.

Website MOD-Only Implementation Fidelity Records. Completing two online implementation checklists, MOD home visitors produced information on their reported implementation in Steps 4 and 5. The 12-item Initial Fidelity Checklist was used to guide home visitors through a set of standard activities starting when the language intervention strategies were first introduced to the caregiver. Thereafter, a five-item Follow-Up Checklist was used for all subsequent home visits. The Follow-Up Checklist also requested information about the parent/caregiver's use of the recommended intervention strategies, including frequency and satisfaction. The MOD system encouraged home visitors through online prompts and reminders to complete the checklists at least monthly for children who were below benchmark. NonMOD home visitors did not complete either of these checklists because they were embedded within the MOD.

Home Visitor Surveys. All home visitors completed an informational survey at the start of the study. This survey captured information regarding home visitors' education, early childhood experience, and current practices. Only the MOD group completed a second survey at the end of the study. This survey was used to collect information on satisfaction with the MOD experience. Home visitors rated each of the five MOD steps on a scale of 1 (*lowest*) to 5 (*highest*) for its usability and usefulness in supporting their decision-making efforts. They also answered questions concerning how they used the MOD information during home visits, including how, and if, it facilitated collaboration between the home visitor and caregivers about the child's language growth.

Analytic Method

Descriptive statistics and analysis of variance (ANOVA) were used to address questions regarding home visitors' usage of the IGDI online data system, MOD implementation, and their satisfaction with the MOD. To address the experimental research question regarding the MOD's effect on children's communication growth, we used multilevel Growth Curve Analysis (GCA; Raudenbush

& Bryk, 2002). As is common in RCTs, we used an "intention to treat" approach in the analysis; that is, we included all home visitors and children in the analysis of growth in communication skills to estimate effects in the context of an expected variation in dosage and intervention fidelity across participants (Piantadosi, 1997).

Several challenges were confronted and addressed in these analyses. For example, nesting or clustering in RCTs can lead to inaccurate estimates of statistical significance (e.g., Hedges, 2007). In this study design, nesting was present as follows: observations were repeated within children, children were nested within home visitor, and home visitors were randomized to treatment conditions. This study design suggests a three-level GCA; however, only two levels of clustering were included in the final GCA. These were (a) repeated observations nested within children and (b) children nested within treatment condition. Because we randomized at the home visitor level, there was no expectation of significant variance at this level. A lack of statistical power to detect the treatment effect at Level 3 additionally supported the two-level analysis, particularly because evaluating the outcomes by treatment condition was the research objective.

To control the potential bias of clustering in estimating significance, the chi-square model comparison test for nested models was used (Hox, 2001). To compare the two groups before and after eligibility, a two-piece growth model was used (Raudenbush & Bryk, 2002; Singer & Willett, 2003). Hierarchical linear modeling (HLM) was used to conduct the analysis. The two-piece analysis allowed examination of children's trends in linear slope before and after becoming eligible and as a function of the experimental treatment. Because individual children became eligible at different months of age, time was scaled in terms of months from eligibility so that the month of eligibility was centered at 0. Time before eligibility was scaled in negative months (i.e., -1 to -12) and after eligibility in positive months (i.e., 1 to 12). In the HLM analysis, time was dummy coded as suggested by Raudenbush and Bryk (2002, p. 179) to separate the before and after splines. This allowed tests of differences in the two groups' mean intercept at eligibility (i.e., time $= 0$) and between linear slopes before and after eligibility and onset of treatment.

The descriptive statistics for Level 1 and Level 2 are provided in Table 1. The general approach to analysis was to conduct a Level 1 analysis of child data across both conditions. At this step, it was possible to preliminarily screen covariates (i.e., age at eligibility, IFSP status), the experimental variable (i.e., MOD groups), and their interactions for inclusion in Level 2 analyses. Results indicated that all of these variables had significant direct effects and needed to be considered in subsequent Level 2 growth modeling. Level 2 analyses were conducted to test the influence of the experimental variable on ECI total communication and to account for the influences of covariates.

The first Level 2 analysis examined the direct effects of the experimental MOD condition on children's growth on the ECI. Because prior analyses indicated that both age at test and IFSP status (i.e., No IFSP $= 0$, IFSP $= 1$) influenced one's ECI total communication score, subsequent analyses were conducted to control for these covariates in building a best-fitting model. Shrinkage in the deviance statistic and the χ^2 test of the differences between nested models was used to include or exclude variables from the model (Raudenbush & Bryk, 2002). Model building began by including the covariates and their interactions first and the experimental variable (i.e., NonMOD $= 0$ and MOD $= 1$) as the last step. We first entered age at eligibility followed by IFSP status and their interaction effects. We tested the hypothesis that adding the experimental effects last would significantly improve model fit beyond that already produced by

TABLE 1
Descriptive Statistics

Variable	*N*	*M*	*SD*	Minimum	Maximum
Level 1 Descriptive Statistics					
ECI total communication	770	7.66	6.18	0	36.2
Before eligibility	770	−0.80	2.02	−12	0
After eligibility	770	1.92	2.19	0	12
Level 2 Descriptive Statistics					
Experimental groups	124	0.51	0.50	0	1
IFSP status	124	0.28	0.45	0	1
Age at eligibility (months)	124	16.81	9.16	4	38
Age × IFSP Status	124	5.33	9.66	0	38
Groups × IFSP Status	124	0.14	0.35	0	1
Groups × Age at Eligibility	124	8.15	10.26	0	38

Note. IFSP = Individual Family Service Plan (IFSP: 0 = None, 1 = IFSP); Experimental groups: 0 = NonMOD, 1 = MOD.

the covariates. Effect sizes were estimated using the procedure for growth curve models described by Feingold (2009).

RESULTS

Was Children's Growth in ECI Total Communication Significantly Greater in the MOD Versus NonMOD Group?

The Level 1 mean intercept at eligibility was 5.21 communications per minute. The mean slope before eligibility was .31 communications per minute per month, and the mean slope after eligibility was 1.38 communications per minute per month (see Figure 2, upper panel, and Table 2). Level 2 analysis of the direct effects of the MOD treatment significantly improved the model fit compared with the Level 1 unconditional model, $\chi^2 = 8.83$, $p = .03$ (see Figure 2, lower panel, and Table 2).

The difference between the groups' mean intercepts was not significantly different at the beginning of the experimental treatment (i.e., eligibility: the point at which each child fell at least −1.0 standard deviation below benchmark). However, the two groups' slopes differed significantly after treatment. Prior to eligibility the NonMOD slope was 0.67 compared with only 0.08 for the MOD group ($d = .64$). After eligibility, slopes increased to 1.00 for the NonMOD group compared with 1.69 communications per minute per month for the MOD group ($d = .41$), a difference of .69 communications per minute between groups. Effect size between groups at 3 months into intervention was $d = .24$, increasing to $d = .47$ at 6 months and to $d = .71$ at 9 months as the trajectories increasingly diverged (see Figure 2, lower panel).

Based on the before and after slopes within the MOD group, a simple forecast comparison of the intervention effect at 3 months after eligibility was 4.6 versus 10 ECI total communications

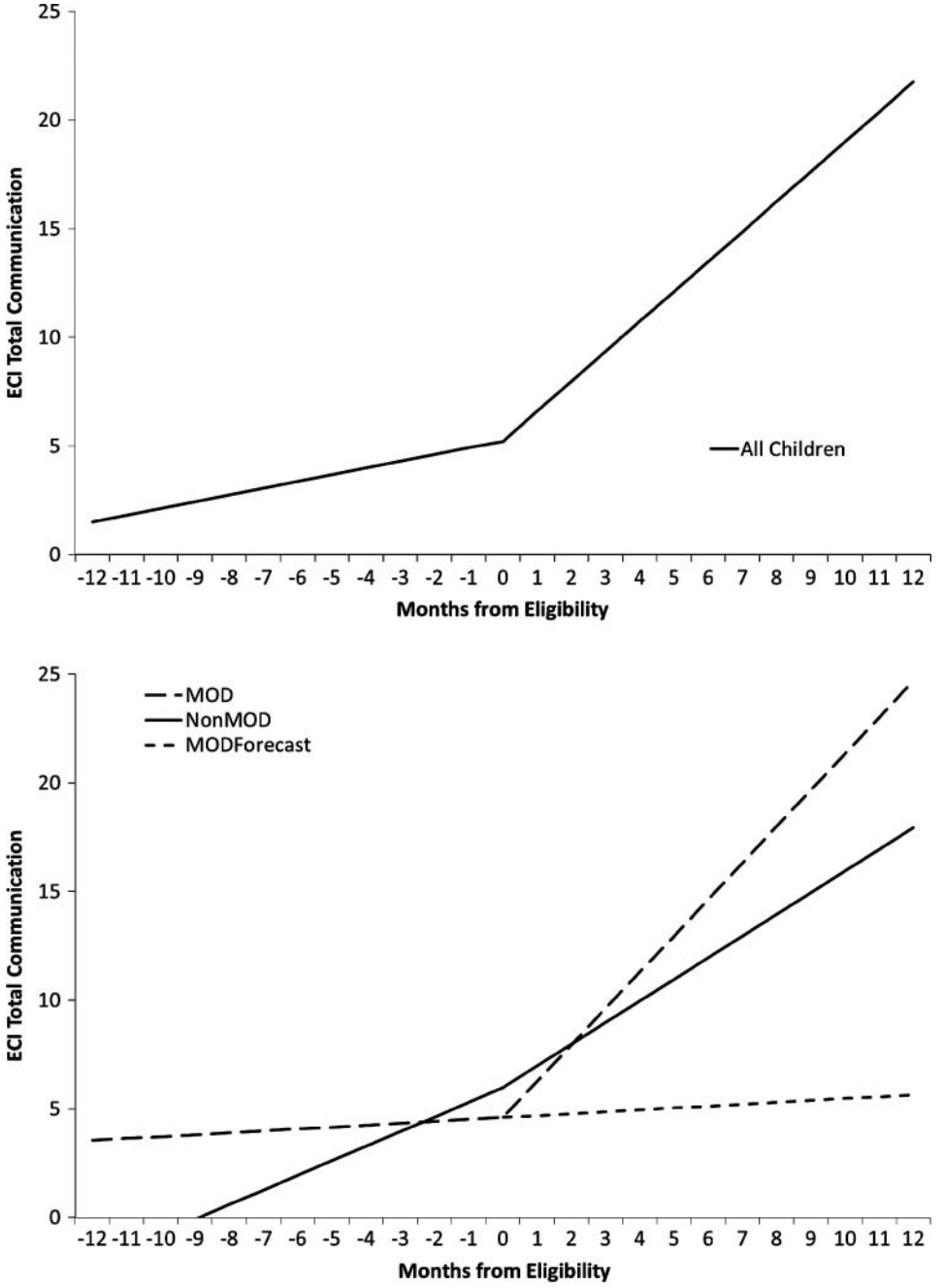

FIGURE 2 ECI total communication two-piece growth trajectories for Level 1 (upper panel) and Level 2 (lower panel) analyses.

TABLE 2
Two-Piece Growth Curve Models

	Fixed Effects	Unconditional Model					MOD Groups Model				
		Coefficient	*SE*	*t*	*df*	*p*	*Coefficient*	*SE*	*t*	*df*	*p*
Level 1	Intercept	5.21	0.40	12.892	123	0.001	5.97	0.67	8.918	122	0.001
	$Slope_{Before}$	0.31	0.10	3.046	123	0.003	0.67	0.22	3.085	122	0.003
	$Slope_{After}$	1.38	0.15	8.797	123	0.001	1.00	0.22	4.572	122	0.001
Level 2	Intercept						−1.38	0.82	1.668	122	0.097
	$Slope_{Before}$						−0.59	0.24	2.452	122	0.016
	$Slope_{After}$						0.68	0.30	2.237	122	0.027

Final Estimation of Variance Components (Based on Units That Had Sufficient Data for Computation)

	Random Effects	Unconditional Model					MOD Groups Model				
		SD	*Variance*	*df*	χ^2	*p*	*SD*	*Variance*	*df*	χ^2	*p*
	Intercept	3.63	13.19	44	237.770	0.001	3.65	13.31	43	242.940	0.001
	$Slope_{Before}$	0.43	0.19	44	85.806	0.001	0.43	0.19	43	91.07	0.001
	$Slope_{After}$	1.15	1.33	44	99.674	0.001	1.11	1.23	43	103.71	0.001
	Level 1	3.92	15.34				3.90	15.23			
	Deviance	4589.90					4581.07				
	Parameters	10					13				

Note. Unconditional versus conditional model test, change in deviance = 7.83, $\chi^2(3) = 8.83$, $p = .03$.

had the MOD intervention not been implemented, growing to only 5.1 versus 14.6 ECI total communications at 6 months later (see Figure 2, lower panel).

Results of building the best-fitting model are reported in Table 3. Compared with the Level 1 unconditional model, the addition of Age at Eligibility significantly increased the fit ($\chi^2 = 94.66$, $p = .0001$). The addition of IFSP status to the model also improved model fit ($\chi^2 = 7.29$,

TABLE 3
Best-Fitting Two-Piece ECI Total Communication Growth Model

Models	Deviance Statistic	Number of Parameters	Decrease in Deviance	χ^2	*df*	*p*
Level 1	4589.898403	10				
Level 2 Age at eligibility	4498.382414	13	91.515989	94.66	6	0.0001
Level 2 Age at eligibility + IFSP	4491.090308	16	7.292106	7.29	3	0.0620
Level 2 Age at eligibility + IFSP + comparison groups	4481.568057	19	9.522251	9.52	3	0.0230

Note. Age and Individualized Family Service Plan (IFSP) interaction effects were not significant.

$p = .062$). Finally, the addition of the MOD group variable also significantly increased model fit ($\chi^2 = 9.52$, $p = .023$). Additional modeling indicated that adding interaction effects into the model did not improve fit. Thus, the best-fitting model was comprised of Age + IFSP status + MOD group. In summary, even after controlling for the covariates of Age at Eligibility and IFSP status, the effects of the MOD treatment on children's ECI growth were significant.

Did the MOD Group Produce Better Home Visitor ECI Implementation Performance Compared with the NonMOD Group?

Overall, children in the NonMOD group received a mean of 6.1 ECI assessments ($SD = 3.5$, range = 1–14) compared with 7.3 ECI assessments ($SD = 4.0$, range = 1–20) in the MOD group, indicating implementation of systematic ECI measurement by both groups. With respect to increasing monthly ECI monitoring after eligibility, analyses indicated that home visitors in both groups rarely conducted monthly ECI assessments before children became eligible (i.e., scoring 1.0 standard deviation below ECI benchmark) but conducted them much more frequently after eligibility. The mean number of days separating ECI assessments was 98.5 ($SD = 28.9$) before eligibility compared with 68.2 ($SD = 33.5$) days after eligibility, a mean reduction of 30 days between assessments.

The distribution of days between ECI assessments for all children before eligibility was 5.1% (Monthly), 24.2% (Midrange), and 70.7% (Quarterly). After eligibility, this changed to 33.8% (Monthly), 35.1% (Midrange), and 31.1% (Quarterly or more) for all children, indicating a mean increase of 28.7% for monthly monitoring and an 11% increase for midrange monitoring across both groups after MOD eligibility (Before versus After main effect, $\chi^2[2,395] = 54.161$, $p = .0001$). However, the difference between the MOD and NonMOD groups' patterns of ECI administration in the after phase was not statistically significant.

What Was the Dosage and Fidelity of MOD Implementation?

Data indicated that individual children in the MOD group experienced different levels of MOD decision making during the study (see Table 4). All 63 MOD group children experienced the first MOD step as soon as they produced an ECI that was 1 standard deviation below benchmark. However, only 12 (19.1%) experienced all five steps, the last step being the determination of

TABLE 4
Proportion of MOD Group Children Experiencing Each Decision-Making Step

Decision-Making Step	Number of Children
1. Is there a problem?	63
2. What is causing the problem?	31
3. What intervention should be used?	30
4. Is the intervention being done?	28
5. Is the intervention working?	12

whether or not the intervention was working. Nearly half of the children experienced Steps 2 through 4 leading to implementation of the home-based language interventions. These children experienced the greatest exposure to the complete MOD intervention.

What Was the Fidelity of First Home Visit Implementation? Initial Fidelity Checklists were completed for 28 out of 63 (44%) children in the MOD group and Follow-Up Checklists for 22 of 63 (35%) children. Thirty-three percent of home visitors reported that they completed the initial and follow-up checklists during the home visit, 33% immediately after the home visit, 8% a day or more after the home visit, and 25% were unsure about when they completed them.

Home visitors reported completing 89% ($SD = 11$) of all items on the Initial Fidelity Checklist (see Table 5). The least implemented was modeling/demonstrating the strategy, Item 6 at 57%. The most frequently implemented items were 2 and 11 (100%), regarding explaining concern over the child's slow rate of growth and suggesting that caregivers keep the routines sheet and intervention handout in a place so that they could see it every day. All other items showed high rates of implementation ranging from 82 to 96%.

What Was the Level of Follow-Up Visit Implementation? The mean percentage of reported follow-up implementation was 99% ($SD = 2.0$) over all items on the Follow-Up Fidelity Checklist (see Table 6). Four of the six items were implemented 100% of the time, and the least, Item 2 (I asked if the caregiver was able to do the strategy[s] after my last visit), was 96%. For Item 5, in which caregivers reported how much they had been using the strategies, 53% of caregivers reported "Often," 33% reported "Sometimes," 13% "Rarely," and 2% "Never."

TABLE 5
Home Visitor Initial Fidelity Checklist Completion by Item

Items	%
1. Was the person with whom you reviewed the strategies the primary caregiver?	86
2. I explained the concern to the caregiver and showed them the ECI graph.	100
3. I talked to them about how they use the strategy across their daily routines.	93
4. I helped them pick one (1) or two (2) routines to do the strategies.	89
5. I gave them the materials related to the strategies.	89
6. I modeled/demonstrated how the parent/guardian should use the strategy.	57
7. I role-played the strategies together with the parent/caregiver.	82
8. I observed the parent/caregiver perform the strategy(s).	89
9. I showed them where to record their usage of the strategy(s) on the routines sheet (attached to this checklist).	93
10. I asked the parent/guardian how they plan on using the strategy across the routines.	89
11. I suggested that they keep the routines sheet and intervention handout in a place they will see it every day.	100
12. I asked if they had any questions.	96
Mean (*SD*) of items for first visit Fidelity Checklist completion	89 (11)

Note. ECI = Early Communication Indicator.

TABLE 6
Home Visitor Follow-Up Fidelity Checklist Completion by Item

Items	%
1. Was the person with whom you reviewed the strategies the child's primary caregiver?	100
2. I asked the caregiver if they were able to do the strategy(s) after my last visit.	96
3. I asked the parent/guardian if they were comfortable doing the strategy(s) and asked if they noticed any improvement.	98
4. I talked to the parent/guardian about how they could continue doing the strategy(s) across some additional routines.	100
5. I talked to the parent/guardian about how much they have been using the strategy(s). I asked them how often they used the strategy(s), and they said (circle one): Often Sometimes Rarely Never	100
6. I left the parent/guardian with a new intervention handout(s) and pointed out where they could record how often and when they used any of the strategies.	100
Mean (*SD*) for follow-up Fidelity Checklist completion	99 (2)

What MOD-Recommended Language Promoting Routines and Intervention Strategies Were Used by the MOD Group? Table 7 shows the frequency of selected language promotion strategies and routines. Reading, Drawing/Writing, Bathing, and Dressing accounted for 66% of the routines home visitors presented to caregivers for implementation. Imitating and expanding, positive attention, commenting and labeling, and following child's lead accounted for 73% of the strategies caregivers were taught to use.

How Did the MOD Facilitate Home Visitor–Caregiver Collaboration? When asked after the study how they selected among the recommended strategies, 73% of home visitors reported that they either selected all of the strategies recommended by the MOD and later collaborated with the family to identify the most appropriate ones, or they chose the best strategies based on their knowledge of the family. Only 20% reported that they always chose recommendations based on their knowledge of the family, and 7% reported that they used some other strategy or did not recall how they selected strategies.

When asked how they used the MOD reports of child progress in deciding whether or not the strategies were working, 46.2% of home visitors reported using them to decide whether to continue more frequent ECIs and fidelity checks, 53.8% said they shared the information with the caregivers, and 23.1% indicated they were not sure or did not remember. Regarding how they shared child progress report and graphs with caregivers, 64.3% gave caregivers the MOD report and the child's graph and reviewed the materials with them, 43% left them with the caregivers after reviewing with them, and 21.4% verbally reported the child's progress.[1]

How Satisfied Were Home Visitors with the MOD?

Ratings reflected high satisfaction with the MOD both in terms of usability, ranging from 3.6–4.4 (5 being the highest), and usefulness, ranging from 3.5–4.5. Step 5 ("Is It Working?") was highest

TABLE 7
Frequency of Each Language-Promoting Routine and Strategy Selected by MOD Home Visitors

Routine	Frequency Selected	%
Reading	23	22
Drawing/Writing	21	20
Bathing	15	14
Dressing	10	10
Diapering	9	9
Eating	8	8
Toy play	8	8
Using numbers	8	8
Taking turns	3	3
Inside play	0	0
Outdoor play	0	0
Cooking	0	0
Total	105	100
Imitating and expanding	31	22
Positive attention	26	19
Commenting & labeling	23	16
Following child's lead	22	16
Providing choices	19	14
Using time delay	11	8
Asking questions	8	6
Total	140	100

rated for usability (4.4) and for usefulness (4.5). The lowest rated was Step 4, "Is It Being Done?" for usability (3.6) and for usefulness (3.5).

DISCUSSION

The purpose of this research was to investigate EHS home visitors' use of evidence-based practices and specifically, to test the efficacy of a web-based decision-making system (the MOD) to support these practices. All home visitors learned to access and use three evidence-based practices: (a) frequent, brief assessment of children's early communication skills for screening and progress monitoring; (b) strategies from two language-promoting interventions; and (c) data-based decision making in the application and use of the language-promoting strategies. Home visitors conducted the assessments in the home, made screening decisions, and had access to intervention information to share with caregivers. Caregivers implemented the interventions at home and home visitors monitored children's response to intervention over time. Because home visitors were randomized within programs, program differences were controlled in the design. Only home visitors randomized to the MOD group could access and use the MOD's additional online decision-making support tools.

Results indicated that children with MOD home visitors made significantly greater gains in ECI total communication even after controlling for age at eligibility and IFSP status. In terms of

home visitors' use of data-based decision-making practices, both groups increased the frequency of their monthly ECI assessments after children fell below benchmark, but there was no significant difference between groups linked to MOD use. The MOD group reported high levels of treatment fidelity and satisfaction with the MOD components.

Identified Children and Their Patterns of Communication Before Eligibility

The percentage of all children falling below benchmark on a universal quarterly screen and becoming eligible for the MOD was 20% of all children screened in the study. This group included a higher percentage of children with IFSPs (28%) compared with the general EHS population (typically 10% as mandated through Health and Human Services). The elevated percentage of children with IFSPs supported the validity of the ECI benchmark used to identify children who are performing lower than their peers. Although not all children with IFSPs have speech, language, and communication issues, children with these issues are the single most common reason infants and toddlers receive early intervention services (Hebbeler et al., 2007).

The identification of children was based on a single occasion of ECI performance at or less than 1.0 standard deviation below the mean of the child's normed age group. MOD home visitors subsequently confirmed this assessment as a valid administration. If it was not confirmed as valid, the ECI was repeated within 2 weeks or shortly thereafter. Making intervention decisions based on only a single below-benchmark performance might be questioned in terms of selection accuracy. Given the quarterly frequency of ECI screening, however, this seemed like a reasonable approach with young children not assessed more frequently. If the criteria had been two or more ECIs below benchmark, a waiting period extending over several months would elapse before addressing the child's low performance. Also, we concluded that increasing the rate of false positives (intervention for those who did not need it) was more desirable than increasing the rate of false negatives (no intervention for those who do need it). Uniform agreement regarding benchmark indicators for universal screening decisions is currently lacking (Fuchs, Fuchs, &Compton, 2004), particularly in early childhood. More research is needed in this area.

It was interesting to consider the characteristics and performance patterns observed in the two groups of children prior to eligibility. The two randomized groups were not significantly different in either the proportion of children with IFSPs or mean level of ECI total communication at benchmark eligibility. However, the groups' slopes before eligibility were significantly different. The NonMOD group displayed a later onset of communication but accelerated faster ($M = .67$ communications per minute per month), compared with the MOD group, whose onset was earlier but showed little acceleration over time ($M = .08$ per minute per month) prior to the MOD intervention (see Figure 2, lower panel).

These patterns are interesting from a growth perspective of late language emergence (Rice, Taylor, & Zubrick, 2008). Both groups might be characterized as emerging late based on their mean intercepts at eligibility, but their growth patterns were significantly different. Perhaps the performance of the children in both groups would have been more similar in both mean level and slope before eligibility had we used a combination of level and slope information for determining eligibility. More research is required to address this issue.

MOD Impact on Children's' Patterns of Communication

Results of the growth curve analyses produced important findings. Subsequent Level 2 analyses indicated that both groups increased their rates of growth (slope) after, compared with before, eligibility. This effect persisted even after accounting for the age of the children at eligibility and IFSP status in the growth model. The trends in ECI total communication were accelerating for both groups, but as the effect size calculations made clear, they diverged systematically over months and intervention with the MOD group achieving increasingly superior communication outcomes over time (Figure 2, lower panel). Additionally impressive was the within MOD group's difference between their forecasted growth trajectory before, compared with after, receiving MOD services.

Impact on Home Visitors' Implementation

It was of interest to examine home visitors' implementation of evidence-based practices. As expected, both groups significantly increased the number ECI assessments that could be classified as monthly and midrange after children fell below benchmark. Increasing monthly monitoring was desired because it gave home visitors more timely information about the progress of at-risk children and whether or not an existing intervention needed to be adjusted or a new intervention implemented. However, MOD group home visitors did not increase their frequency more than NonMOD home visitors. This was surprising given the frequent MOD advice to do so. This might suggest that the response cost of further increasing assessment frequency had reached some practical limit in both groups, given workload and other priorities during home visits. We also learned that in a few cases, caregivers did not want their child assessed frequently and that some home visitors regarded ECI assessment as merely a tool for identifying children in need of intervention and not needed thereafter. Whether or not additional training or more intensive procedures such as program-level, administrative mandates might increase more frequent monitoring remains for future research. Efforts to reduce burden by streamlining ECI administration and scoring of the ECI using mobile devices, for example, capable of uploading and downloading data directly during home visits, could increase efficiency. It might also increase effectiveness by supporting point-of-care decision making compared with the decision-making format used in this study. This could eliminate the need for desktop data entry entirely and reduce intervention onset delays.

It was also important to examine the variation in MOD dosage that children received. Although all 63 MOD group children experienced Step 1 in the decision-making model, just under half experienced Steps 2 through 4 (see Table 4). This was explained by children aging out of EHS services at 36 months of age and the infrequency that ECIs were conducted with some of these children after eligibility. Thus, it appeared that the superior growth in ECI total communication after eligibility in the MOD groups was accounted for by the remaining children in the group who received more of the active ingredients represented in the decision-making process, such as MOD-recommended language intervention strategies and longer time in home-based language intervention. These data also help explain the relatively low number of implementation fidelity checklists contributed by MOD group home visitors because some children never made Step 4, in which the checklists were used. As such, the dosage data seem to reflect the practical reality of using a decision-making approach by home visitors and families served in ongoing EHS programs. It also suggests that additional work is needed to identify at-risk children earlier in

their EHS program as well as efficiency, such that the intervention process can start earlier and take place longer.

The reported implementation fidelity data described high levels of fidelity in terms of the first and follow-up intervention visits implementing Step 4. Home visitors reported using the first visit to describe the child's need for support and to introduce and explain the language-promoting intervention strategies to parents. Follow-up visits were used to monitor parents' progress in implementing the strategies over time and modifying the intervention as needed. The one exception to high fidelity ratings was the home visitors' apparent reluctance to model and demonstrate to the caregivers how to implement the language-promoting strategies. Home visitors also clarified the routines and strategies parents used, the extent that parents reported using the strategies at home (53% reported using them often), and how home visitors used the MOD to support collaboration with parents. Home visitors in the MOD group reported high satisfaction with both the usability and usefulness of each of the MOD's decision-making steps. Considering prior findings (i.e., Roehrig et al., 2008) suggesting that most early interventionists acknowledge the importance of using data for intervention decision making, but only half report doing so, we expect that early childhood service providers will value these ECI tools.

Finally, it should be noted that the contexts surrounding home visitors' implementation of these evidence-based components likely contributed to these results. For example, use of the ECI for quarterly screening was encouraged by local- and state-level program directors and the data monitored as part of their accountability efforts. Using the ECI quarterly and use of the language-promoting intervention strategies was encouraged by these same directors but not formally monitored. The use of the MOD was therefore voluntary and optional based on the interest and discretion of home visitors. If in future studies MOD use was similarly encouraged and monitored, greater levels of implementation would likely be achieved, perhaps leading to greater child outcomes.

Limitations and Future Research

There were at least four limitations to the current randomized trial: (a) lack of a standardized measure of expressive language beyond ECI total communication, (b) lack of independent observational measurement of implementation fidelity for both groups beyond self-report, (c) lack of measurement of the NonMOD group's decision-making practices, and (d) the relatively small sample. Because identification of children was an ongoing process at the program level and MOD decision making could begin as soon as 1 week following identification, it was not feasible to consistently collect a pretest standardized measure of all identified children's expressive and receptive language. Further compounding this problem was the distance of the programs from the researchers; four of the five participating EHS programs were from 119 to 337 miles (192 to 542 km) from the researchers, making additional testing and observation expensive and impractical. Although we do know that ECI total communication is a positive correlate of the Preschool Language Scale (Luze et al., 2001), in this study we were unable to know if the ECI was actually linked to improvement on one or more standardized language scales. Further research is needed with the resources to overcome these challenges.

We lacked sufficient evidence of intervention fidelity and dosage data for both groups. Consequently, we had limited ability to tease out these contributions to children's outcomes. Also,

nearly all available intervention fidelity data was based on self-report with no independent home observations to confirm validity and reliability of home visitors' reports.

More work is needed to improve the usability and perceived usefulness of the implementation fidelity checklists. Home visitors reported that the "Is It Being Done?" step was the least useful and least preferred. Conceptualized as supports and guidance in the MOD implementation, some home visitors reported that they were unclear how completion of the checklists informed intervention decision making and considered it more a way for supervisors to track what they did during home visits. Anecdotally, they reported difficulty completing checklists given their other responsibilities. This suggests that further work is needed to decrease the response cost of completing the checklists and strengthening the understanding of the role of documenting intervention implementation fidelity in evidence-based practice. Future work is needed to streamline the collection of implementation data within the website database. Similarly, data on what parents actually did with their children was limited, and it was also self-report. Home-based data in future studies might be collected using mobile audio or video technologies that allow parents to capture their use of intervention strategies during daily routines.

Replications with larger samples in other locations and early intervention programs are needed to improve the external validity of these initial results. Replications in center-based programs and those combining center and home visitation are also needed. However, we anticipate that the MOD will require modifications to accommodate key differences in center-based versus home visitation service models.

CONCLUSION

The need for evidence-based practice in home visiting intervention is increasingly acknowledged (Bruder, 2010; Buysse & Wesley, 2006). Because of complexity, lack of infrastructure, and lack of training and resources, early childhood interventionists have struggled to fully integrate data-based decision-making practices into their work with children with or at risk for disabilities (Hojnoski et al., 2009; Linas et al., 2010; Roehrig et al., 2008; Sandall et al., 2004).

The MOD is a clinical decision-making support system (CDSS) for home visitors that promotes their use of evidence-based practices. Like effective CDSSs used in medicine, the MOD was integrated with the ECI online data system and home visitors' regular activities. Also, like the CDSSs, the MOD provided home visitors with a range of clinical recommendations and prompts based on analysis and interpretation of children's ECI data. The evidence-based practices supported by the MOD included universal screening and progress monitoring and the inclusion of language-promoting interventions, all which were linked to the online IGDI website.

The MOD overcomes a number of the barriers to implementing data-based decision making in early childhood practices, such as managing and interpreting assessment information, translating data findings into strategy recommendations, individualizing evidence-based intervention, and supporting fidelity of implementation, among others (e.g., lack of access, usability). It represents an alternative to simply providing professional development on how to use and combine evidence-based practice components to inform intervention decision making by providing an infrastructure for doing so. The MOD is supported by this preliminary evidence of its feasibility and efficacy based on accelerating children's growth in ECI early communication skills, the volume of data collection activity generated by intervention practitioners from EHS programs, and acceptable home visitor satisfaction ratings. We believe the MOD represents a major step forward in providing

home visitors and other early interventionists access to tools that support evidence-based decision making in early childhood services.

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NOTE

1. These percentages sum to more than 100% because home visitors could choose more than one option.

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