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EVALUATION OF A PARENT-ADMINISTERED COMPUTER-ASSISTED TUTORING PROGRAM TARGETING LETTER SOUND KNOWLEDGE IN PRESCHOOL-AGED CHILDREN

A dissertation presented by
Matthew Ryan DuBois, C.A.G.S, NCSP

Submitted to
The Department of Counseling and Applied Educational Psychology
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
in the field of
School Psychology

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EVALUATION OF A PARENT-ADMINISTERED COMPUTER-ASSISTED TUTORING PROGRAM TARGETING LETTER SOUND KNOWLEDGE IN PRESCHOOL-AGED CHILDREN

By

Matthew Ryan DuBois

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ABSTRACT

Knowledge of letters sounds has been identified as a primary objective of preschool instruction and intervention. Despite this designation, large disparities exist in the number of letter sounds children know at school entry. Enhancing caregivers’ ability to teach their preschool-aged children letter sounds may represent an effective practice for reducing this variability and ensuring that more children are prepared to experience early school success. This study used a non-concurrent multiple-baseline-across-participants design to evaluate the effectiveness of caregivers (N=3) delivering a computer-aided tutoring program (Tutoring Buddy) targeting letter sound knowledge to their preschool-aged children. Using visual analyses and effect size estimates derived from Percentage of All Non-Overlapping Data (PAND), results were consistent across all three children, as six weeks of intervention yielded large effect sizes for letter sound knowledge (LSK), letter sound fluency (LSF), and nonsense word fluency (NWF). All three caregivers rated the intervention as highly usable and were able to administer it with high levels of fidelity. Taken together, Tutoring Buddy appears to be an effective, simple, and usable tool that caregivers can use to enhance critical early literacy skills.
Dedication

Dedicated to my mother, who taught me that there is no commitment more important, fulfilling, or challenging than being a professional helper.
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I would like to begin by thanking my advisor, Dr. Robert Volpe, for his incredible mentorship and guidance during my seven years of graduate training. Dr. Volpe’s mentorship was the primary reason why I decided to pursue a PhD and it has remained critical throughout my doctoral training. Although I have learned many tangible skills from him, I am most thankful for the lessons he taught me about the importance of approaching work with curiosity, passion, and enthusiasm. It is these lessons that I hope to pass on to others someday.

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Promoting Early Literacy Development: A Review of Early Literacy Interventions for Preschool-Aged Children Targeting Letter Sound Knowledge

Matthew Ryan DuBois, C.A.G.S., NCSP

Northeastern University
Abstract

The purpose of this literature review is to synthesize research regarding effective practices in the promotion of letter sound knowledge in pre-readers. Eight studies met selection criteria and were reviewed to understand (a) what instructional/intervention strategies have been used with preschool-aged children to promote knowledge of letter sounds, (b) the effectiveness of interventions that target knowledge of letter sounds in preschool-aged children, and (c) the duration of interventions that target letter sounds in preschool-aged children. The findings from these studies provide important insights into how children best learn letter sounds, as the acquisition of letter sounds appears to be contingent upon the reception of structured experiences that explicitly target this skill. Although promising, each of the reviewed studies were multi-component interventions that targeted several literacy outcomes. Consequently, the independent impact of teaching letter sounds for the purpose of enhancing letter sound knowledge remains uncertain. Additionally, the majority of the reviewed studies did not measure treatment integrity, assess knowledge of letter sounds in a formative fashion, or use caregivers as interventionists. These findings demonstrate the need for additional research that exclusively targets letter sound knowledge in preschool-aged children. Given the particular influence that caregivers have on child literacy development during the preschool years, recommendations for using caregivers as interventionists for promoting knowledge of letter sounds are discussed.
Promoting Early Literacy Development: A Review of Early Literacy Interventions for Preschool-Aged Children Targeting Letter Sound Knowledge

Teaching children to read is perhaps the most important instructional objective of early elementary school (Faires, Nichols, & Rickelman, 2000). As children progress through their first three years of school, reading increasingly becomes the mechanism by which students are expected to acquire information (i.e., transitioning from “learning to read” to “reading to learn;” Joseph, 2006). Because this expectation exists across all academic content areas, grade-level reading skills rapidly become a requisite for fully accessing academic curricula and experiencing school success. Consequently, 80% of children who experience academic underachievement have deficits in reading (Lerner, 2003).

The importance of early reading instruction if further supported by two robust findings within educational research: literacy deficits emerge early (i.e., as early as the first months of school; Speece & Ritchey, 2005) and remain stable over time (Phillips, Norris, Osmond, & Maynard, 2002). In contextualizing this latter finding, children who present with literacy deficits during first grade carry only a 12% chance of developing grade-level reading skills by the end of elementary school (Juel, 1988; Phillips et al., 2002).

The relative immutability of early reading deficits is hypothesized to be the result of early literacy skills impacting opportunities to practice reading. Nominally described as the “Matthew Effect” (Stanovich, 1986), children with well-developed literacy skills typically read faster than children with weak reading skills. As a result, proficient readers obtain more practice opportunities per instructional session than students with reading deficits. More importantly, however, children with proficient literacy skills typically enjoy reading, resulting in them frequently seeking opportunities to engage in reading. In contrast, children with poor reading
skills tend to perceive reading as challenging, resulting in frustration and a tendency to avoid reading. These disparities in practice opportunities accumulate over time to create large gaps in reading achievement that manifest early and grow over time (Torgesen, 2002).

**Teaching Children to Read**

Longitudinal studies demonstrating the stability of early reading deficits (e.g., Juel, 1988) created an urgency among educators, researchers, and politicians to improve the efficacy of early reading instruction (Torgesen, 2002). In 2000, the National Reading Panel conducted a comprehensive review of early reading research in an effort to identify best practices in teaching children to read. This review yielded what is commonly referred to as the, “Five Big Ideas in Reading,” or the competencies that children must develop in order to become proficient readers. These skills include phonemic awareness, the alphabetic principle, accuracy and fluency with connected text, vocabulary, and reading comprehension.

Although competence in each of these areas is considered necessary for proficient reading, early literacy instructional typically focuses on foundational alphabetic skills, such as knowledge of letter-sound correspondences (used interchangeably henceforth with letter sound knowledge, letter sound expression, or grapheme-phoneme correspondences; Piasta et al., 2012). The focus on letter sounds in early reading instruction stem from their involvement in supporting awareness of the alphabetic principle (Piasta et al., 2012; National Reading Panel, 1999). Learning to read in an alphabetic system requires an understanding that units of text map onto specific units of speech, not units of meaning (Perfetti, 1984). More concretely, children must learn that each letter of the alphabet is associated with a meaningless unit of speech (a phoneme). When children are able to fluently link each letter of the alphabet to an individual phoneme, they develop the capacity to decode and read unfamiliar words, which increases opportunities to
practice reading (Adams, 1990) and makes reading a productive activity (Dodd & Carr, 2002). In contrast, when children are unable to link phonemes with their corresponding letters, they fail to progress beyond a logographic state of reading, which allows children to only read high frequency words that they recognize based on visual features (Dodd & Carr, 2002).

The sequential relationship between letter sound knowledge, decoding, and word reading is delineated in the four-phase model of sight-word development presented by Ehri (2005). In this model, all children begin in a pre-alphabetic phase in which they lack awareness of letter-sound relationships. Children in this stage engage in reading logographically. As children acquire knowledge of letter sounds (partial-alphabetic phase) and begin to apply their grapheme-phoneme correspondences accurately and fluently (full-alphabetic phase), children develop the capacity to exercise their decoding skills to accurately articulate unfamiliar words (consolidated alphabetic phase). Broadly, then, knowledge of letter sounds ought to be conceptualized as a necessary and critical early literacy skill that provides the foundation for all activities that involve decoding and word reading. In support of this conceptualization of early reading development, Ball and Blachman (1991) found that teaching letter sounds to children had an immediate and positive effect on word reading.

Beyond decoding, knowledge of letter sounds may also play a necessary role in the development of phonological awareness (i.e., the ability to detect and manipulate individual phonemes within words), which is the skill area that is most commonly found to be impaired in children with reading deficits (Share & Stanovich, 1995). For example, Foy and Mann (2006) found that the relationship between phonological awareness and letter sound knowledge on tasks that involved phoneme manipulation was bi-directional. Moreover, knowledge of letter sounds facilitated performance on a complex phonemic awareness task that required a deeper, more
explicit awareness of phonological awareness (i.e., deletion and substitution of phonemes). Therefore, knowledge of letter sounds may facilitate sensitivity for the phonological structure that exists within oral language (Foy & Mann, 2006).

Given the importance of letter sound knowledge, it is logical that this skill has been demonstrated to be a reliable and valid longitudinal predictor of reading development (e.g., Speece & Ritchey, 2005). Knowledge of letter sounds has also been found to be independently predictive of later reading ability (i.e., beyond other skills such as phonological awareness and oral language; McBride & Chang, 1999). To this end, knowledge of letter sounds at school entry has been identified as one of the strongest predictors of later reading achievement, including oral reading fluency (Schatsneider, Fletcher, Francis, Carlson, & Foorman, 2004) and word decoding (McBride-Chang, 1999). As such, children who enter school without knowledge of letter sounds are more likely than their peers to have difficulty meeting early literacy benchmarks and are more likely to experience reading deficits during later elementary school (e.g., Bingham, 2007).

**Preschool Literacy Experiences**

The predictive utility of early literacy skills at school entry provides strong evidence that the foundations of proficient reading originate before formal education begins (Senechal, 2006). This understanding has led to educators, researchers, and policymakers to become increasingly interested in the literacy experiences children receive prior to school entry, particularly those that are mediated by caregivers (Rebello-Britto, Brooks-Gunn, &, Griffin, 2006).

Seminal work conducted by Coleman et al. (1966) indicated that parental involvement in their child’s education was the most important variable in predicting academic success. The impact that caregivers have on their children’s reading development is particularly powerful, as the home environment is the setting in which children are first exposed to language and literacy
(Hart & Risley, 1995). As such, Weinberger (1996) found that preschool-aged children whose caregivers provided less reading support and who devoted less time to reading were significantly more likely to experience reading difficulties during elementary school. Similarly, a meta-analysis conducted by Senechal (2006), which involved 16 intervention studies representing 1,340 families, found a strong, positive relationship between caregiver involvement in preschool reading activities and child reading development.

Despite the importance of caregiver involvement in literacy development, teaching children to read is not necessarily an intuitive practice. Because this uncertainty may adversely affect the quality and quantity of the literacy experiences provided by caregivers (Weinberger, 1996), researchers have investigated ways to enhance the efficacy of caregiver-mediated literacy activities. Of the caregiver-mediated activities that have been investigated in the literature, dialogical reading (also referred to as shared book reading) is the most popular for preschool-aged children (Mol, Bus, de Jong, & Smeets, 2008; Bingham, 2007).

In dialogical reading, parents actively involve children in book reading by increasing their responses to text (Mol, et al., 2008). Specifically, caregivers ask questions about pictures, point to words as they are read, ask children to make predictions, discuss word meanings, and engage in frequent verbal exchanges about the story (Bingham, 2007). In a comprehensive meta-analysis examining the impact of dialogical reading, Mol and colleagues (2008) found that when compared to reading-as-usual (i.e., non-interactive reading), dialogical reading was significantly more effective in increasing preschool-aged children’s receptive ($d = 0.22$) and expressive vocabulary ($d = 0.59$). In addition to enhancing language development, research has also found dialogical reading to positively impact children’s knowledge of print concepts (Bingham, 2007).

Although dialogical reading is effective for promoting language development, preschool
engagement in this activity has been found to account for only 8% of the variance in later reading ability (Bus, van Ijzendoor, & Pellegrini, 1995). Similarly, Evans, Bell, and Shaw (2000) found that after controlling for child age, parent education, and child ability, shared book reading during preschool made no contributions to the prediction of letter sound knowledge in kindergarten or to performance on a phonemic awareness task.

The minimal impact that dialogical reading has on later reading outcomes is hypothesized to be a function of the practice not addressing skills that are most immediately related to reading. The capacity to read connected text rests upon rapid automatized naming, phonemic awareness, and letter sound knowledge, which have been described as the three cognitive foundations of reading (Hulme & Snowling, 2013). This designation stems from the understanding that deficits in these areas are causally related to impairments in reading (Hulme & Snowling, 2013). Because dialogical reading does not address these skills, it is likely insufficient as a stand-alone mechanism for promoting children’s literacy development. Logically, then, activities that explicitly target these cognitive foundations are likely necessary for later proficient reading.

**Targeting Letter Sound Knowledge**

Of the three cognitive foundations in reading, letter sound knowledge may be the skill that is most easily and rapidly remediated through early intervention (Hulme & Snowling, 2013), as competence in this area is achieved through rote memorization of a finite set of phoneme-grapheme correspondences (Piasta & Wagner, 2010). This understanding, combined with its predictive utility at school entry (Schartneider, 2004), has resulted in it being a recommended target of preventative intervention for preschool-aged children (Piasta, Justice, McGinty, & Kaderavek, 2012). For example, the National Academy of Sciences released a consensus report in 1998 titled Preventing Reading Difficulties in Young Children (Snow, Burns, & Griffin, 1998).
that outlined effective practices in the prevention of reading failure. This report heavily emphasized a need to allocate resources toward supports for young children who exhibit weaknesses in areas that are most closely linked to later reading achievement (Piasta et al., 2012). Among the skills that were highlighted were print concepts (e.g., understanding that reading is done left to right), knowledge of letter names, and knowledge of letter sounds. Although each of these foundational skills are important, only knowledge of letter sounds directly corresponds to one of the big ideas in learning to read (i.e., the alphabetic principle).

Despite the importance of letter sound knowledge, ambiguity exists regarding how to most effectively teach this skill to preschool-aged children (Piasta & Wagner, 2010). Specifically, although it is known that passive exposure to text is insufficient for enhancing knowledge of letter sounds (Evans et al., 2000), the best approach to promoting competence in this area is unclear. A primary source of this uncertainty is that other skills, such as phonological awareness, are more commonly researched in educational literature (National Instituted of Child Health and Human Development, 2000). In response to the paucity of research regarding effective instruction for teaching letter sounds, the National Early Literacy Panel (NELP, 2008) synthesized literature regarding the “interventions, parenting activities, and instructional practices” that promote development of alphabetic skills (including letter sound knowledge) in preschool-aged children (NELP, 2008, p. vi).

In summarizing the effects of 24 “code-focused interventions” on alphabetic skills (i.e., interventions that attempted to help children “crack the code” of written language), the panel found a medium effect size of 0.38. In contrast, interventions that did not include a code-based component, such as shared reading, did not have a significant impact on alphabetic knowledge.

Although this report was useful in demonstrating the importance of code-based training
on alphabetic skills, there are limitations that must be addressed. First, the report did not isolate studies that primarily focused on letter sound training, as interventions that targeted phonological awareness and various alphabetic skills were combined. Second, the study did not separate various alphabetic outcomes, such as letter naming, letter writing, and letter sound knowledge (Piasta & Wagner, 2010). Instead, the outcomes were combined, which makes the impact of the interventions on letter sound knowledge unknown. As a result of these limitations, the activities that are effective in teaching letter sounds to preschool-aged children remains unclear.

Accordingly, the purpose of this review is to synthesize intervention research that has (a) explicitly taught letter sounds to preschool-aged children and (b) included a measure of letter sound expression as an outcome variable. In order to provide a comprehensive review, children who received letter-sound instruction/intervention at school entry will be included, as they have not yet been exposed to formalized literacy instruction. Additionally, given the importance of caregiver involvement in early literacy development, particular focus will be given to those interventions that were mediated by caregivers. The following questions will guide this review.

1. How have preschool-aged children been taught letter sounds (i.e., what instructional/intervention strategies and approaches have been used)?
2. To what extent is instruction/intervention that targets knowledge of letters sounds in preschool-aged children effective in promoting letter sound knowledge?
3. What is the duration of interventions targeting letter sound knowledge in preschool-aged children (e.g., the number of intervention sessions that are provided)?

**Literacy Interventions Targeting Letter Sound Expression in Pre-Reading Children**

As noted, teaching letter sounds is a primary objective of preschool instruction and intervention (Piasta & Wagner, 2010). For example, the National Association for the Education
of Young Children (NAEYC, 1998) and the Early Reading First and Reading First programs (U.S. Department of Education, 2002; 2003) identified knowledge of letter sounds and development of the alphabetic principle as essential goals for the preschool years. To this end, several studies have supported the efficacy of teaching letter sounds to pre-readers. For organizational purposes, professionally-mediated and caregiver-mediated intervention studies will be reviewed separately. When reviewing professionally-mediated interventions, separate attention will be given those studies that provided intervention to typically developing children and those studies that provided intervention to children with disabilities.

**Professional-Mediated Literacy Interventions**

**Typically developing children.** Using a quasi-experimental, between-subjects design, Johnston and Watson (2004) compared the efficacy of three whole-class approaches to promoting the phonics and phonological awareness of 304 beginning-of-year kindergarten students. Each intervention was provided daily for 20 minutes and involved a classroom teacher explicitly teaching letter sounds by introducing a letter visually, demonstrating its sound, and providing examples of words that started with and ended with the sound. The three approaches differed by inclusion of additional elements, such as training in phonological awareness (e.g., rhyming activities) and blending (e.g., decoding activities).

The dependent variables employed in this study were letter sound expression (measured by presenting letters in random order and asking children to articulate their sounds) and a measure of decoding (measured via a nonsense word task). At baseline, most students across the three groups had a score of 0 on all measures, suggesting that they were non-readers. Following 16 weeks of intervention, each group experienced significant gains in letter sound knowledge and decoding. Training in letter sounds alone yielded an effect size of 2.36 for letter sound
expression and 0.55 for nonsense word decoding; training in letter sounds and phonological awareness yielded an effect size of 3.00 for letter sound expression and 0.72 for nonsense word decoding; and training in letter sounds and blending/decoding produced an effect size of 5.99 for letter sound expression and 1.83 for nonsense word decoding. This final approach was also significantly more effective than the other two in promoting growth in letter sound knowledge and decoding (the other two approaches were not significantly different on either measure).

The efficacy of all three approaches provides strong evidence that an explicit approach to teaching letter sounds, or one that involves presenting a letter and demonstrating its sound, is an effective device for enhancing letter sound knowledge and decoding in non-readers. Moreover, providing children with opportunities to practice decoding may enhance acquisition of letter sounds, perhaps through additional opportunities to practice letter-sound relationships.

Additional support for class-wide approaches to enhancing letter sound knowledge was provided by Solity, Deavers, Kerfoot, Crane, and Cannon (1999). Using a quasi-experimental design with a control group, the authors evaluated the impact of a structured early-reading curriculum on the letter sound knowledge, sight-word knowledge, and phonological awareness of 235 beginning-of-year kindergarten students. The curriculum involved classroom teachers implementing daily 12-minute lessons that involved four, 2-minute activities that focused on training in letter sounds, segmenting, decoding, and sight-word vocabulary (the remaining time was used for reading the class a story). A group of 198 children served a control group and received instruction as usual in their classrooms.

At baseline, the letter sound knowledge (measured as the number of letter sounds out of 26 that the children were able to articulate correctly following their presentation) of the students in the treatment group was 1.91 ($SD = 4.44$), compared to 1.99 ($SD = 4.62$) in the control group.
At the end of the school year, both groups made significant gains on this measure. However, children in the treatment group knew significantly more letter sounds than children in the control group. On average, children in the treatment group knew 17 letter sounds \((SD = 8.21)\), compared to just 9.95 \((SD = 8.54)\) for the control group, resulting in a large effect size \((d = 0.84)\).

The authors also conducted separate analyses for the lowest performing students (students who performed in the bottom 25% across the literacy measures at baseline) and the highest performing students (students who performed in the top 25% across the literacy measures at baseline). These analyses found that the lowest performing and highest performing students in the treatment group performed significantly better than their counterparts in the control group for knowledge of letter sounds, indicating that the curriculum was effective for students, regardless of initial skill level. Although these findings are promising, the specific activities that were used to train students in letter sounds were not provided. Similarly, no description was provided regarding the type of literacy instruction that was provided to students in control classrooms.

Group-based approaches to enhancing letter sound knowledge have also been found effective for preschool-aged children. Working with Head Start, Yeh (2003) used a quasi-experimental, between-subjects design to compare two approaches to enhancing the phonemic awareness of 44 preschool-aged children. The first approach focused on rhymes, alliteration, and story activities, while the second focused on phoneme segmentation and blending. In both conditions, children were instructed twice a week for 20 minutes in groups of three to five children. In the rhyming group, the teacher presented a word and had children come up with words that rhymed with it or started with the same letter. No explicit teaching of letter sounds was included in this approach. In the segmentation approach, children were explicitly taught letter sounds (i.e., visually presenting a letter and demonstrating its sound) and engaged in tasks
that involved constructing and decoding words on a magnetic board.

The impact of the approaches was evaluated by comparing performance on a number of early literacy tasks, including blending, segmenting, and letter sound knowledge (measured by presenting children with lower case letters and asking them to articulate their sound). At baseline, there were no differences in letter sound knowledge between the two groups. Following nine weeks of intervention, however, the segmentation group performed significantly better than the rhyming group on the letter sound knowledge task ($d = 1.13$). These findings are critical in understanding the activities that are necessary for enhancing letter sound knowledge. Activities that are thought to facilitate phonological awareness, such as rhyming, are likely ineffective for promoting knowledge of letter sounds. Instead, children require explicit references to grapheme-phoneme correspondences and frequent opportunities to practice these relationships.

Additional support for using an explicit approach to teaching letter sounds to non-readers was provided by Lennon and Slesinksi (1999), who used an experimental design with a wait-list control group to evaluate the impact of a daily, 30-minute 1:2 tutoring intervention (i.e., one tutor and two children) on the literacy skills of kindergarten students who exhibited deficits in letter naming knowledge at school entry. Implemented by a classroom teacher, the first half of each intervention session involved the tutor engaging in shared book reading with the children. In the second half, the children engaged in a variety of teacher-led activities, which included direct instruction in letter sounds (e.g., visually introducing a letter, demonstrating its sound, and presenting it in multiple contexts within a story) and the alphabetic principle (e.g., using a magnetic board and instructing children to switch the initial consonant to create different words).

To evaluate the intervention, the authors measured the letter naming ability of 330 students at school entry. The 80 students with the lowest letter naming scores were selected to
receive intervention. Forty students were randomly selected to receive intervention during the first 10-week session and the remaining 40 students represented the wait-list control group. In addition to this wait-list group, a comparison group of 40 high-scoring children (randomly selected from a pool of children who performed in the top 15% on the letter naming task) and a comparison group of 40 medium-performing children (randomly selected from the pool of students who did not comprise the high-achieving group or the low-achieving groups) were created. The medium-performing comparison group, who also received intervention, was created to evaluate if pre-intervention literacy skills impacted responsiveness to the intervention.

Two dependent measures were used to evaluate growth in letter sound knowledge. The first was a letter sound knowledge task that required children to orally articulate the sounds of each letter in the alphabet, including hard and soft consonants and long and short vowels, from graphic representations (scores on this task could range from 0-35). The second was a nonsense-word task in which children were required to decode CVC trigrams and CV bigrams. Following ten weeks of training, the low-performing treatment group experienced significant gains in letter sound knowledge ($d = 0.98$) and decoding ($d = 0.69$) from baseline, and performed significantly better than the wait-list control group on these measures ($d = 0.88$ and 0.59 for letter sound knowledge and decoding, respectively). The medium-performing group also experienced significant growth in letter sound knowledge ($d = 0.82$) and decoding ($d = 1.15$) from baseline, and performed significantly better than the low-performing treatment group ($d = 1.01$ and 0.91 for letter sound knowledge and decoding, respectively). There were no significant differences at post-intervention between the medium-performing treatment group and the high-performing group in regards to letter sound knowledge and decoding skills.

The high-performing group performed significantly better than the low-performing
treatment group on the measures of letter sound knowledge and decoding following 10 weeks of intervention. However, there were no significant differences between the high-performing group and a group of 19 students in the original low-performing treatment group who continued to receive intervention for an additional 10 weeks. Finally, two years post-treatment, children who received intervention had a significantly lower rate of placement in special education than students with similar characteristics who did not receive the intervention. This study provides evidence that training in letter sound knowledge is effective for students with limited and well-developed literacy skills. More importantly, however, explicit training in letter sounds reduced the likelihood of later reading difficulties and eliminated the reading achievement gap between low-performing students and high-performing students. Although this study possesses many strengths (use of an experimental design, multiple comparison groups), the data were collected by the individuals who provided intervention, which may have biased the findings.

**Children with disabilities.** Children with disabilities are particularly at risk for experiencing delays in their literacy development (Gillon, 2005). To this end, Gillon (2005) used a quasi-experimental design with a control group to evaluate the impacts of an early literacy intervention on 12 preschool-aged children with moderate to severe speech impairments. Although the primary objective of the intervention was to enhance phonological awareness, the intervention included components that explicitly targeted letter sound knowledge. From ages three to five, the children in the treatment group received an average of 25.5 intervention sessions at their preschool center from a certified teacher. The intervention was play-based and the activities that targeted letter sound knowledge included the teacher introducing letters and their sounds (e.g., “This letter is t, it makes the /t/ sound”), having children repeat the sounds (e.g., “Can you make the /t/ sound?”), and having children find a toy that began with a targeted
letter (e.g., “Can you find a toy that starts with /t/?”). The first sounds that were trained were ones that were associated with the child’s name (e.g., the first letter of the child’s name).

Two measures of letter sound knowledge were used. The first was a subtest from the Primary Inventory of Phonological Awareness (PIPA; Dodd, Crosbie, MacIntosh, Teitzel, & Ozanne, 2000), which presents children with lower case letters and requires them to articulate their sounds. The second was a nonsense-word task that required children to decode ten CVC trigrams. These assessments were administered at school entry and following their first year of school. At the end of their first school year, the treatment group’s performance on these tasks was compared to a control group of 19, typically developing children, who did not receive formalized instruction in phonological awareness or letter sound knowledge.

The treatment group performed significantly better than the control group on the decoding task, with an effect size of 1.17. Although no statistical differences on the PIPA were found, this is meaningful, as it suggests that their knowledge of letter sounds was comparable to students without disabilities. It is important to note that no baseline levels of letter sound knowledge or decoding were measured (these were measured at school entry and following one year of school). As a result, the gains could have been due to classroom instruction (no description of the literacy experiences students received in their classrooms was provided).

In a similar study, Trout, Epstein, Mickelon, Nelson, and Lewis (2003) used an experimental design with two control groups to evaluate the efficacy of an early literacy intervention on six beginning-of-year kindergarten students. In total, three groups of children were evaluated in this study. The first two groups were comprised of six children each who were identified as being at risk for developing an emotional disability (risk status was determined via parent-competed rating scales). The third group was comprised of six children who were deemed
to be at low risk for developing an emotional disability (described as a norm-referencing group). One group of students who were at risk for developing an emotional disability received a literacy intervention that focused on enhancing their phonemic awareness, letter sound knowledge, and sight-word knowledge. The remaining two groups of students served as comparison groups.

The treatment involved daily, 30-minute, one-on-one tutoring sessions that were provided by a trained graduate student at the children’s schools. The intervention was based on the Reading Master I Program (Engleman & Bruner, 1988), which provides explicit instruction in phoneme-grapheme correspondences. The activities involved the tutor demonstrating a sound, having the child articulate the sound, and having the child decode words. One-minute curriculum-based assessments were used to measure growth in letter sound knowledge and decoding ability. The letter sound knowledge task presented children with 74 upper-case letters and required them to articulate as many sounds as they could in one minute. The decoding task presented children with a page of two and three letter blends (e.g., sim and ak) and required them to articulate as many letter sounds as they could in one minute.

Scores for the treatment at-risk group and the control at-risk group were compared to the norm-referencing group and reported as effect sizes (negative scores indicate performance that is below that of the norm-referencing group). At baseline, the effect sizes for the treatment group and the control group were -0.28 and -1.67 respectively for the letter sound fluency task. The effect sizes for the treatment and the control group were -0.50 and -0.33 respectively for the decoding task. At the end-of-school-year assessment, effect sizes for letter sound fluency and decoding indicated normative improvements in performance for the treatment group (0.81 and 3.57 respectively) and normative declines in performance for the control group (-1.88 and -3.01 respectively). Therefore, the provision of early intervention for the at-risk students allowed them
to outperform the norm-referencing group on measures of letter sound knowledge and decoding, providing further evidence of the effectiveness of early interventions that explicitly target letter sound knowledge. However, it must be noted that only six students in the study received intervention, which limits the generalizability of the results.

**Caregiver-Mediated Literacy Interventions**

The described studies have supported the use of professionals in teaching letter sounds to pre-readers. However, the use of professional interventionists during preschool is typically reserved for those in need of intensive early intervention. In most circumstances, the foundations of early literacy are provided by caregivers, which makes evaluation of caregiver-mediated letter sound interventions particularly important (Rebello-Britto, Brooks-Gunn, & Griffin, 2006).

van Bysterveldt, Gillon, and Moran (2006) used a quasi-experimental design with a control group to evaluate the effects of a caregiver-mediated intervention on the phonological awareness, letter naming knowledge, and letter sound knowledge of seven preschool-aged children with Down Syndrome. The intervention involved caregivers teaching their children letter sounds during shared book reading (i.e., pointing to a letter, saying its name, demonstrating its sound, and providing an example of a word that begins with the sound). Caregivers implemented this intervention four times a week, for six weeks, with sessions lasting 10 minutes. Caregivers were instructed to select four letters for training during each session.

In addition to comparing pre- and post-intervention measures of phonological awareness (measured via an initial phoneme task in which children identified a picture that started with a presented sound), letter naming knowledge (measured by presenting the 26 letters and asking children to articulate each letter’s name), and letter sound knowledge (measured by presenting the 26 letters and asking children to articulate each letter’s sound) for children in the treatment
group, the efficacy of the intervention was also evaluated by comparing growth in these measures to a group of seven typically developing children who did not receive intervention.

At baseline, the group of typically developing children knew significantly more letter sounds \((M = 11.42)\) than the treatment group \((M = 0.71)\). Given the magnitude of this difference, it is not surprising that the control group continued to perform significantly better at post-intervention \((M = 13.28)\) than the treatment group \((M = 4.67)\). To more clearly understand these findings, the authors performed separate dependent samples \(t\) tests for the treatment and control groups. Children in the treatment group made significant gains in letter sound knowledge, whereas the children in the control group did not. Additionally, the pre-post effect sizes for treatment group were large \((d = 1.01)\), whereas the pre-post effect sizes for the control group were quite small \((d = 0.21)\). It is important to note that the treatment group’s data were skewed by two children who knew no letter sounds at baseline or post-intervention. The authors reported that the caregiver of one of these children did not implement the intervention with fidelity and that the other child had the lowest expressive and receptive language skills in the group (the remaining five children learned an average of six letter sounds during intervention). This finding is of particular importance, as is demonstrates the need to (a) carefully monitoring treatment integrity and (b) intervene with interventionists when integrity is observed to be low.

Additional support for using caregivers to teach letter sounds was provided by Kraft, Findlay, Major, Gilberts, and Hofmeister (2001). The authors employed a quasi-experimental design with a control group to evaluate the efficacy of having caregivers teach their beginning-of-year kindergarten children letter sounds and decoding skills during shared book reading. During a two-hour training session, the authors taught 22 caregivers how to (a) pronounce letter sounds, (b) teach letter sounds (i.e., pointing to a letter, demonstrating its sound, and providing
an example of a word that begins with the sound), (c) correct errors in letter sound articulation, and (d) teach their children to blend CVC trigrams. Next, caregivers were provided with books with readability levels ranging from kindergarten through mid first grade (as parents finished books, they exchanged them with books with more challenging readability levels) and were instructed to teach letter sounds and blending during nightly 20-minute sessions. The training of letter sounds was highly structured. Specifically, sessions began with a letter-sound training task that was led by caregivers (introducing a letter and demonstrating its sound). Parents reinforced this knowledge throughout the story and provided a review of the sound when the story ended.

The authors evaluated the effects of the intervention by comparing the treatment group’s performance on the Letter Identification, Visual Auditory Learning, Word Attack, and Word Identification tasks on the Woodcock Reading Mastery Tests, Revised (1987) to a control group of 23 kindergarten students who did not receive formalized reading instruction. Although the authors did not directly assess knowledge of letter sounds, the Word Attack measure requires application of letter sound knowledge. Following a year of intervention, the treatment group performed significantly better on Word Attack than the control group ($d = 0.53$). These results are important, as they demonstrate that a carefully developed and structured intervention implemented by caregivers following a brief training can be effective in promoting decoding ability and knowledge of letter sounds in pre-readers. However, Word Attack was only measured at post-intervention, which is a major threat to the internal validity of the study.

**Discussion**

The reviewed studies provide important insights into how children best learn letter sounds. The acquisition of letter sounds appears to be contingent upon the reception of structured experiences that explicitly target this skill. In application to practice, the teaching of letter sounds
should involve a visual introduction of a grapheme, an oral demonstration of the grapheme-
phoneme correspondence, and frequent opportunities to orally articulate this relationship.

Although the length of the reviewed interventions varied greatly, significant gains in letter sound
knowledge were obtained in as little as nine weeks (Yeh, 2003).

It is important to note that none of the reviewed studies exclusively focused on teaching
letter sounds. Instead, the existing intervention research with this population has focused on
multi-component interventions targeting several literacy outcomes. Consequently, the
independent impact of teaching letter sounds for the purpose of enhancing letter sound
knowledge is uncertain. Additionally, not all of the studies in this review directly assessed
children’s knowledge of the 26 letter-sound correspondences. Assessing this outcome is critical,
as fluent retrieval of all letter sounds is necessary for proficient decoding (Ehri, 2005).

The reviewed studies also varied greatly in the stringency of their designs and
measurements. For example, only two studies employed experimental designs (Lennon &
Slesinski, 1999; Trout et al., 2003). Additionally, although the sample sizes used by Johnson &
Watson (2004) and Lennon and Slesinksi (1999) were impressive, the remaining studies had
treatment groups that were relatively small (e.g., Trout et al., 2003 provided treatment to just six
children). Moreover, only one study (van Bysterveldt et al., 2006) measured treatment integrity.
Because it is unknown to what extent the interventions were delivered as described in the
remaining studies, it is difficulty to draw clear conclusions regarding their impact on letter sound
knowledge. Finally, six of the eight studies only measured letter sound knowledge and/or
decoding prior to and following intervention (Lennon & Slesinski, 1999 measured letter sound
knowledge mid-way through the intervention), and Gillon (2005) only measured decoding at
post-intervention. Because no formative assessment of letter sound knowledge or decoding was
conducted (e.g., weekly assessments), the recommended duration of letter sound intervention for pre-readers is unknown (i.e., the point when intervention provides diminishing returns). Taken together, there is a strong need for research that (a) exclusively targets letter sound knowledge in preschool-aged children, (b) measure children’s knowledge of letter sounds prior to, during, and following treatment, and (c) measures treatment integrity throughout intervention delivery.

**Caregivers as Interventionists**

As evidenced by Kraft et al. (2001) and van Bysterveldt et al. (2006), caregivers are potentially effective interventionists for promoting knowledge of letter sounds in preschool-aged children. Additionally, the effect size estimates obtained by van Bysterveldt et al. (2006) are consistent with that of studies where professionals administered intervention. Although promising, little research has directly investigated caregiver-mediated letter-sound interventions with preschool-aged children (Piasta & Wagner, 2010). The lack of research in this area may be the product of letter sound knowledge being contingent upon reception of standardized and prescribed activities. Although caregivers have delivered structured interventions with success (e.g., Resetar, Noell, & Pellegrin, 2006), caregiver implementation of these types of supports are prone to treatment integrity challenges that often adversely impact the efficacy of proposed interventions (van Otterloo, van Der Leij, & Veldkamp, 2006). For example, in Kraft et al. (2001), a significant amount of the variance in post-treatment outcomes was accounted for by how consistently and accurately parents implemented the intervention. Similarly, in van Bysterveldt et al. (2006), poor treatment integrity led to a lack of treatment response altogether.

Given these concerns, when a formalized approach to increasing caregiver involvement in early literacy is selected, professionals must (a) design an intervention that caregivers can delivery with fidelity, (b) provide a training that will teach accurate intervention implementation,
and (c) develop strategies that support treatment integrity throughout intervention delivery.

**Intervention characteristics.** A critical component of intervention design is feasibility, or characteristics that support accurate implementation (Briesch, Chafouleas, Neugebauer, & Riley-Tilman, 2013). For caregivers, interventions that are too complex, time intensive, costly, and cumbersome are unlikely to be delivered with fidelity (Witt, Noel, LaFleur, & Mortenson, 1997). In contrast, interventions that are simple, easy to learn, brief, inexpensive, and engaging to children are likely to be implemented correctly (Hester et al., 2003).

**Training caregivers.** The elements of effective caregiver trainings include direct instruction, reinforcement, modeling, and corrective feedback (Resetar, et al., 2006). In applying these strategies to practice, effective training sessions typically begin by providing an overview of the intervention’s purpose, expected impacts, and evidence base (Casey & Williamson, 2011). Providing this information is critical because caregivers are more likely to implement interventions that they are knowledgeable about and believe will be effective (Eckert & Hintze, 2000). Next, a professional should model correct intervention implementation. In support of this practice, caregiver-implemented interventions have been found to be more effective when intervention implementation was modeled during training than when it was not (Erion, 2006).

Finally, caregiver trainings must include repeated opportunities to practice implementation (Witt, et al., 1997), which is typically achieved through role-play. During role-play, the professional should observe implementation and provide reinforcement for components delivered correctly and corrective feedback for components delivered incorrectly. To ensure that caregivers have learned the requisite skills to implement the intervention, researchers have established pre-determined criterion levels of integrity that caregivers must reach before the training ends (Casey & Williamson, 2011).
Support during implementation. Initial levels of treatment integrity tend to be high immediately following training and then decline shortly thereafter (Witt et al., 1997). Therefore, providing caregivers with on-going support during implementation is likely critical for sustaining integrity. A common and effective mechanism for accomplishing this goal is to meet with caregivers throughout treatment delivery (Kraft et al., 2001). These meetings are used to observe implementation, discuss concerns, and provide feedback. Performance feedback, which involves observing implementation and providing corrective feedback for components delivered incorrectly and praise for components implemented accurately, has been found to enhance treatment integrity for academic interventions (Codding, Feinberg, Dunn, & Pace, 2005).

Usability

The aforementioned characteristics of intervention design, training, and support have generally been found to enhance treatment integrity. However, as evidenced by van Bysterveldt et al. (2006), predicting the a priori likelihood that a specific caregiver will implement a proposed letter-sound intervention as intended is critical in anticipating the potential efficacy of the support. Research attempting to predict how consumers will use an intervention was initiated three decades ago in the exploration of treatment acceptability (Witt & Elliot, 1985). Defined as the degree to which an interventionist deems a treatment to be appropriate, fair, and reasonable (Kazdin, 1980), interventions that are perceived as highly acceptable are more likely to be implemented with integrity (Eckert & Hintze, 2000). By identifying the aspects of an intervention that are rated as acceptable and unacceptable to interventionists, interventions can be altered to increase the likelihood that they will be used with fidelity (Witt & Elliot, 1985).

Despite the logical relationship between acceptability and integrity, correlations between these two constructs are weaker than expected (e.g., Mautone et al., 2009). Given the need to
uncover other variables that affect implementation, the multivariate construct of usage has been introduced into the literature (Chafouleas, Briesch, Riley-Tillman, & McCoach, 2009). Based in an ecological model of treatment adherence, usage evaluates aspects of the individual, the intervention, and the environment that may impact how an individual uses an intervention over time (Sanetti & Kratochwill, 2009).

Accordingly, Chafouleas, Briesch, Riley-Tilman, and McCoach (2009) developed the Usage Rating Profile-Intervention (URP-I), which can be used to help explain how the various components of an intervention, individual, and environment will impact implementation. In its most recent revision (Briesch, Chafouleas, Neugebauer, & Riley-Tilman, 2013), the 29-item URP-I measures 6 factors of usage: Acceptability, Understanding, Feasibility, Family–School Collaboration, System Climate, and System Support. In application to supports implemented by caregivers, the scales of Acceptability (e.g., perceptions regarding how effective the treatment is likely to be), Understanding (e.g., knowledge of how to implement the intervention), and Feasibility (e.g., perceptions of how easy intervention implementation will be) are most appropriate. In general, interventions that are perceived by caregivers to be acceptable, within their skill base, and feasible are likely to be implemented with integrity (Briesch, et al., 2013).

**Computer-Aided Instruction**

A potential strategy for increasing the overall usability of supports delivered by caregivers is to use technology-based interventions. Two models of technology-based intervention are computer-based instruction and computer-aided tutoring. Computer-based instruction (CBI) is characterized by a child working with a computer independently (Kulik, 2003). In computer-aided tutoring (CAT), an interventionist uses a computer to assist in treatment delivery (Volpe et al., 2011). Because technology-based interventions may enhance the
ease in which individuals can deliver intervention – which is likely to increase the acceptability, feasibility, and understanding of interventions – their use is conceptualized by many as a practical and effective strategy for enhancing treatment integrity (Burns, & Griffin, 1998).

**Computer-based instruction.** Although providing instruction via the computer has intuitive appeal, research has generally not supported its efficacy. For example, in a review of 42 studies published between 1990 and 2001, Blok et al. (2002) found a small effect size ($d = 0.19$) for CBI programs that targeted early reading skills. Similarly, in a large-scale randomized evaluation of five recently developed CBI reading programs, positive effects were generally not found, as effect sizes ranged from -0.01 to 0.06 (Campuzano, Dynarski, Agodini, & Rall, 2009).

A major limiting factor of CBI programs is that they are commonly designed by software developers who have little knowledge regarding academic interventions (Bishop & Santoro, 2006). As a result, many available CBI reading programs lack inclusion of evidence-based teaching practices. Moreover, when CBI supports are designed by scientists with knowledge of effective instructional practices, the interface design is typically poor, which inhibits the program’s ability to promote skill development (Bishop & Santoro, 2006).

Beyond the design of CBI programs, independent engagement with a computer is likely inconsistent with an ideal learning environment. CBI operates under a model in which a one-on-one relationship is established between the child and the information to be acquired (Edwards & Mercer, 1987). From a constructivist standpoint, learning is a social activity, and as such, interacting with others for the purpose of developing and applying knowledge is critical (Edwards & Mercer, 1987). More concretely, computers do not currently provide the social and instructional supports that are needed for learning.

Additionally, the capacity to gain and hold a student’s attention throughout instruction is
critical, as without attention, there can be no learning (Gagné & Driscoll, 1988). Although the technological features of CBI programs are highly engaging for students (e.g., presenting information through multiple sensory modalities, using large prints and colors; Ota & DuPaul, 2002), they lack the capacity to effectively monitor student attention throughout the entirety of intervention sessions (Bishop & Santoro, 2006). As a result, children may lose valuable instructional time while using CBI programs due to periods of inattention.

**Computer-aided tutoring.** Nominally described as computer-aided tutoring (CAT), this model of intervention delivery employs computers as an aid for intervention delivery, not as a replacement for one-on-one instruction (Chambers et al., 2008). Specifically, the computer can be used to (a) present intervention stimuli, (b) guide the tutor through each step of the intervention, and (c) record, store, and displays progress monitoring data. Importantly, interventionists remains necessary in treatment delivery, as they (a) listen to oral responses and provide corrective feedback, (b) determine when sessions are complete, and (c) monitor attention to ensure active engagement in the learning process (Bishop & Santoro 2006).

Because CAT programs automatize many aspects of intervention delivery, the training, planning, and implementation demands placed upon interventions are minimal (Volpe et al., 2011). This is a critical consideration for those interested in promoting the widespread use of evidence-based supports, as CAT programs permit a greater variety of individuals (e.g., caregivers) to provide high-quality, intensive early reading intervention to children.

**Caregiver-led CAT interventions.** Although a paucity of research has directly investigated caregiver implementation of CAT programs, evidence exists that caregivers can use CAT programs effectively. Watson and Hempenstall (2008) evaluated a caregiver-delivered CAT intervention called Funnix, which targets phonemic awareness, letter-sound fluency,
nonsense word fluency, and oral reading fluency during 30-minute tutoring sessions. Participants included 31 kindergarten and first-grade students and their caregivers. Fifteen parent-child dyads received intervention immediately and the remaining 16 pairs served as a waitlist-control group.

Following six months of intervention, kindergarteners in the treatment group performed significantly better than kindergarteners in the control group on measures of letter sound fluency, oral reading fluency, nonsense word decoding, and phonemic awareness. Effect size estimates for gains in performance from pre to post test for the treatment group were large, as they exceeded 1.20 for each outcome. First-grade students in the treatment group demonstrated significant gains in letter sound fluency, letter name knowledge, non-word decoding, and oral reading fluency from pre-test to post-test. However, these differences were not significantly greater than first-grade students in the control group. The authors indicated that the intervention was delivered with fidelity, however, no formal treatment integrity data were reported.

*Tutoring Buddy.* A CAT program that has garnered attention in recent years is Tutoring Buddy (Volpe, 2009), which was designed to teach young children letter sounds using incremental rehearsal (IR; Tucker, 1989). Initially developed to teach vocabulary, IR is a drill-based technique that teaches unknown pieces of information one at a time by systematically interspersing them among already known pieces of information (Joseph, 2006). IR is unique among existing drill procedures given its inclusion of several evidence-based practices that are thought to increase acquisition and retention by facilitating the movement of newly presented information from short-term memory to long-term memory. These include distributed practice (Burns et al., 2004), errorless learning (Browder & Shear, 1996), teaching to automaticity (Jones & Christensen, 1999), and frequent opportunities to respond (OTR; Greenwood, Delquadri, & Hall, 1984). The inclusion of a high proportion of known material is also thought to increase
rates of reinforcement (Skinner, 2002), which may enhance students’ sense of success and facilitate high levels of on-task behavior (Neef, Iwata, & Page, 1977). The existing literature on IR has supported its effectiveness in promoting mastery/acquisition (e.g., Bunn, Burns, Hoffman, & Newman, 2005), fluency (e.g., Burns, 2005), retention (e.g., MacQuarrie, Tucker, Burns, & Hartman, 2002), and generalization (Nist & Joseph, 2008). IR has also been found effective for a broad array of academic tasks, including letter sound knowledge (Volpe, Burns, DuBois, & Zaslofsky, 2011), letter naming (Bunn et al., 2005), sight-word knowledge (Szadokierski & Burns 2008), reading fluency (Burns, Deans, & Foley, 2004), and reading comprehension (Burns, et al., 2004). IR has been found effective for a broad array of students, including preschool-aged children (Bunn et al., 2005), children identified as learning disabled (Burns, 2005), and ELL students (Matchett & Burns, 2009). Despite these findings, IR is often criticized for being inefficient and cumbersome for interventionists (Skinner, 2008). Tutoring Buddy was developed in response to these criticisms, as it simplifies IR administration by eliminating the need to manipulate flashcards and by making intervention sessions more efficient (i.e., the program presents a continuous string of letters, as opposed to one letter a time; and uses a more challenging 72% to 28% ratio of knowns to unknowns; DuBois, Volpe, & Hemphill, in press).

In the first evaluative study of Tutoring Buddy, Volpe et al. (2011) used a multiple-baseline-across-participants design to investigate the effects of the program on four kindergarten students whom were under responsive to an evidence-based secondary reading intervention. Tutoring Buddy had a significant impact on letter sound fluency, as the effect size was 2.87 across the four participants. The gains were quite impressive given that average tutoring session lasted approximately five minutes. It is important to note that the tutors were first-year graduate
students who had not previously implemented an academic intervention. Despite the novelty of providing intervention, treatment fidelity across sessions was 99.9% (range 97 – 100%).

A follow-up study conducted by DuBois et al. (in press) attempted to replicate and extend the findings of Volpe et al. (2011) with 30 kindergarten and first-grade students who were identified by their classroom teachers as struggling readers. In addition to measuring letter sound knowledge and letter sound fluency, the authors measured the impact of the intervention on decoding skills. Using a randomized group-design with a wait-list control group (15 students in each group), the effects of the intervention were evaluated using multiple level modeling. Results were consistent across all the three dependent measures, as rates of growth for letter sound knowledge, letter sound fluency, and nonsense word fluency, as well as level of performance for each measure following treatment, were significantly higher for the treatment group as compared to the control group. The effect sizes for gains in the treatment group from baseline were in the medium range, as they were .53, .59, and .67 respectively for LSE, NWF, and LSF.

Given the simplicity of Tutoring Buddy and its impact on letter sound knowledge across two studies, it may represent a tool that caregivers can use to teach their preschool-aged children letter sounds. This application of Tutoring Buddy would be particularly important, as it would address several areas of need within early reading research. Specifically, caregiver use of Tutoring Buddy with preschool-aged children would allow for a clearer understanding regarding the independent impact that letter sound training has on the acquisition of letter sounds during preschool. This research would also provide important information regarding (a) the efficacy of a caregiver-mediated CAT intervention, (b) how CAT impacts caregiver’s perceptions of intervention usability, and (c) how CAT impacts the degree to which caregivers are able to implement a structured, early literacy intervention as intended.
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Table 1: Summary of Study Characteristics and Treatment Outcomes
Knowledge: Decoding = all measures that included the decoding of non-words.

Note. N = total number of participants; E = experimental design; QS = quasi-experimental design; B-S = between-subjects; Con = control group comparison; Pre = preschool; K = kindergarten; T = teacher; C = caregiver; Format = the size of the groups where children received intervention; WC = whole class; SG = small group; 1:1 = one-on-one intervention; 1:2 = two children and one interventionist; Course = length of treatment; Session duration = length of treatment sessions in minutes; LSK = letter sound recognition; L = letter; T = teacher; C = caregiver; T = teacher; P = between-pairs.

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Abstract

Knowledge of letters sounds has been identified as a primary objective of preschool instruction and intervention. Despite this designation, large disparities exist in the number of letter sounds children know at school entry. Enhancing caregivers’ ability to teach their preschool-aged children letter sounds may represent an effective practice for reducing this variability and ensuring that more children are prepared to experience early school success. This study used a non-concurrent multiple-baseline-across-participants design to evaluate the effectiveness of caregivers (N=3) delivering a computer-aided tutoring program (Tutoring Buddy) targeting letter sound knowledge to their preschool-aged children. Using visual analyses and effect size estimates derived from Percentage of All Non-Overlapping Data (PAND), results were consistent across all three children, as six weeks of intervention yielded large effect sizes for letter sound knowledge (LSK), letter sound fluency (LSF), and nonsense word fluency (NWF). All three caregivers rated the intervention as highly usable and were able to administer it with high levels of fidelity. Taken together, Tutoring Buddy appears to be an effective, simple, and usable tool that caregivers can use to enhance critical early literacy skills.

The foundations of proficient reading are established during the preschool years by acquiring competence in a number of emergent literacy skills (Piasta, Justice, McGinty, & Kaderavek, 2012). For example, letter sound knowledge at school entry has been found to be one of the strongest predictors of later reading achievement, including oral reading fluency (Schatsneider, Fletcher, Francis, Carlson, & Foorman, 2004) and word decoding (McBride-Chang, 1999). As such, children who enter kindergarten without knowledge of letter sounds are more likely than their peers to experience reading deficits in later elementary school (Bingham, 2007). These deficits carry meaningful implications for later achievement, as children who struggle with reading throughout their first three years of school are unlikely to ever read at grade level (Phillips, Norris, Osmond, & Maynard, 2002). Importantly, being a poor reader throughout one’s education is linked to chronic academic underachievement (Lerner, 2003) and higher incidences of school failure and school dropout (Torgesen, 2002).

**Letter Sounds**

The predictive utility of letter sound knowledge at school entry has resulted in this skill being a primary objective of preschool instruction and intervention (Piasta et al., 2012). For example, the National Association for the Education of Young Children (NAEYC, 1998) and the Early Reading First and Reading First programs (U.S. Department of Education, 2002; 2003) identified knowledge of letter sounds as an essential goal for the preschool years. Similarly, the National Academy of Sciences released a consensus report titled *Preventing Reading Difficulties in Young Children* (Snow, Burns, & Griffin, 1998) that outlined effective practices in the prevention of reading failure. This report heavily emphasized a need to allocate resources toward
supports for young children who exhibit weaknesses in areas that are most closely linked to later reading achievement. Among the skills that were highlighted were print concepts (e.g., understanding that reading is done left to right), knowledge of letter names, and knowledge of letter sounds. Although each of these foundational skills is important, only knowledge of letter sounds directly corresponds to one of the big ideas in learning to read (i.e., the alphabetic principle; National Reading Panel, 2000).

Learning to read in an alphabetic system requires an understanding that units of text map onto specific units of speech, not units of meaning (Perfetti, 1984). Children must learn that each letter of the alphabet is associated with a meaningless unit of speech (a phoneme). When children are able fluently link each letter of the alphabet to an individual phoneme, they develop the capacity to decode and read unfamiliar words, which increases opportunities to practice reading (Adams, 1990) and makes reading a productive activity (Dodd & Carr, 2002). In contrast, when children are unable to link phonemes with their corresponding letters, they fail to progress beyond a logographic state of reading, which allow them to only read high frequency words that they recognize based on visual features (e.g., the word “McDonalds”; Dodd & Carr, 2002).

The sequential relationship between letter sound knowledge, decoding, and word reading is delineated in the four-phase model of sight-word development proposed by Ehri (2005). In this model, all children begin in a pre-alphabetic phase in which they lack awareness of letter-sound relationships. Children in this stage engage in reading logographically. As children acquire knowledge of letter sounds (partial-alphabetic phase) and begin to apply their grapheme-phoneme correspondences accurately and fluently (full-alphabetic phase), children develop the capacity to exercise their decoding skills to accurately articulate unfamiliar words (consolidated alphabetic phase). Broadly, then, knowledge of letter sounds can be conceptualized as a critical
early literacy skill that provides the foundation for all activities that involve decoding and word reading. In support of this conceptualization of early reading development, Ball and Blachman (1991) found that teaching letter sounds to children had an immediate and positive effect on word reading.

Beyond decoding, knowledge of letter sounds may also play a necessary role in the development of phonological awareness (i.e., the ability to detect and manipulate individual phonemes within words), which is the skill area that is most commonly found to be impaired in children with reading deficits (Share & Stanovich, 1995). For example, Foy and Mann (2006) found that the relationship between phonological awareness and letter sound knowledge on tasks that involved phoneme manipulation was bi-directional. Moreover, knowledge of letter sounds facilitated performance on a complex phonemic awareness task that required a deeper, more explicit awareness of phonological awareness (i.e., deletion and substitution of phonemes). Therefore, knowledge of letter sounds may facilitate sensitivity for the phonological structure that exists within oral language (Foy & Mann, 2006).

The Impact of Caregivers

Emergent literacy research has led educators and researchers to become increasingly interested in the caregiver-mediated literacy experiences children receive prior to school entry (Rebello-Britto, Brooks-Gunn, & Griffin, 2006). The focus on caregivers and their involvement in reading development stems from the understanding that the home environment is the setting in which children are first exposed to language and literacy (Hart & Risley, 1995). As a result, the impact that caregivers have on their children’s reading development is profound. For example, Weinberger (1996) found that preschool-aged children whose caregivers provided less reading support and who devoted less time to reading were significantly more likely to experience
reading difficulties during elementary school. Similarly, a meta-analysis conducted by Senechal (2006) found a strong, positive relationship between caregiver involvement in preschool reading activities and children’s later reading development.

Given the impact caregivers have on their children’s literacy development, researchers have attempted to train caregivers in effective literacy practices (Senechal, 2006). Of the caregiver-mediated activities that have been investigated in the literature, dialogical reading (also referred to as shared book reading) is the most popular for preschool-aged children (Mol, Bus, de Jong, & Smeets, 2008; Bingham, 2007). Although dialogical reading is effective for promoting language development (Mol, et al., 2008; Bingham, 2007), preschool engagement in this activity has been found to account for only 8% of the variance in later reading ability (Bus, van Ijzendoor, & Pellegrini, 1995). Similarly, Evans, Bell, and Shaw (2000) found that after controlling for child age, parent education, and child ability, shared book reading during preschool made no contributions to the prediction of letter sound knowledge in kindergarten.

The minimal impact that dialogical reading and other informal caregiver-led literacy activities have on later reading outcomes (e.g., simply asking caregivers to increase the quantity of shared book reading; Evan, Shaw, & Bell, 2000) has resulted in an increased focus on training caregivers to engage in standardized activities with their children that target specific early literacy skills (Senechal, 2006). This approach is particularly important for enhancing knowledge of letter sounds, as research suggests that learning letter sounds is contingent upon reception of standardized experiences that explicitly target this skill (Piasta & Wagner, 2010).

Although caregivers have delivered structured interventions with success (Fishel & Ramirez, 2005; Resetar, Noell, & Pellegrin, 2006), caregiver implementation of these types of supports is prone to treatment integrity issues (van Otterloo, van Der Leij, & Veldkamp, 2006).
Not surprisingly, the consistency and accuracy with which caregivers implement interventions are key predictors of post-treatment outcomes, including knowledge of letter sounds (e.g., Kraft, Findlay, Major, Gilberts, & Hofmeister, 2001). Moreover, low treatment integrity can lead to a lack of treatment response altogether (van Bysterveldt, Gillon, & Moran, 2006).

**Technology-Based Interventions**

A potential method for supporting treatment integrity is to provide performance feedback throughout intervention delivery. Performance feedback, which involves observing implementation and providing corrective feedback for components delivered incorrectly and praise for components implemented accurately, has been found to enhance treatment integrity for academic interventions (Codding, Feinberg, Dunn, & Pace, 2005). However, given that many caregivers have a limited understanding of pedagogy and intervention delivery (Chambers, Abrami, McWhaw, & Therrien, 2001; Ehri, Dreyer, Flugman, & Gross, 2007), performance feedback may be insufficient as a stand alone mechanism for supporting fidelity. To this end, designing intervention procedures to be less dependent upon pre-existing knowledge is conceptualized as a potentially effective strategy for promoting treatment integrity and treatment effectiveness (Noell & Gansle, 2006). Technology-based interventions can help accomplish this goal by automating complex intervention components (Snow, Burns, & Griffin, 1998).

Among the models of technology-based intervention that currently exist are computer-based instruction and computer-aided tutoring. In computer-based instruction (also described as computer-assisted instruction in the literature), a child works independently with a computer (Kulik, 2003). Although providing instruction via the computer has intuitive appeal, research has generally not supported its efficacy (Slavin, Lake, Davis, & Madden, 2010; Kulik, 2003; Campuzano, Dynarski, Agodini, & Rall, 2009). The lack of empirical support for CBI is
hypothesized to be due to (a) a failure to utilize evidence based-teaching/intervention practices, (b) poor interface design, and (c) insufficient monitoring by adults to support learning by increasing attention, motivation, and relevancy (Bishop & Santoro, 2006).

**Computer-aided tutoring.** As an alternative to CBI, computer-assisted tutoring (CAT) programs have been developed. Based on research supporting the superiority of (a) one-on-one instruction over CBI (Slavin et al., 2010) and (b) professionals over non-professionals in intervention delivery (Chambers, Abrami, McWhaw, & Therrien, 2001), CAT can make intervention delivery less dependent upon pre-existing knowledge by using technology to support intervention planning, delivery, and assessment (Chambers et al., 2008). Specifically, the computer can be used to (a) present intervention stimuli, (b) guide the tutor through each step of the intervention, and (c) record, store, and display progress monitoring data. Although the computer reduces their burden, interventionists remain necessary in treatment delivery, as they (a) listen to oral responses and provide corrective feedback, (b) determine when sessions are complete, and (c) monitor attention to ensure active engagement (Bishop & Santoro 2006). Therefore, the CAT model of intervention delivery attempts to use computers as an aid for intervention delivery, not as a replacement for one-on-one instruction.

Because CAT programs automatize many aspects of intervention delivery, they reduce the training, planning, and implementation demands placed upon interventionists (Volpe et al., 2011). This is a critical consideration for those interested in promoting the widespread use of evidence-based supports, as CAT programs permit a greater variety of individuals (e.g., caregivers, paraprofessionals, older children) to provide high-quality, intensive early reading intervention to children.

**Tutoring Buddy.** A CAT program that has garnered attention in recent research is
Tutoring Buddy (Volpe, 2009), which teaches young children letter sounds using incremental rehearsal (IR; Tucker, 1989). IR is an instructional drill procedure that teaches unknown units of information one at a time by systematically interspersing them between known units of information (Joseph, 2006). Specifically, known words are inserted between each presentation of an unknown word with increasingly more known words being presented until the unknown word is presented four to nine times (e.g., *unknown word*, first known word, *unknown word*, first known word, second known word, *unknown word*, first known word, second known word, third known word, *unknown word, etc.*; Burns & Sterling-Turner, 2010).

The existing literature on IR has supported its effectiveness in promoting mastery/acquisition (e.g., Bunn, Burns, Hoffman, & Newman, 2005), fluency (e.g., Burns, 2005), retention (e.g., MacQuarrie, Tucker, Burns, & Hartman, 2002), and generalization (Nist & Joseph, 2008). IR has been found effective for a broad array of academic tasks, including letter sound knowledge (Volpe, Burns, DuBois, & Zaslofsky, 2011; DuBois, Volpe, & Hemphill, 2014), letter naming (Bunn et al., 2005), sight-word knowledge (Szadokierski & Burns 2008), reading fluency (Burns, Deans, & Foley, 2004), and reading comprehension (Burns, et al., 2004). IR has been found effective for a broad array of students, including preschool-aged children (Bunn et al., 2005), children with learning disabilities (Burns, 2005), students who are English Language Learners (Peterson, Brandes, Kunkel, Wilson, Rahn, Egan, & McComas, 2014; Matchett & Burns, 2009), and children with intellectual disabilities (Burns, 2007).

Despite these findings, implementation of IR can be cumbersome. Specifically, IR procedures require interventionists to present information on flashcards in a specific sequence, which is relatively time intensive (e.g., intervention sessions take approximately 15 to 20 minutes). Accordingly, a primary rationale for developing Tutoring Buddy was to reduce
demands placed upon interventionists delivering IR. Specifically, Tutoring Buddy eliminates the
need to prepare or manipulate paper flashcards, automates progress monitoring, and shortens
intervention sessions to about five minutes.

In the first evaluation of Tutoring Buddy utilizing a multiple-baseline-across-participants
design, Volpe and colleagues (2011) investigated the effects of the program on four kindergarten
students who were unresponsive to an evidence-based secondary reading intervention. The
program had a significant and positive impact on letter sound fluency, as the effect size was 2.87
across the four participants. These gains were impressive given that the average tutoring session
lasted approximately five minutes. It is important to note that the tutors in the study were first-
year graduate students who had not previously implemented an academic intervention and that
all four children were deemed unresponsive to a class-wide peer tutoring intervention that
targeted early literacy skills. Treatment fidelity across sessions was 99.9% (range 97 – 100%).
These initial data provided evidence that Tutoring Buddy is a highly effective intervention.

A follow-up study conducted by DuBois et al. (2014) attempted to replicate and extend
these findings with 30 kindergarten and first-grade students who were identified by their
classroom teachers as struggling readers. Three graduate students in school psychology served as
tutors. In addition to measuring letter sound knowledge and letter sound fluency, the authors
measured the impact of the intervention on decoding skills (i.e., nonsense word fluency). Using a
randomized group-design with a wait-list control group, rates of growth for letter sound
knowledge (LSK), letter sound fluency (LSF), and nonsense word fluency (NWF), as well as
level of performance for each measure one week post treatment, were significantly higher for the
treatment group as compared to the control group.

Purpose
Given that Tutoring Buddy is hypothesized to remove many of the barriers that are associated with implementation, it may represent a tool that caregivers can use to enhance their preschool-aged children’s knowledge of letter sounds. Heretofore, there has been a paucity of research directly investigating caregiver implementation of CAT programs with preschool-aged children. The purpose of this study was to investigate several aspects of caregiver implementation of Tutoring Buddy with preschool-aged children. The following research questions were used to guide this study.

1. Will caregiver implementation of Tutoring Buddy increase knowledge of letter sounds in preschool-aged children?

2. Will gains in letter sound knowledge result in generalization of skills, as measured by letter sound fluency and nonsense word fluency?

Based on previous research (Volpe et al., 2009; DuBois et al., 2014), it was expected that rate of growth for LSK would be approximately two sounds learned per week for each child. Additionally, it was expected that the rate of growth for LSF and NWF would be approximately two correct letter sounds/correct letter sequences per week (in DuBois et al., 2014, there was approximately a one-to-one correspondence for increases in LSF and NWF). Finally, the effect sizes for each dependent variable were expected to be medium to large, as DuBois et al. (2014) found effect sizes of 0.53, 0.59, and 0.67 respectively for LSF, NWF, and LSF.

In addition to these two research questions, which were addressed experimentally, the following secondary (or exploratory) research questions were also investigated:

3. To what extent is Tutoring Buddy deemed usable (i.e., acceptable, understandable, feasible) by caregivers prior to, during, and following intervention implementation?

Given that the intervention is simple, brief, and has demonstrated efficacy, it was
hypothesized that mean caregiver ratings of acceptability, understanding, and feasibility would be favorable as indicated by average ratings of five or greater on a six-point scale (e.g., agree or strongly agree).

4. To what extent are caregivers able to administer the Tutoring Buddy intervention with integrity and consistency?

Given that Tutoring Buddy is easy to implement, that caregivers will be provided with a script to view during implementation, and that they will receive weekly performance feedback regarding implementation, it was hypothesized that session integrity and component integrity would exceed 80% for each caregiver. Similarly, because (a) intervention sessions are likely to be brief (approximately five minutes) and (b) caregivers are likely to deem Tutoring Buddy as a highly usable intervention, it was hypothesized that caregivers will consistently implement the intervention three times a week.

5. What is the instructional efficiency of Tutoring Buddy delivered by caregivers for increasing the LSK, LSF, and NWF of preschool-aged children?

Based on findings from previous studies (Volpe et al., 2009; DuBois et al., 2014), it was expected that between 0.25 and 0.50 letter sounds would be learned per minute of instruction with Tutoring Buddy. Additionally, it was hypothesized that LSF and NWF scores would increase by approximately 1.00 correct letter sounds/correct letter sequences per minute of instruction with Tutoring Buddy.

6. How will child behavior problems during intervention sessions, as measured by the Academic Intervention Rating Scale (AIRS; Volpe, Briesch, & Burns, 2011), impact the effectiveness and efficiency of the Tutoring Buddy intervention?

Given the positive relationship that exists between academic engagement and learning
(e.g., Greenwood, Horton, & Utley, 2002), it was expected that higher levels of problem behavior will be associated with lower gains in LSK, LSF, and NWF. Similarly, given that inattentive and disruptive behavior may increase the length of intervention sessions, it was expected that higher levels of these behaviors will be associated with lower levels of instructional efficiency for all three dependent variables.

**Methods**

**Participants and Recruitment**

Participants consisted of three caregivers and three children who were recruited through an early education program located in a suburb of Boston, MA. An advertisement describing the study (Appendix A) was posted in the program’s weekly newsletter and interested caregivers were instructed to contact the principal investigator. There were no participation restrictions regarding gender, ethnicity, race, socio-economic status, health, or disability status. Only children who were able to see letters in 68-point font, who were able to orally articulate letters sounds, and who knew six or fewer letter sounds were eligible to participate This last restriction was included to permit potentially meaningful gains in LSK.

In total, four caregivers contacted the author with interest in participating in the study. After meeting with the author and learning more about the length of the study, one caregiver decided not to participate. The remaining three dyads met all participation requirements and chose to participate. Demographic information for the participating families was collected using the questionnaire in Appendix H. Detailed information regarding the three dyads is provided below.

**Dyad 1.** The first dyad consisted of a 4-year, 2-month-old, English speaking, Caucasian female (Jane) and her 28-year-old biological mother. Jane was identified at age 2 as having a
communication disability related to expressive language and social pragmatic deficits. Although Jane received speech and language therapy services to address her disability (these services were provided as part of her Individualized Education Program), she had not previously received explicit training in letter-sound correspondences. Jane attended preschool for 20 hours a week and had participated in preschool for 18 months when she entered the study. Jane’s mother obtained a Master’s of Fine Arts and was a homemaker. Jane’s father obtained a doctoral degree and was employed at a financial firm. During the study, only Jane’s mother administered the intervention.

**Dyad 2.** The second dyad consisted of a 4-year, 9-month-old male (Andy) and his 35-year-old biological mother. Although Andy had not previously been identified as having a disability, his mother was concerned with his literacy development and his academic readiness to begin kindergarten. Andy attended preschool for 15 hours a week and had been participating in preschool for 8 months prior to entering the study. Andy’s mother and father learned English as a second language and spoke both Spanish and English at home. Andy’s mother reported that his expressive language skills in English were more developed than his skills in Spanish. Andy’s mother obtained a Bachelor of Arts degree and was a homemaker. Andy’s father obtained a Masters of Business Administration and was employed in information technology. During the study, only Andy’s mother administered the intervention.

**Dyad 3.** The third dyad was a 4-year, 10-month-old Hispanic female (Mary) and her 33-year-old biological mother. Mary was identified at age 3 as having a communication disability and received speech and language therapy services to address articulation deficits. These services were discontinued six months prior to treatment. Mary attended preschool for 15 hours a week and had been participating in preschool for 8 months prior to entering the study. Mary’s mother
and father learned English as a second language and spoke both Spanish and English at home. Mary’s mother reported that her expressive language skills in English were more developed than her skills in Spanish. Mary’s mother obtained a Bachelor of Arts degree in social work and was a homemaker. Mary’s father obtained a Bachelors of Arts degree in business and owned a construction company. During the study, only Mary’s mother administered the intervention.

Materials and Measures

Tutoring Buddy. The Tutoring Buddy program was delivered one-on-one using an iPad. There were no specifications regarding the model or the version of the iPad used. The Tutoring Buddy program, which was downloaded as an application onto caregiver’s iPads, consisted of three essential elements, (1) a pre-intervention assessment of LSK, (2) a set-up screen, and (3) the IR procedure. The pre-intervention assessment of LSK, which involved showing 24 letters one at a time in random order (x and q were excluded), served as the dependent measure of LSK. The program also provided caregivers with a time series of their children’s progress. The features of the program are described in detail below.

Intervention script. All caregivers were provided with a 15-item script that explicitly described each component of the intervention (Appendix G). The script detailed (a) how to implement each step of the intervention, (b) the oral instructions that caregivers should provide their children, (c) how to select letter sounds for intervention, (d) how to provide corrective feedback, (e) and how to articulate each letter sound.

Treatment integrity. Treatment integrity data were collected using a 22-item procedural checklist completed by the researcher (Appendix F). This checklist has been used in previous research to measure treatment integrity during Tutoring Buddy delivery (DuBois et al., 2014).
**Usage Rating Profile – Intervention.** Usability data were collected with a modified, 18-item version of the revised Usage Rating Profile - Intervention (URP-I; Briesch, Chafouleas, Neugebauer, & Riley-Tilman, 2013). Specifically, three of the six URP-I scales were used and the wording was altered to reflect its use with caregivers. The wording of the URP-I was also modified to reflect the timing of the measurement occasion (i.e., prior to, during, and following treatment; Appendices C, D, and E). The three subscales that were used were the acceptability, understanding, and feasibility subscales. The Acceptability subscale includes nine items and measures how acceptable an individual finds an intervention to be and how enthusiastic he/she is to implement it. The Understanding subscale includes three items and measures perceived knowledge regarding intervention implementation. The Feasibility subscale includes six items and measures perceptions of how easy the intervention will be to implement in regards to time commitment and intrusiveness. Questions in each subscale were scored along a 6-point Likert scale, with higher ratings indicating higher levels of acceptability, feasibility, and understanding. The acceptability, understanding, and feasibility subscales have acceptable levels of internal consistency, with alpha levels of 0.95, 0.79, and 0.88, respectively (Briesch et al., 2013).

**Letter Sound Fluency.** AIMSweb letter sound fluency (LSF) progress-monitoring probes (NCS Pearson, Inc, 2005) were used to measure LSF. The letter sound fluency task involves showing children a page of lower case letters and asking them to articulate as many letter sounds as they can in one minute. Scores were calculated as the number of correctly articulated letter sounds in one minute. Similar measures correlate strongly with standardized measures of phonological processing (Hintze, Ryan, & Stoner, 2003) and have demonstrated strong alternate form reliability (range, .74 - .89).

**Nonsense Word Fluency.** DIBELS 6th edition kindergarten, NWF progress monitoring
probes (Dynamic Measurement Group, 2008) were used to assess the alphabetic principle (Good & Kaminski, 2002). The nonsense word fluency task involves showing children a page of pseudo-words (e.g., lut) and asking them to sound out as many of the pseudo-words as they can in one minute. Scores were calculated as the number of correctly articulated letter sequences in one minute. The kindergarten probes have demonstrated strong alternate form reliability (.94; Speece, Mills, Ritchey, & Hillman, 2003; Good et al., 2004).

**Wechsler Preschool and Primary Scale of Intelligence – Fourth Edition.** Information regarding children’s general language abilities was measured using the Verbal Comprehension Index of the Wechsler Preschool and Primary Scale of Intelligence – Fourth Edition (WPPSI-IV, Wechsler, 2012). The WPPSI-IV is an individually administered scale of intelligence for children ages 2 years, 6 months to 7 years, 3 months. The Verbal Comprehension Index is composed of two subtests (Information and Similarities) and is thought to measure the knowledge that a child acquires from his/her environment. The Verbal Comprehension Index has demonstrated strong internal consistency, short-term temporal stability, and inter-scorer agreement (Wechsler, 2012).

**Child/Home Early Language and Literacy Observation.** The Child/Home Early Language and Literacy Observation (CHELLO; Nueman, Dwyer, Koh, 2007) was used prior to treatment initiation to formally assess the home literacy environments of the participating children. Designed for home-based settings with children aged 0 to 5, the CHELLO is comprised of two separate tools: the Literacy Environmental Checklist and the Group/Family Observation.

The Literacy Environmental Checklist, which focuses on the physical environment of the home, measures five areas: book area (four items), book use (six items), writing materials (six items), educational toys (three items), and technology (three items). The checklist records the
presence or absence of certain features (e.g., Is a book area set aside just for book reading?) and observers score the items on a dichotomous scale (yes or no) or a 3-point scale. Ratings are then added together to derive a total score ranging from 0-26. Scores below 11 indicate that the literacy environment is poor, scores between 11 and 20 indicate that the literacy environment is fair, and scores 21 and above indicate that the literacy environment is excellent. The Literacy Environmental Checklist has acceptable levels of inter-rater reliability (.84) and internal consistency (α = .78).

The Group/Family Observation includes 13 observational components across three subscales: Physical Environment (three components), Support for Learning (three components), and Teaching Strategies (seven components). Each component includes three to four items that are rated on a 1 to 5 scale with rubric descriptions. An average score is then calculated for each component. The averages for the 13 components are summed to provide a total score. Scores 21 and below indicate that the environment is deficient, scores 22 to 32 indicate that the environment is fair, scores 33 to 43 indicate that the environment is basic, scores 44 to 54 indicate that the environment is above average, and scores 55 to 65 indicate that the environment is exemplary. The Group/Family Observation has moderate levels of inter-rater reliability (.54) and high levels of internal consistency (α = .96).

**Academic Intervention Rating Scale.** The Academic Intervention Rating Scale (AIRS; Volpe et al., 2011; Appendix I) is a measurement tool that is completed by interventionists to rate a child’s behavior during an intervention session. The AIRS contains 9 items along a 4-point Likert Scale and measures three aspects of off-task behavior: inattention (e.g., difficulty concentrating), hyperactivity (e.g., restless or overactive), and hard to manage (e.g., needs coaxing). Responses on the AIRS were used to help contextualize treatment responsiveness and
efficiency (e.g., if treatment response or treatment efficiency was poor, the AIRS would provided potential hypotheses as to why, such as high levels of inattention or hyperactivity during intervention sessions). For each AIRS subscale, total ratings of 0 indicate that the type of behavior was not present at all during the intervention session, total ratings of 3 indicate that there were slight or ambiguous occurrences of the behavior during the intervention session, total ratings of 6 indicate that there were definite occurrences of the behavior during the session, and total ratings of 9 indicate the behavior was observed often during the intervention session.

**Design and Procedures**

Once caregivers agreed to participate in the study, they were presented with a consent form in person at their home. The consent form is included in Appendix B. During this meeting, the author described each detail of the study. The oral description of the study focused on three important requirements for participation. Caregivers had to agree to (a) participate in a Tutoring Buddy training session delivered by the researcher, (b) implement the intervention with their child three times a week, and (c) meet with the researcher each week for 30 minutes so that he could evaluate the effects of the intervention (i.e., measure LSF and NWF) and observe the caregivers as they administered Tutoring Buddy.

**Experimental Design.** The present study utilized a nonconcurrent multiple-baseline-across-participants design to assess the efficacy of the Tutoring Buddy intervention. Nonconcurrent multiple-baseline designs, which are often used in applied settings, differ from tradition concurrent designs in that measurement occasions are not temporally aligned (Christ, 2007). When using noncurrent multiple-base designs, a priori identification of baseline lengths is recommended (Christ, 2007). Once baseline lengths, each of unequal duration, are determined, participants are assigned to one of the baseline lengths.
The length of the baseline phase in the present study was 8 days for Dyad 1 (Jane), 16 Days for dyad 2 (Andy), and 24 days for Dyad 3 (Mary). Dyads were assigned to baseline lengths based on their availability to begin the study. For example, Dyad 3 had pre-existing demands that necessitated that (a) their baseline phase begin two weeks after Dyad 1 and (b) they have a longer baseline phase. The staggered implementation of the intervention within this multiple-baseline design afforded the opportunity to demonstrate three replications of a measured effect, which is required to confidently attribute desired outcomes to an intervention (Horner, 2005). This design also supports external validity by demonstrating the impact of an intervention across multiple participants.

**Baseline.** During baseline, all three children were assessed on the dependent measures (LSK, LSF, and NWF) in their homes. These assessments were administered three times consecutively in each session and the median score for each represented their score that session. If a child was unable to produce an accurate response within the first ten items on the LSF or NWF task (i.e., first ten letter or first ten nonsense words), the assessment was discontinued and the child received a score of 0. LSK was not measured with the Tutoring Buddy program during baseline (as caregivers did not have access to the program during this time). Instead, children had their LSK measured by the researcher using paper flashcards that were presented in random order. During baseline, children had their LSK, LSF, and NWF measured on three occasions: on the first day of baseline, at the mid-point of their baseline (i.e., on day 4 for Jane, on day 8 for Andy, and day 12 Mary), and on the final day of their baseline. Prior to treatment initiation, the researcher conducted an observation using the CHELLO and administered the Verbal Comprehension subtests of the WPPSI-IV.

The Tutoring Buddy intervention required that children know at least one letter sound
prior to treatment initiation. However, Jane did not know any letter sounds following her first baseline assessment. Accordingly, Jane’s caregiver was instructed to teach Jane the grapheme-phoneme correspondence of the first letter of her name (i.e., /j/). This training consisted of Jane’s mother making a flashcard with the letter on it, Jane’s mother demonstrating the sound (e.g., “This letter makes the sound /j/, like Jane”), and Jane’s mother asking her to repeat the sound (e.g., “What sound does this make?”). Jane’s mother continued this procedure nightly until she could articulate the letter’s sound within three seconds of presentation (in the absence of training). The training resulted in Jane learning one letter sound during baseline. Other than this activity, caregivers were instructed not to change their literacy activities during baseline.

Prior to implementing the intervention, caregivers were required to meet with the researcher for a one-hour training session in their home. This session occurred immediately prior to the first intervention session. To begin, the researcher downloaded the Tutoring Buddy application onto the caregiver’s iPad. Using role-play, the researcher then demonstrated how to implement the intervention, with the caregiver acting as the child. The caregiver then practiced implementing the intervention with the researcher serving as the child. Role-play continued until the caregiver demonstrated that she was able to implement each component of the intervention accurately (the researcher used the 22-item procedural checklist provided in Appendix F to measure accuracy). Caregivers were also required to be able to articulate each letter sound correctly before the training was completed. This was assessed by having parents articulate each letter sound. Immediately following this training, caregivers completed the URP-I.

**Intervention phase.** The intervention continued for all participants for 6 weeks. If no growth had been evident for a child for more than four intervention sessions, treatment would have been terminated for that child. Additionally, it was determined prior to treatment initiation
that the intervention would continue for children who learned all 24 targeted letter sounds before 6 weeks of intervention, as additional training would likely support gains in fluency. Caregivers were instructed to implement Tutoring Buddy three times a week. The following intervention steps took place using the Tutoring Buddy program on the iPad. Each session began with the child being presented with 24 lowercase letters one at time in random order (x and q were excluded). The child was asked to say the sound of each letter. The caregiver recorded correctly and incorrectly articulated sounds by pressing either the ‘k’ (for known) or ‘u’ (for unknown) button on the iPad screen.

After this pre-test, caregivers selected four letters from a list of known letters and two letters from a list of unknown letters to use in the intervention. All letter sounds were trained using lowercase letters. Using lowercase letters is recommended given that most letters appear as lowercase in connected text (Carnine, Silbert, & Kameenui, 1997). Caregivers were instructed to start with continuous sounds (e.g., /a/ and /o/) before moving onto stop sounds (e.g., /b/ and /g/). To prevent confusion, letters with similar visual features (e.g., ‘b’ and ‘d’) were trained during different sessions whenever possible. The four known letters did not have to be four different letters. For example, if the child only knew one letter sound, that letter sound could be used to represent all four known letters or if the child knew two letter sounds, each could be used twice to represent the four known letter sounds. Letters were repeated during Mary’s first three intervention sessions and during Jane’s first six intervention sessions.

Once the letters were selected, caregivers began the intervention by pressing the ‘continue’ button on the screen. Once the button was pressed, the first unknown letter appeared on the screen in 68-point font, the caregiver modeled its sound, and the caregiver asked the child to repeat the sound (e.g., *This letter makes the sound /m/, like the first sound in*
‘mmmmp...mop.’ What sound?). After the child correctly articulated the sound, the caregiver pressed the ‘next’ button on the screen and the software generated a string of 14 letters in the order prescribed by the IR method: first unknown, first known, first unknown, first known, second known, first unknown, first known, second known, third known, first unknown, first known, second known, third known, fourth known (Figure 2). The entire 14-letter string appeared on the screen and the caregiver pointed to each letter and asked the child to articulate its sound. Upon completing this sequence, a second unknown letter sound was introduced just as the first. However, the first unknown became the first known and the fourth unknown was removed. Therefore, each IR sequence utilized a 4:1 ratio of known to unknown letter sounds.

All errors were corrected using a standardized correction procedure (regardless if the letter was considered known or unknown). The caregiver said, “Stop,” modeled the correct pronunciation, and asked, “What sound?” Once the child accurately pronounced the sound, he/she was instructed to return to the beginning of the IR sequence. Sessions ended when the child accurately completed the IR sequence for both targeted letter sounds.

During the intervention phase, caregivers met with the researcher once or twice a week for 30 minutes in their homes. Although two meetings were scheduled each week, caregivers frequently had to cancel meetings due to conflicts. This resulted in the researcher meeting with each caregiver eight times over the six weeks. During these meetings, the researcher observed implementation of the intervention and completed the procedural checklist. Following the intervention session, caregivers completed the AIRS. Next, the researcher discussed with the caregiver the treatment integrity data (i.e., provided praise for components delivered correctly and corrective feedback for elements delivered incorrectly or omitted), factors that were impeding treatment delivery, and ways that treatment delivery could be further supported.
Mothers completed the URP-I a second time following three weeks of intervention and a third time after completion of the intervention.

**Treatment responsiveness.** To measure treatment responsiveness, LSK data were collected prior to each IR session. These data were collected via the Tutoring Buddy’s pre-intervention assessment (i.e., showing children a letter and asking them to articulate its sound). Sounds that were pronounced correctly within three seconds of their presentation were considered known. LSK scores could range from 0-24. The AIMSweb LSF task (NCS Pearson, Inc, 2005) and the kindergarten NWF subtest of the Dynamic Indicators of Early Literacy Skills (DIBELS; Dynamic Measurement Group, 2008) were administered by the researcher once a week during the treatment phase to measure gains in LSF and NWF (these assessment were completed prior to intervention sessions). Following standardized procedures, both assessments were administered three times consecutively and the median score served as the dependent measure.

**Treatment integrity.** Measures of treatment fidelity were obtained via direct observation and through the tutoring program. Specifically, the researcher observed caregivers engaging in the intervention once or twice a week and completed the 22-item procedural checklist (Appendix F). These data were used to calculate session integrity (or the percentage of steps that were administered correctly during each intervention session) and component integrity (or the percentage of instances that each step of the program was delivered correctly across all intervention sessions). Treatment integrity data were collected for 44% of intervention sessions for Jane and Andy and 53% of intervention sessions for Mary, which exceeds the 20% of intervention sessions criteria recommended for monitoring treatment integrity (Perepletchikova & Kazdin, 2005). In addition to treatment integrity, the Tutoring Buddy program was used to
measure weekly dosage (or the number of intervention sessions delivered each week) and total dosage (or the total number of intervention sessions that were delivered during the intervention), as the program recorded the date and time of each intervention session.

**Interobserver agreement.** Interobserver agreement (IOA) data for LSK was calculated by having the researcher independently score the LSK assessment as he observed implementation on the intervention. This score was then compared to the LSK score provided by the program. As a result, IOA for LSK was collected during all measurement occasions. A unique feature of the program is that caregivers can press the screen during the LSK assessment to hear the correct articulation of a letter’s sound. This seems to have facilitated a high degree of accuracy in scoring these assessments (100% agreement was found between the researcher’s and the caregiver’s LSK scores).

A research assistant aided the researcher in collecting inter-observer agreement data for LSF, NWF, treatment integrity, and the AIRS. This was done by having the research assistant independently score assessments and complete checklists as the researcher or caregivers completed them (e.g., the research assistant independently scored the LSF and NWF assessments as the researcher administered them; the research assistant and the caregivers independently completed the AIRS). The research assistant had received substantial training in administering academic assessments throughout her coursework and was proficient in administering LSF and NWF assessments.

IOA data for LSF, NWF, and treatment integrity were collected during 33%, 33% and 25% of assessment occasions, respectively. IOA was calculated for LSF, NWF, and treatment integrity by totaling the total number of agreements on correct and incorrect responses/steps, dividing by the total number of attempted items/steps, and multiplying by 100%. IOA for LSF
was 100%, 98%, and 99% respectively for Jane, Andy, and Mary. Similarly, IOA for NWF was 100%, 97%, and 99% respectively for Jane, Andy, and Mary. Finally, IOA for treatment integrity was 93%, 100%, and 98% respectively for Jane, Andy, and Mary.

IOA was collected for the AIRS during 25% of assessment occasions. IOA for the AIRS was calculated by summing agreements on items, dividing by the total number of agreements and disagreements on items (agreements were defined as scores that fell within one point of each other), and multiplying by 100%. IOA for the AIRS was 100%, 89%, and 100% respectively for Jane, Andy, and Mary.

**Efficiency.** The researcher timed all intervention sessions that he observed, resulting in 44% of intervention sessions being timed for Jane and Andy and 53% of intervention sessions being timed for Mary. The average length of these sessions was then multiplied by the total number of treatment sessions that each child received. This number was then used to represent an estimate of the total amount of time that each child spent in intervention. Instructional efficiency for LSK was calculated by summing the total number of letter sounds each student learned during the intervention, dividing by the total number of seconds that he/she was estimated to have spent in instruction, and multiplying by 60. Efficiency for LSF and NWF was calculated by summing gains in LSF and NWF, dividing by the total number of seconds that students were estimated to have spent in instruction, and multiplying by 60.

**Results**

**Demographics Information**

On the CHELLO, the physical environment of Jane’s home was rated as ‘Excellent’ and Jane’s mother’s interactions with her were rated as ‘Above Average.’ The physical environment of Andy’s home was rated as ‘Fair’ and Andy’s mother’s interactions with him were rated as
‘Basic.’ The physical environment of Mary’s home was rated as ‘Excellent’ and Mary’s mother’s interactions with her were rated as ‘Above Average.’ Therefore, the literacy environments of all three children were average to above average.

On the Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition (WPPSI-IV), Jane’s Verbal Comprehension Index (VCI) score fell at the 55th percentile (Standard Score = 102). Similarly, Andy’s VCI score fell at the 82nd percentile (Standard Score = 114) and Mary’s VCI score fell at the 75th percentile (Standard Score = 110). Therefore, all three children possessed average to above average language skills.

**Treatment Effectiveness**

LSK, LSF, and NWF data were independently charted for each child by phase (i.e., comparing the baseline phase to the intervention phase; Figure 1). Charted data were then visually inspected for changes in trend as a function of the sequential introduction of the intervention across the three participants. During baseline, no gains in LSK, LSF, or NWF were observed for Mary or Andy. Likewise, Mary made no gains in LSF or NWF. However, because the IR procedure requires knowledge of at least one known letter sound, she was taught one letter sound during baseline. Baseline intercepts for the three children ranged from 1 to 6 for LSK and 0 to 4 for LSF and NWF. Linear slopes were calculated for each student using linear least square estimation. Resultant slopes indicated average daily gains during baseline. For LSK, baseline slopes were .13, .00, and .00 respectively for Jane, Andy, and Mary. For LSF, baseline slopes were .00 for all children. For NWF, baseline slopes were .00, -.07, and .00 for Jane, Andy, and Mary respectively.

As demonstrated in Figure 1, positive and steady growth in LSK was observed for all three students immediately following introduction of the Tutoring Buddy intervention.
Importantly, notable changes in level and trend were demonstrated for each child during intervention. The slopes for Jane, Andy, and Mary improved to .39, .41, and .23, respectively. In regard to average weekly growth, Jane, Andy, and Mary learned 2.67 (range: 1 - 5), 3.00 (range: 0 - 5), and 1.83 (range: 1 – 3) letters sound each week, respectively.

For Andy and Mary, consistent positive growth was observed for LSF and NWF immediately following implementation of the Tutoring Buddy intervention. Notable changes in level and trend were also demonstrated. For LSF, the slopes for Andy and Mary improved to .30 and .27, respectively. For NWF, the slopes for Andy and Mary improved to .33 and .21, respectively. In regard to average weekly growth, Andy’s LSF and NWF scores increased by 2.67 (range 1 - 4) and 2.00 (range: 0 – 5) units each week, respectively. On average, Mary’s LSF and NWF scores increased by 1.67 (range 0 - 3) and 1.50 (range: 0 – 2) units each week, respectively.

Jane’s trends in LSF and NWF were more variable, however. Specifically, Jane made no gains in LSF and NWF following the first week of treatment. Although steady gains in these dependent measures were observed in weeks 2 and 3 of treatment, declines in performance were observed during week 4 (i.e., NWF returned to baseline, LSF was 5 correct letter sounds per minute lower in week 4 than in week 3). Following this decline in performance, Jane made positive and steady gains in LSF and NWF during weeks 5 and 6. Despite this variability, Jane’s slopes for LSF and NWF improved during intervention to .14 and .07, respectively. A summary of means for LSK, LSF, and NWF during the baseline and intervention phases is presented in Table 1.

In addition to visual analyses and slope parameters, effect sizes were derived from Percentage of All Non-Overlapping Data (PAND; Parker, Hagan-Burke, & Vannest, 2007).
PAND is expressed as the percentage of data points that do not overlap between baseline and intervention phases and is recommended over Percentage of Non-Overlapping Data (PND) because it considers all data points equally (Parker et al., 2007). PAND is calculated by first identifying the total number of data points that overlap between baseline and intervention (i.e., the minimum number of data points that would have to be transferred across phases for complete data separation). This number is then divided by the total number of data points and subtracted from 100%. Importantly, PAND can then be translated into a Pearson’s Phi Coefficient to determine effect sizes. Phi Coefficients can range from -1 to 1, with effect sizes of 0.2 being considered small, effect sizes of 0.5 being considered medium, and effect sizes of 0.8 being considered large (Cohen, 1988).

For Andy and Mary, PAND was 100% for LSK, LSF, and NWF. The corresponding effect sizes for Andy and Mary were 1.00 for LSK, LSF, and NWF. For Jane, PAND was 100% for LSK and LSF, and 89% for NWF. The resultant effect sizes were 1.00, 1.00, and 0.83 for LSK, LSF, and NWF, respectively. Taken together, given that (a) three replications of a treatment effect were observed for each dependent measure and (b) large effect sizes were found for each dependent variable across the three children, Tutoring Buddy delivered by caregivers was an effective tool for enhancing preschool-aged children’s LSK, LSF, and NWF.

**Usability**

The third research question addressed the extent to which caregivers deemed Tutoring Buddy to be a usable intervention. As detailed above, the URP-I subscales of Acceptability, Understanding, and Feasibility were used to measure this construct. A summary of URP-I scores is provided in Table 2.

Following the initial Tutoring Buddy training, the average Understanding, Acceptability,
and Feasibility score across the caregivers was 5.26 (SD = 0.65), 5.33 (SD = 1.15), and 5.56 (SD = 0.51) respectively, indicating that as a group, the caregivers deemed the intervention to be highly usable. Within this measurement occasion, Jane’s mother’s scores were lowest, as her mean scores were 4.78, 4.00, and 5.00 respectively for the understanding, acceptability, and feasibility subscales. Although Jane’s mother’s ratings on the Acceptability scale indicate that she “slightly agreed” that the intervention was an acceptable way to teach letters sounds, she may have experienced some uncertainty regarding how well the intervention would fit within her current family practices.

Following three weeks of intervention, the average understanding, acceptability, and feasibility score across the three caregivers was 5.66 (SD = 0.56), 5.26 (SD = 0.61), and 5.61 (SD = 0.54) respectively, indicating that as a group, the caregivers continued to rate the intervention as highly usable following three weeks of use. Importantly, Jane’s mother’s acceptability score increased to 4.78 during this measurement occasion, indicating that she found the intervention to be more acceptable after using it for three weeks. In contrast, Mary’s mother’s acceptability rating decreased from 6.00 to 4.67 during this measurement occasion. Although this rating indicated that she “Agreed” that the intervention was acceptable, she reported that she was slightly less committed to carrying out the Tutoring Buddy intervention (it is important to note that Mary’s mother gave birth three weeks before treatment initiation).

Finally, following treatment termination, the average understanding, acceptability, and feasibility score across the three caregivers was 5.66 (SD = 0.58), 5.26 (SD = 0.65), and 5.61 (SD = 0.54) respectively. As a group, the caregivers continued to rate the intervention as highly usable after using it for six weeks.

Taken together, at all three measurement occasions, caregivers “agreed” or “strongly
agreed” that they understood the procedures involved in Tutoring Buddy and that implementation was feasible within their existing demands. Additionally, at all three measurement occasions, caregivers “slightly agreed” or “agreed” that Tutoring Buddy was an acceptable way to increase their child’s early literacy skills. These data suggest that caregivers perceived the intervention to be a simple, easy, acceptable, and easily understood (i.e., highly usable) tool for increasing their children’s early literacy skills.

**Treatment Integrity**

The fourth research question addressed the extent to which caregivers were able to implement the Tutoring Buddy intervention with fidelity and consistency. Treatment integrity scores across observed intervention sessions was 88% for Jane (range: 68% - 100%), 97% for Andy (range: 86% - 100%), and 91% for Mary (range: 82% - 100%). Therefore, each caregiver exceeded the 80% treatment integrity criterion needed to attribute obtained outcomes to intervention implementation (Perepletchikova & Kazdin, 2005).

Similarly, for each item, component integrity scores across all intervention sessions exceeded 80% for each caregiver, with the exception of item 9 on the treatment integrity sheet. This item instructed caregivers to target continuous sounds before stop sounds (see Appendix F). Specifically, Jane’s mother implemented this component correctly in 50% of observed sessions, Andy’s mother implemented this component correctly in 75% of observed sessions, and Mary’s mother implemented this component correctly in 38% of observed sessions.

In regard to dosage, Jane’s mother and Andy’s mother implemented the intervention three times each week, for a total dosage of 18 intervention sessions. Therefore, they were able to perfectly adhere to intervention schedule outlined prior to treatment initiation. Mary’s mother implemented the intervention 15 times during the 6 weeks (there were 3 weeks where she
implemented the intervention only two times). Therefore, she implemented 15 of the desired 18 intervention sessions.

**Instructional Efficiency**

The fifth research question evaluated the instructional efficiency of Tutoring Buddy delivered by caregivers for enhancing LSK, LSF, and NWF. As noted above, instructional efficiency was measured as the amount learned per minute of instruction with Tutoring Buddy. Because only a portion of treatment sessions were timed (44%, 44%, and 53% of sessions respectively for Jane, Andy, and Mary), efficiency scores represent an approximate statistic. The average length of treatment sessions was 292.63 seconds for Jane (SD = 51.53), 128.25 seconds for Andy (SD = 45.73), and 142.50 seconds for Mary (SD = 40.34). For context, the average length of intervention sessions in DuBois et al. (2014) was approximately 120 seconds. In regard to LSK, the instructional efficiency was 0.18, 0.47, and 0.31 respectively for Jane, Andy, and Mary. These rates are generally consistent with previous research (DuBois et al., 2014) that found Tutoring Buddy to result in 0.25 to 0.50 letter sounds being learned per minute of instruction (DuBois et al., 2014). In regard to LSF, the instructional efficiency was 0.11 for Jane, 0.42 for Andy, and 0.28 for Mary. Finally, the instructional efficiency for NWF was 0.06 for Jane, 0.34 for Andy, and 0.25 for Mary. Instructional efficiency data are summarized in Table 3.

**Child Behavior During Intervention**

The final research question addressed the impact of child problem behaviors, as measured by the AIRS, on instructional effectiveness and instructional efficiency. The mean AIRS ratings for Jane across measurement occasions was 6.63 for Inattention (SD = 1.99), 5.63 for Hyperactivity (SD = 1.99), and 6.88 for Hard to Manage (SD = 2.10), indicating that high
levels of inattentive and disruptive behaviors were observed during intervention sessions. The mean AIRS ratings for Andy across measurement occasions was 4.24 for Inattention (SD = 1.58), 2.50 for Hyperactivity (SD = 1.19), and 3.34 for Hard to Manage (SD = 1.30), indicating that slight occurrences of inattentive and disruptive behavior occurred during intervention sessions. Similarly, the mean AIRS ratings for Mary across measurement occasions were 2.63 for Inattention (SD = 1.51), 2.25 for Hyperactivity (SD = 1.58), and 2.25 for Hard to Manage (SD = 1.16), indicating that only slight occurrences of inattentive and disruptive behavior occurred during intervention sessions. These data are summarized in Table 4.

**Discussion**

The purpose of this study was to investigate several aspects of caregiver implementation of Tutoring Buddy with preschool-aged children who were identified as at-risk for later reading failure based on caregiver concern’s regarding their literacy development. Consistent with previous research (DuBois et al., 2014; Volpe et al., 2011), results indicate that Tutoring Buddy was highly effective for teaching letter sound correspondences, and corresponding gains were observed for letter sound fluency and decoding. Additionally, the present study extends prior research by being the first to demonstrate the efficacy of Tutoring Buddy in preschool-aged children and to demonstrate its efficacy when implemented by caregivers.

In examining growth rates for LSK, 0.88 letter sounds were learned per intervention session (across the three children, the average intervention session lasted approximately 165 seconds). Impressively, this growth rate compares favorably to similar studies that have involved school-aged children. For example, in DuBois et al. (2014), who used Tutoring Buddy to teach letter sounds to kindergarten and first-grade students, 0.83 letter sounds were learned per session. Similarly, Peterson and colleagues (2014) used IR to teach letter sounds to three
kindergarten students who were English language learners. As was done in the present study, two unknown letter sounds were targeted during each session (intervention sessions lasted between 10 and 15 minutes). Because Peterson et al. (2014) employed a less challenging ratio of known to unknown letter sounds, (2:6 compared to 2:4 in the current study) children in that study had many more opportunities to respond (OTR) to intervention targets. Despite the additional OTR and lengthier intervention sessions, students in Peterson et al. (2014) learned slightly fewer letter sounds per session, as approximately 0.77 letter sounds were learned per session (i.e., across the three students, 34 total letter sounds were learned over 44 total sessions).

Although it was hypothesized that problem behavior would reduce the effectiveness of the intervention, results do not support this hypothesis. Specifically, despite disparate levels of problem behavior during intervention sessions, Jane and Andy learned a similar number of letter sounds during the intervention (16 and 18 letter sounds, respectively). Moreover, although Jane engaged in much higher levels of inattentive and disruptive behavior, she learned five more letter sounds than Mary during the intervention. In contrast, however, data do support the hypothesis that problem behavior reduces the efficiency of the Tutoring Buddy intervention by lengthening intervention sessions. Specifically, Jane’s intervention sessions were 2.28 and 2.06 times longer than Andy’s and Mary’s, respectively. In turn, Andy and Mary’s instructional efficiency rates for LSK were 2.61 and 1.72 times larger than Jane’s. Although the sample is too small to make clear conclusions regarding the relationship between efficiency and problem behavior, these results demonstrate a negative relationship exists between these two variables (i.e., higher levels of problem behavior are associated with lower levels of instructional efficiency).
In contextualizing the clinical significance of the intervention, each child’s post-intervention LSF score was two to three times higher than the benchmark for fall of kindergarten (which is three correct letter sounds; NCS Pearson, Inc, 2005) and Andy’s post-intervention LSF score approximated that of a mid-year kindergarten student. Benchmarks for NWF do not begin until January of kindergarten (Dynamic Measurement Group, 2008). However, Andy’s post-intervention NWF score exceeded this criterion (the January benchmark is 13 correct letter sequences). Although Jane’s and Mary’s NWF scores do not meet this criterion, they were well positioned to meet this benchmark at the beginning of kindergarten.

The results of this study provide support that a computer-aided tutoring program delivered by caregivers can be used to promote the development of important early literacy skills in preschool-aged children. This finding carries important implications for those working with preschool-aged children and their families, as widespread implementation of Tutoring Buddy may help close the gap that presently exists in the number of letter sounds that children know at school entry.

The findings of the present study extend the work of previous caregiver-mediated interventions targeting early literacy skills. For example, van Bysterveldt, Gillon, and Moran (2006) and Kraft, Findlay, Major, Gilberts, and Hofmeister (2001) instructed caregivers to teach their preschool-aged children letter sounds during shared book reading. In both studies, caregivers were instructed to teach letter sounds in a highly structured manner (i.e., caregivers were instructed to point to a letter, say its name, demonstrate its sound, and provide an example of a word that begins with the sound). Caregivers in van Bysterveldt et al. (2006) provided intervention for six weeks and the caregivers in Kraft et al. (2001) provided intervention for one year. These structured approaches to training letter sounds were found effective, as large pre-post
effect sizes were found for letter sound knowledge (van Bysterveldt, et al., 2006) and decoding skills (Kraft et al., 2006). Critically, however, in Kraft et al. (2001), a significant amount of the variance in post-treatment outcomes was accounted for by how consistently and accurately caregivers implemented the intervention. Similarly, in van Bysterveldt et al. (2006), poor treatment integrity led to a lack of treatment response altogether for one child. Given these findings, when a formalized approach to increasing caregiver involvement in early literacy is used, professionals must (a) design an intervention that caregivers can delivery with fidelity, (b) provide training that will teach accurate intervention implementation, and (c) develop strategies that support treatment integrity throughout intervention delivery. To this end, the emphasis on these three variables in the present study seems to have supported treatment fidelity and treatment effectiveness.

It is important to note that DuBois and colleagues (2014) found larger effects on LSF and NWF than on LSK. Although Tutoring Buddy targets acquisition, the inclusion of previously known items, the presentation of a string of letters, and the large number of opportunities to respond are also thought to enhance fluency. In the current study, all three children demonstrated the largest gains in LSK. These discrepant findings may be explained by differences in baseline levels of LSK.

The average baseline LSK score for the children in the treatment group in DuBois and colleagues (2014) was approximately 13, and all children knew at least four letter sounds. In comparison, only Andy knew more than one letter sound at baseline in the present study. Therefore, the children in DuBois et al. (2014) had substantially more opportunities to rehearse already known letter sounds, likely resulting in greater gains in LSF and NWF. For example, during the first week of intervention, Jane and Mary were only able to rehearse and gain fluency
with one known letter sound, whereas children in DuBois and colleagues (2014) were able to rehearse and gain fluency with four known letter sounds during every intervention session. In support of this hypothesis, Andy, who had the highest LSK score at baseline, made the largest gains in LSF and NWF. Therefore, although Tutoring Buddy will likely have a positive impact on LSF and NWF regardless of the number of letter sounds known at baseline, the impact of the intervention on LSF and NWF may be positively correlated with baseline levels of LSK.

Given the importance of enhancing academic skills in an efficient manner (Skinner, 2008), the efficiency of Tutoring Buddy for enhancing LSK, LSF, and NWF was explored in the present study. Consistent with previous research (DuBois et al., 2014; Volpe et al., 2011), approximately 0.28 letter sounds were learned per minute of instruction with Tutoring Buddy across the three children (i.e., for every four minutes of instruction with the program, children learned approximately one letter sound). Although the instructional efficiency statistics for LSF and NWF were lower than anticipated (based on previous research, it was hypothesized that efficiency statistics for LSF and NWF would approach 1.00), they were consistent with efficiency rates estimated by Volpe and colleagues (2011). Specifically, Volpe and colleagues (2011) estimated the instructional efficiency of Tutoring Buddy for LSF to be between 0.16 and 0.25 letter sounds gained per minute of instruction. In the present study, instructional efficiency estimates across the three children were 0.22 for LSF and 0.17 for NWF.

In order to explain the lower than anticipated efficiency rates, the length of intervention sessions and the gains made in LSF and NWF must be addressed. In the present study, Andy and Mary engaged in moderate levels off-task behavior and Jane engaged in high levels of off-task behavior. In contrast, the interventionists in the DuBois et al. study (2014) reported that the children engaged in minimal levels of off-task behavior (the novelty of meeting with an
unfamiliar adult and receiving the intervention at school likely supported their engagement). Given this difference, a parsimonious explanation of the lower than anticipated rates is that the children in the present study engaged in higher levels of off-task behavior, which in turn lengthened intervention sessions and reduced efficiency.

However, the data do not support this hypothesis. Specifically, in DuBois et al. (2014), the average length of intervention sessions was just seven seconds shorter than the average length of Andy’s intervention sessions. Despite this similarity, Andy’s efficiency rates for LSF and NWF were less than half that of the students in DuBois et al. (2014). Moreover, although Jane’s and Mary’s sessions were 2.41 and 1.17 times longer than the average sessions in DuBois et al., their efficiency rates were 9.09 and 3.57 times smaller for LSF and 16.67 and 4.00 times smaller for NWF.

The average child in DuBois et al. (2014) increased their LSF and NWF score by approximately 15 units. In contrast, Jane, Andy, and Mary increased their LSF scores by 9, 12, and 9 units and increased their NWF scores by 4, 9, and 7 units, respectively. Although problem behavior did increase the length of intervention sessions, it likely also impacted the degree to which the children attended to intervention stimuli.

Ehri’s (2005) model of sight-word development may also help explain the lower than anticipated gains in NWF. Within this model, the ability to decode unfamiliar words (consolidated alphabetic phase) rests upon the ability to automatically apply knowledge of grapheme-morpheme correspondences. When presented with the NWF task, all three children only attempted to articulate the letter sounds within each nonsense word that they had previously learned (as opposed to treating the nonsense word as unit and attempting to decode it as a holistic unit). This observation, combined with their age and the understanding that they had only been
practicing letter-sound correspondences for six weeks, suggests that they were in the partial-alphabetic phase of sight-word development. This designation would account for the lower than anticipated NWF scores, as the children would not yet have developed the ability to decode nonsense words (i.e., blend sounds). In contrast, the children in DuBois et al. (2014) were receiving Tier 1 instruction in decoding. The reception of Tutoring Buddy likely allowed them to capitalize on this instruction and to develop the capacity to blend sounds (consolidated alphabetic phase). As a result, they were better able to generalize their knowledge of letter sounds to obtain higher NWF scores.

The collection of AIRS data provides important insights into the use of Tutoring Buddy. Given that behavior problems were observed with preschool-aged children and caregiver interventionists, but were not reported with school-aged children and more traditional interventionists (Volpe et al., 2011; DuBois et al., 2014), the use of behavioral supports may be necessary when Tutoring Buddy is utilized by non-traditional interventionists and administered to preschool-aged children. The inclusion of behavioral supports, such as the opportunity to earn tangible reinforcements, may support on-task behavior and reduce the length of intervention sessions.

Although previous research (Volpe et al., 2011; DuBois et al., 2014) provided evidence regarding Tutoring Buddy’s efficacy and efficiency, this is the first study to measure the usability of the program with caregivers. Given the simplicity, briefness, and effectiveness of the intervention, it was not surprising that the caregivers rated Tutoring Buddy as highly acceptable, highly feasible, and easy to understand. This finding is critical for wide-spread implementation, as the more usable an intervention is deemed to be, the more likely it is that it can be used with fidelity by a variety of interventionists (Sanetti & Kratochwill, 2009). To this end, despite using
caregivers who had no previous intervention experience, all three caregivers were able to use the intervention accurately and with consistency. In addition to providing support for the theoretical relationship between usability and treatment integrity, these data provide initial evidence that Tutoring Buddy can be used with fidelity by caregivers.

As noted above, competent integrity did not reach acceptable levels for the direction to select continuous sounds before stop sounds. This direction was included because continuous sounds are thought to be easier for children to pronounce. Caregivers reported that when they selected sounds for training, they typically chose sounds they that thought be appropriate (instead of referring to the intervention script and selecting continuous sounds). Given the impact of the intervention across the three dependent measures, this component may not be critical. However, future versions of the program may want to automate the selection of letter sounds, as this would further simplify and standardize administration.

As compared to using paper flashcards, delivering IR with Tutoring Buddy appears to have several advantages. Specifically, the findings from DuBois et al. (2014) and the present study suggest that Tutoring Buddy increases the instructional efficiency of IR. Additionally, Tutoring Buddy automates progress monitoring, shortens IR intervention sessions, simplifies IR administration, seems to support student interest, and is perceived as highly usable for interventionists. Taken together, these findings support delivering IR via Tutoring Buddy.

Theoretical Implications and Applications to Practice

Research over the previous decades has identified a host of interventions that support academic development throughout early childhood. However, improving childhood outcomes necessitates widespread adoption of these practices. Given the research to practice gap (Kelly et al., 2010), the transmission of evidence-based practices to caregivers, and there subsequent use,
is likely lacking. This discrepancy has resulted in recent efforts to make evidence-based practices more accessible to those who have not traditionally provided intervention (e.g., Fabiano et al., 2012). The primary mechanism for achieving this goal is to make well-established interventions more usable for consumers (Briesch et al., 2013). To this end, Tutoring Buddy was purposefully designed to make IR administration simple, understandable, brief, and feasible. This focus allowed Tutoring Buddy to be used effectively by caregivers who had not previously provided intervention. Although additional research is needed to more clearly understand the relationship between usability and treatment use, the results of this study provide evidence that emphasizing usability during intervention design is an effective way to increase the use of well-established interventions by non-traditional interventionists.

Focusing on usability within early literacy research is also well aligned with a prevention-based model. Increasing parental engagement in research-based activities is a way to ensure that more children receive important literacy experiences prior to kindergarten. In turn, the reception of these experiences is likely to decrease the risk for later reading failure (Torgesen, 2002). For school districts that service children with risk factors associated with reading failure, allocating resources towards providing parents of preschool-aged children with usable interventions is particularly worthwhile. Allocating resources for this type of programming may decrease the occurrence of more costly and difficult to remediate reading difficulties during elementary school (Torgesen, 2002). Although working with preschool-aged children often does not fall under the traditional responsibilities of elementary schools, the paradigm shift in school psychology towards ensuring the success of all children has allowed school psychologists to extend their services and competencies beyond the class and school level and into the community (Power, 2008). Operating under this framework permits practitioners to
broaden their work to include preschool-aged children, their caregivers, and the communities in which they develop.

One-on-one supports are typically conceptualized as tertiary interventions within a response to intervention paradigm, as they typically require substantial resources. Although Tutoring Buddy is a one-on-one intervention, it requires very few resources. The creation of low resource one-on-one and small group interventions may require a re-conceptualization of primary, secondary, and tertiary supports. Specifically, instead of using student to interventionist ratio to define intervention levels, schools may define level of support based on the number of resources that they require (e.g., Volpe et al., 2011). In this model, primary resources would require the fewest resources and tertiary interventions would be the most resource intensive. Conceptualizing supports in this manner may increase the number of students who can receive one-on-one supports and may ultimately reduce the number of students who require the most intensive interventions.

Limitations and Future Directions

Although the results of the present study are promising, there are several limitations that must be addressed. First, the sample consisted of only three caregivers recruited from a single community. Replicating this work with larger samples recruited from a variety of settings and communities will increase the external validity of the findings and provide important information regarding potential characteristics and variables that will impact treatment response. For example, using larger samples of children with a variety of disabilities would permit a clearer understanding of how different populations respond to Tutoring Buddy. If found effective across disability categories, Tutoring Buddy may represent an appropriate home-based support for children with challenges that impact their school readiness. In addition to the size of the sample,
the caregivers in the study were self-selecting. Their motivation to participate likely positively impacted treatment integrity scores and the frequency in which the intervention was administered.

It is important to note that the caregivers in the present study were all highly educated. This characteristic may have supported treatment integrity and treatment effect. However, as demonstrated by Gano (2014), who found that elementary school students were able to administer Tutoring Buddy effectively, the ability to administer the intervention is likely unrelated to educational level. Using the Flesh-Kincaid formula, the readability of the intervention script was estimated to be at a 5th-grade level. As a result, the intervention script is likely appropriate for most interventionists. In future studies, ensuring that the readability of the intervention script matches the reading ability of the interventionist is likely an important consideration.

An additional limitation of the study is that maintenance of skills was not measured (the schedule of caregivers prevented these data from being collected). As a result, the sustained effects of the intervention are unknown. Finally, no comparison intervention was used. As a result, it is unknown how other interventions delivered targeting letter sound knowledge during preschool compare in efficacy, efficiency, and usability.

The results of this study provide strong evidence that the usability of Tutoring Buddy facilitates its implementation by those with limited intervention experience. This is a particularly important finding for schools with limited resources. Children at risk for reading failure necessitate instruction that is both qualitatively and quantitatively more intensive than conventional curricula (Adams, 1990). Although one-on-one interventions delivered by highly qualified interventionists are quite effective, the resources required by this model of intervention
delivery is typically cost prohibitive for schools (Fielding, Kerr, & Rosier, 2007). A low resource alternative to this approach is to use non-traditional interventionists, such as peers and community volunteers (Volpe, et al., 2011). Demonstrating the effectiveness of Tutoring Buddy with peers or with community volunteers would quite important, as use of these types of interventionists would serve to increase the instructional capacity of a school and the number of students who could receive intervention.

Future studies using non-traditional interventionists should also investigate the level of support that is needed to facilitate adequate levels of fidelity. In the present study, the researcher met with caregivers weekly to observe implementation and provide performance feedback. However, because all three caregivers implemented the intervention with fidelity, very little corrective feedback was provided (the corrective feedback that was provided focused on aspects of administration that likely did not impact the efficacy of the intervention, such as the order in which letter sounds were selected for training). This preliminary finding suggests that the simplicity of the intervention may permit more minimal levels of support. In clarifying the level of outside support that is needed, future work could compare levels of treatment integrity found in the present study to a group that receives only a single training session. If Tutoring Buddy were implemented with fidelity and found effective with only a single training session, it would dramatically increase its use at home and other educational settings. Specifically, meeting with several interventionists each week would likely exhaust the resources of a single consultant. In contrast, holding individual or group-based training sessions and allowing individuals to use Tutoring Buddy on their own is likely highly feasible.

Finally, although Tutoring Buddy has been found effective for enhancing LSK, LSF, and NWF, its long-term impact on literacy development has yet to be investigated. Understanding
this aspect of Tutoring Buddy is critical, as its widespread use is likely dependent upon its ability
to positively impact literacy development throughout early elementary school. Accordingly, an
important focus of future research will be on understanding how receiving Tutoring Buddy
during preschool or early kindergarten impacts literacy outcomes at the end of kindergarten and
beyond (e.g., on oral reading fluency during first grade).
References


Chambers, B., Abrami, P., McWhaw, K., & Therrien, M. C. (2001). Developing a computer-assisted tutoring program to help children at risk learn to read. In P. Abrami (Ed.), *Understanding and promoting complex learning use technology*. [Special issue on
instructional technology]. *Educational Research and Evaluation, 7*, 223–239


Fabiano, G. A., Pelham, W. E., Cunningham, C., Yu, J., Gangloff, B., Buck, M., … Gera, S.


National Reading Panel. (2000). *Teaching children to read: An evidence-based assessment of the scientific research on reading and its implications for reading instruction.* Washington,


Author.


Figure 1: Dependent measures separated by child

Baseline

Parent Tutoring

Jane

Andy

Mary

Days

LSK

LSF

NWF
Figure 2: Example of IR sequence used in Tutoring Buddy

```
    m  a  m  a  b  m
    a  b  c  m  a  b  c
      d
```
### Table 1: Mean LSK, LSF, and NWF Scores

<table>
<thead>
<tr>
<th></th>
<th>LSK Baseline</th>
<th>LSK Intervention</th>
<th>LSF Baseline</th>
<th>LSF Intervention</th>
<th>NWF Baseline</th>
<th>NWF Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane</td>
<td>0.67</td>
<td>8.67</td>
<td>0.33</td>
<td>4.33</td>
<td>0.00</td>
<td>2.17</td>
</tr>
<tr>
<td>Andy</td>
<td>5.67</td>
<td>19.33</td>
<td>3.67</td>
<td>14.0</td>
<td>4.33</td>
<td>12.83</td>
</tr>
<tr>
<td>Mary</td>
<td>1.00</td>
<td>7.83</td>
<td>1.00</td>
<td>5.50</td>
<td>0.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Total</td>
<td>2.45</td>
<td>11.94</td>
<td>1.67</td>
<td>7.94</td>
<td>1.44</td>
<td>6.67</td>
</tr>
<tr>
<td></td>
<td>Time 1</td>
<td>Time 2</td>
<td>Time 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Jane</strong></td>
<td>5.61</td>
<td>5.87</td>
<td>5.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mary</strong></td>
<td>5.83</td>
<td>6.00</td>
<td>6.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Andy</strong></td>
<td>6.00</td>
<td>6.78</td>
<td>4.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5.26</td>
<td>5.33</td>
<td>5.56</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Time 1 was measured prior to treatment initiation, Time 2 was measured after three weeks of intervention implementation, Time 3 was measured following treatment termination.
Table 3. Efficiency Statistics

<table>
<thead>
<tr>
<th></th>
<th>Total Seconds in Intervention</th>
<th>Average Length of Intervention Session (in seconds)</th>
<th>LSK</th>
<th>LSF</th>
<th>NWF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane</td>
<td>5,267.25</td>
<td>292.63</td>
<td>.18</td>
<td>.11</td>
<td>.06</td>
</tr>
<tr>
<td>Andy</td>
<td>2,308.50</td>
<td>128.25</td>
<td>.47</td>
<td>.42</td>
<td>.34</td>
</tr>
<tr>
<td>Mary</td>
<td>2,137.50</td>
<td>142.50</td>
<td>.31</td>
<td>.28</td>
<td>.25</td>
</tr>
</tbody>
</table>

*Note: Efficiency is measured as amount learned per minute of instruction*
Table 4. Mean Ratings for Academic Intervention Rating Scale (AIRS)

<table>
<thead>
<tr>
<th></th>
<th>Inattention Mean (SD)</th>
<th>Hyperactivity Mean (SD)</th>
<th>Hard to Manage Mean (SD)</th>
<th>Total Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andy</td>
<td>4.25 (1.58)</td>
<td>2.50 (1.19)</td>
<td>3.34 (1.30)</td>
<td>10.13 (3.83)</td>
</tr>
<tr>
<td>Mary</td>
<td>2.63 (1.51)</td>
<td>2.25 (1.58)</td>
<td>2.25 (1.16)</td>
<td>7.13 (3.18)</td>
</tr>
<tr>
<td>Jane</td>
<td>6.63 (1.99)</td>
<td>5.63 (1.99)</td>
<td>6.88 (2.10)</td>
<td>19.13 (4.97)</td>
</tr>
<tr>
<td>Total</td>
<td>4.50 (2.34)</td>
<td>3.46 (2.21)</td>
<td>4.17 (2.51)</td>
<td>12.13 (6.49)</td>
</tr>
</tbody>
</table>
Appendix A

Advertisement for Recruitment

Faculty at Northeastern University have created a computer program that has been shown to effectively teach young children important early reading skills. Recently they have developed a version of the software for the iPad. The program is very easy to use, and only takes about five minutes a day. If you have a preschool child who is at least 4 years old and would like to participate in a study to evaluate the effectiveness of the iPad program, please contact Matthew DuBois at dubois.ma@husky.neu.edu. The study is expected to take place during the spring and will require approximately 6 hours of time over 6 weeks. The study will also involve a weekly home visit to evaluate how the program is being administered and how it is working.
Appendix B

Consent for Participation

CONSENT FOR PARTICIPATION IN A RESEARCH PROJECT

Principal Investigator: Robert Volpe, PhD, Northeastern University  
Graduate Student Investigator: Matthew DuBois, MS, Northeastern University  
Study Title: Evaluating a computer-assisted tutoring program targeting letter sound knowledge with caregivers as interventionists

Informed Consent to Participate in a Research Study
You and your child are invited to take part in a research study. This form will tell you about the study, but you may also ask the researchers (dubois.ma@husky.neu.edu, r.volpe@neu.edu, 617-373-7970) any questions. You and your child do not have to participate if you do not want to. If you decide that you and your child will take part in the study, please sign at the bottom of this form. We will give you a copy of the signed form to keep.

Why am I being asked to take part in this research study?
You have indicated that you would like to participate in the study and help your child learn letter sounds, which is one of the important building blocks for reading. You have also indicated that you have a pre-school aged child and that you own an iPad.

Why is this research study being done?
Faculty at Northeastern University have created a computer program that teaches young children important early reading skills. The purpose of the study is to evaluate if an iPad version of the program is easy to use and if it helps children learn specific early literacy skills.

What will we ask you and your child to do?
If you choose to participate:

- We will first show you how to use the program to teach your child letter sounds. This one-hour training session will take place in your home and will include learning how to use the program and learning how to pronounce letter sounds.
- After this training, you will be asked to use the program on your own with your child at least 3 times a week for at least 6 weeks. Each session will take about 5 minutes and will include a short rating form at the end.
- A graduate student from Northeastern University will also meet with you once a week at your home for about 30 minutes. The purpose of this meeting will be to help us understand how your child is responding to the intervention (this will be done by having your child pronounce letter sounds for one minute) and to evaluate how the intervention is being administered. This will involve the graduate student observing you administer the intervention and him/her providing you with feedback. The audio recording will also be used by the graduate student to provide feedback about how the intervention is being administered.
Will there be any risk or discomfort to me or my child?
We do not anticipate there being any risks associated with participating in this study. However, some children may find learning letter sounds challenging and some parents may find the program difficult to use at first. In anticipation of these potential discomforts, the program has been designed to be highly engaging, brief, and simple to use.

Will my child benefit by being in this study?
Research has shown that the skills targeted by the software program are essential for early reading success. We expect that teaching your child these skills will improve your child’s readiness for kindergarten.

Who will see the information about me?
All information about you and your child will be kept private. We will change you and your child’s name to a random number so that his or her name is not on any forms. This consent form will also be kept separate from all other forms. Information from this study will only be viewed by us and members of our research team. Any reports or publications based on this research will not identify any individuals involved in the project.

You should also know that the Northeastern University Institutional Review Board (IRB) may inspect study records as part of its auditing program, but these reviews will only focus on the researchers and not on you or your child’s involvement. The IRB is a group of people that reviews research studies to make sure they are safe for participants.

Will I be paid?
There will be no financial remuneration for participating in this study.

If I do not want to participate in this study, what choices do I have?
You and your child do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate.

Who can I contact if I have questions or problems?
Take as long as you need before you make a decision. We will be happy to answer any question you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact Rob Volpe (617-373-7970, r.volpe@nue.edu) or Matthew DuBois (860-481-9671, dubois.ma@husky.neu.edu). If you have any questions about your rights as a participant, you may contact Nan C. Regina, Director, Human Subject Research Protection, 960 Renaissance Park, Northeastern University Boston, MA 02115 (n.regina@neu.edu, 617-373-4588). You may call anonymously if you wish.
Authorization:

I agree that _______________________________ will take part in the study.

(your name and your child name)

Signature:________________________________________

Relationship:____________________________________

Date:___________________________________________

Phone Contact:__________________________________

________________________________________________
Signature of Person Obtaining Consent          Phone

Matthew DuBois
Appendix C

Usability Form - Baseline

Please evaluate the Tutoring Buddy intervention by circling the number that best describes your agreement or disagreement with each statement. You must answer each question.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutoring Buddy is an effective choice for teaching letter sounds.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I will be able to devote time to implementing Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I understand how to use Tutoring Buddy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am knowledgeable about Tutoring Buddy’s procedures.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy is a good way to help my child prepare for kindergarten.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The total time required to use Tutoring Buddy will be manageable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am not interested in implementing Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I have positive attitudes about using Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy is a good way to teach my child letter sounds.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Preparation of materials for Tutoring Buddy appears minimal.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Material resources needed for Tutoring Buddy are reasonable.</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Slightly Disagree</td>
<td>Slightly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-------------------</td>
<td>----------------</td>
<td>-------</td>
</tr>
<tr>
<td>I will use Tutoring Buddy with a good deal of enthusiasm.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy is too complex to carry out accurately.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy will not be disruptive to my family.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am committed to carrying out Tutoring Buddy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy’s procedures easily fit in with my current family’s practices.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I understand the procedures of Tutoring Buddy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The amount of time required for record keeping seems reasonable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix D

Usability Form – During Intervention

Please evaluate the Tutoring Buddy intervention by circling the number that best describes your agreement or disagreement with each statement. You must answer each question.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutoring Buddy is an effective choice for teaching letter sounds.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am able to devote time to implementing Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I understand how to use Tutoring Buddy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am knowledgeable about Tutoring Buddy's procedures.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy is a good way to help my child prepare for kindergarten.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The total time required to implement Tutoring Buddy is manageable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am not interested in implementing Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I have positive attitudes about implementing Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy is a good way to teach my child letter sounds.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Preparation of materials for Tutoring Buddy is minimal.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Slightly Disagree</td>
<td>Slightly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-------------------</td>
<td>---------------</td>
<td>-------</td>
</tr>
<tr>
<td>Material resources needed for Tutoring Buddy are reasonable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am implementing Tutoring Buddy with a good deal of enthusiasm.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy is too complex to carry out accurately.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy is not disruptive to my family.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I am committed to carrying out Tutoring Buddy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Tutoring Buddy’s procedures easily fit in with my current family’s practices.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I understand the procedures of Tutoring Buddy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>The amount of time required for record keep is reasonable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix E

Usability Form – Following Intervention

Please evaluate the Tutoring Buddy intervention by circling the number that best describes your agreement or disagreement with each statement. You must answer each question.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutoring Buddy was an effective choice for teaching letter sounds.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>I was able to devote time to implementing Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>I understood how to use Tutoring Buddy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>I was knowledgeable about Tutoring Buddy’s procedures.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Tutoring Buddy was a good way to help my child prepare for kindergarten.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>The total time required to implement Tutoring Buddy was manageable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>I was not interested in implementing Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>I had positive attitudes about implementing Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Tutoring Buddy was a good way to teach my child letter sounds.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Preparation of materials for Tutoring Buddy was minimal.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Slightly Disagree</td>
<td>Slightly Agree</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-------------------</td>
<td>----------------</td>
<td>-------</td>
<td>----------------</td>
</tr>
<tr>
<td>Material resources needed for Tutoring Buddy were reasonable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>I implemented Tutoring Buddy with a good deal of enthusiasm.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Tutoring Buddy was too complex to carry out accurately.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Tutoring Buddy was not disruptive to my family.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>I was committed to carrying out Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Tutoring Buddy’s procedures easily fit in with my current family’s practices.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>I understood the procedures of Tutoring Buddy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>The amount of time required for record keep was reasonable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>
Appendix F

*Treatment Integrity Sheet*

Date:  
Tutor:  
Person Completing Sheet:  
Number of Yes’: ____/22

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Say, “I am going to show you some letters, and I want you to tell me what sound each letter makes.”</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>2) Click the ‘assessment’ button</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>3) Click the ‘go’ button to begin the pre-assessment</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>4) If the child does not respond to the sight of a letter, or says the letter name, say, “what sound?”</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>5) If the child does not respond within two-seconds, says that they do not know the letter, or says an incorrect sound, press the ‘u’ button to mark an incorrect response.</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>6) If the child gives a correct response, press the ‘k’ button to mark a correct response.</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>7) Press the ‘continue’ button</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>8) When the pre-test is finished, select 4 letters from the known list and 2 letters from the unknown list</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>9) When selecting unknown letters, select continuous sounds first. If no continuous sounds are available, select stop sounds.</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stop sounds– B,C,D,G,H,J,K,P,T,W,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10) If possible, do not select letters with similar features (e.g. B and D).</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>11) Click on the “Start Intervention” button to begin the intervention.</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>12) Say, “We are ready to start practicing some letter sounds.” Point to the unknown letter and say, “This letter makes the sound (letter sound), like the first sound in (give an example of a word that starts with that sound). What sound?”</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>13) Press the ‘next’ button</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>14) Point to each letter in the string and say, “what sound?” If the child says the letter name, say, “what sound?”</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>
15) If the child does not correctly pronounce the letter sound, or does not say a letter sound within two-seconds, say, “Stop. This sound is (blank). What sound? Okay, let’s start at this line again.”

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

17) When the child has successfully completed the entire sequence without making an error, press the “next” button.

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

18) Say, “This letter makes the sound (letter sound), like the first sound in (give an example of a word that starts with that sound). What sound?”

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

19) Point to each letter in the string and say, “what sound?”
If the child says the letter name, say, “what sound?”

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

20) If the child does not correctly pronounce the letter sound, or does not say a letter sound within two-seconds, say, “Stop. This sound is (blank). What sound? Okay, let’s start at this line again.”

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

21) When the child has successfully completed the entire sequence without making an error, press the “next” button.

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

22) Press the ‘continue’ button to complete the intervention

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
</table>

Notes:
Appendix G

Intervention Script

Tutoring Buddy Directions

1.) Once the Tutoring Buddy program is open, press the ‘Setup’ button.
2.) Say, *I am going to show you some letters and I want you to tell me what sound each letter makes.*
3.) Press the ‘pre-test’ button.
4.) If the child gives a correct response, press the *up arrow.*
5.) If the child does not respond within two-seconds, says that they do not know the letter, or says an incorrect sound, press the *down arrow.*
6.) When the pre-test is finished, **select 4 letters from the known list and 2 letters from the unknown list.**
   a. If there are continuous sounds (e.g., a, e, l, o, u, m, r, s, v, z) target those first. Then start with stop sounds (.e.g., b, c, d, g, h, j, k…). Try not to select similar letters for the same session (e.g., b, d)
7.) Press the ‘intervention’ button.
8.) Say, “*Okay, we are ready to start practicing some letter sounds.*” Point to the unknown letter and say, “*This letter makes the sound (letter sound), like the first sound in (give an example of a word that starts with that sound). What sound?*” Press the *right arrow* to move to the next screen.
9.) Point to each letter in the string and say, **“what sound?”**
10.) If the child does not correctly pronounce the letter sound, or does not say a letter sound within two-seconds, say, **“Stop. This sound is (blank). What sound? Okay, let’s continue. “**
11.) Repeat the sequence of letters twice. **Press the right arrow to move to the next screen.**
12.) After teaching the first letter sound, introduce the second letter sound by repeating steps 9 through 12.
13.) After the second letter sound has been taught, press the ‘Go to results’ button.
14.) Click the ‘Results’ button and the number of known letter sounds will appear.
15.) Press the ‘Back to Welcome button’ to return to the first screen.
Most Common Sounds Pronunciation Key

These pronunciation examples may be modified or distinguished to be consistent with regional dialects and conventions of American English. The letters "x" and "q" are not used. The letters "h," "w," "y," and "r" are used only in the initial position. The letters "c" and "g" are used only in the final position.

<table>
<thead>
<tr>
<th>Letter</th>
<th>Sound</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>/a/</td>
<td>bat</td>
</tr>
<tr>
<td>e</td>
<td>/ɛ/</td>
<td>bet</td>
</tr>
<tr>
<td>i</td>
<td>/ɪ/</td>
<td>bit</td>
</tr>
<tr>
<td>o</td>
<td>/o/</td>
<td>top</td>
</tr>
<tr>
<td>u</td>
<td>/u/</td>
<td>hut</td>
</tr>
<tr>
<td>b</td>
<td>/b/</td>
<td>bat</td>
</tr>
<tr>
<td>c</td>
<td>/k/</td>
<td>bic</td>
</tr>
<tr>
<td>d</td>
<td>/d/</td>
<td>dad</td>
</tr>
<tr>
<td>f</td>
<td>/f/</td>
<td>fan</td>
</tr>
<tr>
<td>g</td>
<td>/ɡ/</td>
<td>pig</td>
</tr>
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<td>/h/</td>
<td>hat</td>
</tr>
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<td>j</td>
<td>/j/</td>
<td>jet</td>
</tr>
<tr>
<td>k</td>
<td>/k/</td>
<td>can</td>
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<tr>
<td>l</td>
<td>/l/</td>
<td>lot</td>
</tr>
<tr>
<td>m</td>
<td>/m/</td>
<td>man</td>
</tr>
<tr>
<td>n</td>
<td>/n/</td>
<td>not</td>
</tr>
<tr>
<td>p</td>
<td>/p/</td>
<td>pan</td>
</tr>
<tr>
<td>r</td>
<td>/r/</td>
<td>ran</td>
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<tr>
<td>s</td>
<td>/s/</td>
<td>sat</td>
</tr>
<tr>
<td>t</td>
<td>/t/</td>
<td>sip</td>
</tr>
<tr>
<td>v</td>
<td>/v/</td>
<td>van</td>
</tr>
<tr>
<td>w</td>
<td>/w/</td>
<td>wet</td>
</tr>
<tr>
<td>y</td>
<td>/j/</td>
<td>yak</td>
</tr>
<tr>
<td>z</td>
<td>/z/</td>
<td>zipper</td>
</tr>
</tbody>
</table>
Appendix H

Demographics Questionnaire

CHILD AND FAMILY BACKGROUND FORM

For the purposes of this survey, the following questions refer to your child participating in the study.

Date:
Gender: M F
DOB:

1. Home and Family Background

a. I am this child’s:
Birth Mother
Birth Father
Adoptive Mother
Adoptive Father
Stepmother
Stepfather
Grandparent
Guardian
Nanny/Babysitter
Other

b. What language is spoken in the child’s home? (Please check all that apply)
English
Chinese (Circle one: Mandarin or Cantonese)
Spanish
Other

c. What language does the child speak at home? (Please check all that apply)
English
Chinese (Circle one: Mandarin or Cantonese)
Spanish
Other

d. Number of people living in the home:
Children in the home (including your child in this study): __________
Adults in the home: ___________
Total living in home: __________

e. Number of your child’s siblings in the home:
Older: __________
Younger: ____________
f. What is your child’s ethnicity? (Please check all the apply)
African American/Black
Asian/Pacific Islander
Hispanic/Latino/a
Native American
White/Non-Hispanic Other Unknown

g. Check the primary adult caregivers who are responsible for the child:
Birth Mother
Birth Father
Adoptive Mother
Adoptive Father
Stepmother
Stepfather
Foster Mother
Foster Father
Grandmother
Grandfather
Other Female Relative
Other Male Relative
Other Parental Figure
Other Parental Figure

h. The child’s current living situation is best characterized as:
House owned by family
House rented by family
Apartment owned by family
Apartment rented by family
Subsidized or public housing
Supported program or institutional living
Other

i. Approximate annual family income:
Less than $25,000
$25,000-$49,999
$50,000-$74,999
$75,000-$99,999
$100,000-$125,000
More than $125,000

j. For the persons who are primarily responsible for raising the child, please check their highest level of educational attainment:
Less than high school diploma
High school graduate or equivalent
Vocational/technical education after high school or some college/Associate’s degree
College graduate
Graduate or professional school

k. For the persons who are primarily responsible for raising the child, please estimate the number of hours worked per week:

2. Educational Background of Child

a. Is your child currently attending (please check all that apply):
   Early Intervention
   Preschool Kindergarten
   Childcare Center
   Elementary School
   Head Start or Early Head Start
   Child not in school
   Other

b. If so, how long? hours/week: _____

c. If so, how many months has your child been attending? ________

d. If so, how many times in a typical month do you or any other adult in your household go to meetings, participate in activities, or volunteer at your child’s program/school?
   Never
   Once
   Twice
   3 or more times

e. Did the child previously attend (please check all that apply):
   Early Intervention
   Preschool
   Kindergarten
   Childcare Center
   Elementary School
   Head Start or Early Head Start
   Child not in school
   Other

f. If so, how long? hours/week: _____

g. If so, how many months has your child been attending? ________

h. In the past, was your child identified as having a delay or disability? Yes No

i. Is your child currently identified as having a delay or disability? Yes No

j. If so, how is this delay or disability described? Please check all that apply:
   Adaptive Cognitive
   Motor Social/Emotional Speech/Language
   Autism/PDD
   Down Syndrome
Other genetic syndrome
Other
Don’t know

k. If the child has received services for a developmental delay or disability, was an IFSP or an IEP completed? Yes No

l. *If yes, was it an:* IFSP, an IEP, or both?
Appendix I

Academic Intervention Rating Scale

Child Name: _______________________

Date: ________________________

For each item describe your child’s behavior during the intervention, circle:

0  item was not observed
1  slight occurrence
2  definite occurrence
3  observed often during session

For each problem observed, score only the item that most specifically describes the behavior. Circle a score for every item.

<table>
<thead>
<tr>
<th>1. Difficulty concentrating</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Restless, or overactive</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Acts without thinking</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Doesn’t want to finish</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Easily distracted</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Misbehaves</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Off-topic comments/questions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Doesn’t seem to listen</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Needs coaxing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>