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EFFECTS OF ADAPTED INSTRUCTION ON THE ACQUISITION OF LETTER-SOUND CORRESPONDENCES BY YOUNG CHILDREN WITH AUTISM SPECTRUM DISORDERS AND COMPLEX COMMUNICATION NEEDS

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Elizabeth Benedek Wood

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The dissertation of Elizabeth Benedek Wood was reviewed and approved* by the following:

David B. McNaughton
Professor of Special Education
Dissertation Advisor
Chair of Committee

Richard M. Kubina, Jr.
Associate Professor of Special Education

David L. Lee
Associate Professor of Special Education

Linda H. Mason
Associate Professor of Special Education

Janice C. Light
Distinguished Professor of Communication Sciences and Disorders

Kathy L. Ruhl
Professor of Special Education
Head of the Department of Educational and School Psychology and Special Education

*Signatures are on file in the Graduate School

Abstract

Reading is one of the most critical skills taught in schools (Heller, Fredrick, Tumlin, & Brineman, 2002). Individuals who acquire literacy skills are more likely to experience success in school, and to obtain and maintain employment (Adams, 1990; Light & McNaughton, 2009b; Slavin, Karweit, & Madden, 1989). It is therefore an educational priority to address reading instruction for individuals with complex communication needs (i.e., individuals with limited speech), many of whom do not acquire basic literacy skills (Light & McNaughton, 2009b; Koppenhaver & Yoder, 1992). Considering that as many as 50% of individuals with autism do not develop functional speech (Lord & Paul, 1997; Mesibov, Adams, & Klinger, 1997), this is a population of individuals who are at-risk for experiencing reading challenges (Nation, Clarke, Wright, & Williams, 2006). The primary goal of this study was to investigate the impact of adapted instruction on teaching letter-sound correspondences to young learners with autism spectrum disorders and complex communication needs. A multiple-probe multiple baseline research design across participants was used to evaluate the effects of instruction on the acquisition of letter-sound correspondences by three young children with autism spectrum disorders and complex communication needs. All three children (ages 3 to 5) reached criterion for identifying the letter-sound correspondences targeted during instruction. All three children also provided evidence of maintenance and generalization of letter-sound correspondence skills. Results, social validity, educational implications, and future research directions are discussed.

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CHAPTER 1

Introduction

Reading is often identified as the most critical skill taught in schools (Heller, Fredrick, Tumlin, & Brineman, 2002). Individuals who develop effective literacy skills are more likely to experience success in school and to obtain and maintain employment (Adams, 1990; Light & McNaughton, 2009b; Slavin, Karweit, & Madden, 1989). Researchers have found that individuals with speech deficits are typically at-risk for experiencing reading difficulties (Bishop & Snowling, 2004; Fey, Catts, & Larrivee, 1995; Nation & Norbury, 2005; Scarborough, 2005; Scarborough & Dobrich, 1990). For individuals with *complex communication needs* (i.e., speech skills that do not meet their daily communication needs), many do not acquire basic literacy skills (Light & McNaughton, 2009b; Koppenhaver & Yoder, 1992) and even a fewer number develop advanced literacy skills (Beringer & Gans, 1986; Kelford Smith, Thurston, Light, Parnes, & O'Keefe, 1989; Light & Lund, 2006; Light & McNaughton, 2009b). Given that as many as 50% of individuals with autism do not develop speech that meet their daily communication needs (Lord & Paul, 1997; Mesibov, Adams, & Klinger, 1997), this is a population of individuals who are likely to struggle in developing proficient literacy skills (Nation, Clarke, Wright, & Williams, 2006). Reading and writing skills are especially important for this population of individuals as they may need to make use of these literacy skills as a form of augmentative and alternative communication (AAC), and to support communicative interactions with others.

Research investigating reading instruction for learners with low-incidence disabilities (e.g., autism, developmental disabilities, or moderate to profound intellectual

disabilities) has often examined the teaching of a small number of sight words and vocabulary items (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006). While sight word reading is important, providing learners with the opportunity to acquire conventional reading skills (e.g., applying letter-sound correspondences and blending these sounds to decode words) is critical for developing independent and proficient reading skills (Groff, 1998; Stahl, Duffy-Hester, & Stahl, 1998).

Evidence-Based Reading Instruction

Reading researchers and educators have focused much attention on investigating and implementing evidence-based reading interventions (Adams, 1990; National Institute for Literacy, 2001, National Reading Panel, 2000; Snow, Burns, & Griffin, 1998). In the largest evidence-based review on teaching children how to read, the National Reading Panel (2000) identified three critical areas of reading that should be addressed during reading instruction: (a) *alphabetics*, which includes *phonemic awareness* (understanding that words are made up of individual sounds) and *phonics* (applying letter-sound correspondences and blending these sounds to decode words); (b) *fluency* (reading text effortlessly and accurately); and (c) *comprehension* (deriving meaning from text), which includes *vocabulary* (understanding the meaning of individual words) and *text comprehension* (understanding the meaning of connected text). Together, these areas include five critical components essential to the reading process: (a) phonemic awareness, (b) phonics, (c) fluency, (d) vocabulary, and (e) text comprehension. Based on these findings, the National Reading Panel (2000) provided recommendations for instructional practices that support the skill development for each of the previously mentioned reading components.

The National Reading Panel (2000) found that *explicit instruction* (i.e., a clear and direct approach for presenting information to the learner) and *systematic instruction* (i.e., a prescribed and logical sequence of instruction), when combined with instructional scaffolding, teacher feedback, and repeated opportunities for practice, produced positive results for learners' phonics skills, reading fluency, and reading comprehension. In fact, when considering starting points for formal reading instruction, researchers have consistently found that explicit instruction, in both phonics and phonemic awareness, plays a critical role in becoming a skilled reader (Adams, 1990; Carnine, Silbert, Kame'enui, & Tarver, 2010; Chall, 1989; Groff, 1998; Stahl et al., 1998; Vellutino, 1991).

When individuals do not have the skills necessary to accurately decode words, they often experience difficulty developing reading fluency and reading comprehension (Adams, 1990; Perfetti, 1985; Vellutino, 1991). Given that the ultimate goal of reading is to derive meaning from text (Bursuck & Damer, 2007; Carnine et al., 2010; Gibson & Levin, 1975), providing instruction that works toward this goal (beginning with instruction on letter-sound correspondences and applying letter-sound correspondences to decode words) is critical for helping students to develop effective, independent, and proficient reading skills.

Early reading instruction. Early reading instruction that takes place during the preschool years often includes informal, but meaningful and motivating literacy experiences (e.g., storybook reading, discussion of text in the environment) to assist young children in learning concepts about print and story structure (Teale & Sulzby, 1986; Yaden, Rowe, & MacGillvray, 2000). Although these informal experiences are

important, researchers have found that formal instruction is necessary to support the acquisition of skills that are critical to early reading achievement (Adams, 1990; Chall, 1989; Ehri & Roberts, 2006; Vellutino, 1991). In fact, the National Reading Panel (2000) reported that providing systematic and *synthetic phonics* (i.e., explicit instruction on converting letters into sounds and to blending sounds to form words) was particularly effective for younger learners considered at-risk for reading difficulties as well as for learners with disabilities. According to the National Reading Panel, phonics instruction (which begins with instruction on identifying letter-sound correspondences and then blending these sounds to read words) presented in early school years was much more effective than when presented after first grade.

When considering the skills necessary for developing early reading skills, researchers have consistently reported that phonics is a critical skill for learning to read (Adams, 1990; Chall, 1989; Ehri & Roberts, 2006; Vellutino, 1991). During the beginning stages of phonics instruction, learners first learn letter-sound correspondences (Adams, 1990; Chall, 1967; National Reading Panel, 2000) and then learn how to apply letter-sound correspondences to read and spell words (Adams, 1990; Ball & Blachman, 1991). For learners with complex communication needs who may require AAC, literacy skills can potentially provide these individuals with an effective method of communication (Beukelman & Mirenda, 2005; Heller et al., 2002; Light & McNaughton, 2009b). Therefore, providing instruction on letter-sound correspondences to young learners with autism and complex communication needs can support the development of early reading achievement and spelling skills, which may provide young learners with literacy skills that will support their ability to communicate.

Phonemic awareness, which is the understanding that words are made up of individual sounds (i.e., phonemes) and discriminating between these sounds, is another strong predictor of early reading achievement (Adams, 1990; Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Chard, Simmons, & Kame'enui, 1998; Ehri & McCormick, 1998; Hatcher, Hulme, & Ellis, 1994; National Early Literacy Panel, 2004; Oudeans, 2004). Like phonics instruction, the National Reading Panel (2000) recommends explicitly teaching phonemic awareness skills to young learners. When investigating best practices for teaching phonemic awareness, researchers have consistently reported that instruction is even more effective when explicitly connecting phonemes to letters (Ball & Blachman, 1991; Byrne & Fielding-Barnsley; Ehri & McCormick, 1998; Hatcher et al.; 1994; Oudeans, 2004). Based on these findings, the current research provides evidence that teaching young learners about the relationship between letters and their corresponding sounds appears to support early reading achievement.

Reading Instruction for Students with Autism Spectrum Disorders

Individuals with complex communication needs are a diverse, heterogeneous group of individuals with a wide range of disabilities, including individuals with autism spectrum disorders (ASD). Individuals with ASD are a growing segment of the special education and the general education population (Goodman & Williams, 2007). In order to support the meaningful participation of these students in the general education curriculum, and to prepare these individuals for a full range of educational, recreational, and vocational opportunities, there is a critical need to identify instructional activities that support the development of effective reading skills for young learners with ASD.

The diagnostic criteria for ASD include: (a) deficits in communication skills, (b) deficits in social skills, and (c) restricted and repetitive interests and patterns of behavior (American Psychiatric Association, 2000). In general, learners with speech and language impairments are considered at-risk for developing reading disabilities and for experiencing reading difficulty, and continue to remain at-risk as they grow older (Bishop & Snowling, 2004; Fey et al., 1995; Nation & Norbury, 2005; Scarborough, 2005). Speech and language impairments may lead to difficulties in producing and/or comprehending language. Such difficulties are likely to have serious implications not only in learning how to read, but also in participating in reading and writing instructional activities. Given that the majority of learners with ASD demonstrate language delays (Kjelgaard & Tager-Flusberg, 2001; Leekam, 2007; Tager-Flusberg & Joseph, 2003) and that as many as 50% of learners with autism never develop functional speech (Lord & Paul, 1997; Mesibov, et al., 1997), this population of students is at-risk for experiencing reading difficulties.

In addition to language delays, deficits in social interactions and a restricted repertoire of interest can also impact reading acquisition for learners with ASD. For example, deficits in social interaction can create challenges for (a) demonstrating joint attention, and (b) interacting and responding during instruction (American Psychiatric Association, 2000). In addition, demonstrating a restricted repertoire of interests can lead to difficulty in (a) attending to a new task, or one that is of limited interest; and (b) generalizing information across different contexts (American Psychiatric Association, 2000). These characteristics can negatively impact the learning and participation of learners during traditional reading activities (Blischak, 1995; Coleman-Martin, Heller,

Cihak, & Irvine, 2005; Heller et al., 2002) and, therefore, should be taken into account when providing reading instruction to learners with ASD.

Although there is an increase in the number of students with ASD included in general education classrooms (Dunlap, Kern, & Worcester, 2001; Goodman & Williams, 2007), children with ASD are often excluded from the literacy activities that take place in the general education classroom (Kluth & Darmody-Latham, 2003). Instead, reading instruction for children with ASD often focuses on the memorization of sight words (Copeland & Calhoon, 2007; Vacca, 2007). In fact, the majority of the research on reading for learners with ASD, much like the research on reading instruction for individuals with other low-incidence disabilities, focuses exclusively on sight-word instruction (Browder et al., 2006). Although teaching sight-word reading is an important area of instruction, particularly for teaching learners how to read phonetically irregular words, it typically focuses on memorizing single words rather than teaching a generalizeable strategy that allows the learner to decode a wide range of words (Adams, 1990; Bursuck & Damer, 2007; Carnine, et al., 2010). Therefore, relying on sight-word reading approaches can significantly limit what a learner can read.

At present, we have only a limited understanding of reading instruction for learners with ASD, especially those with complex communication needs (Benedek-Wood & McNaughton, 2009; Koppenhaver & Erickson, 2009). Similar to learners at-risk for reading difficulties (including learners with high-incidence disabilities), researchers have reported that learners with significant disabilities can also benefit from instruction on letter-sound correspondences and single-word decoding (Coleman-Martin et al., 2005; Conners, 1992; Fallon, Light, McNaughton, Drager, & Hammer, 2004; Flores, Shippen,

Alberto, & Crowe, 2004; Light & McNaughton, 2009a, 2009b; Millar, Light, & McNaughton, 2004; Nietupski, Williams, & York, 1979). However, given the unique characteristics of learners with ASD, it is important to consider how to best meet the needs of these learners in order to support the development of independent and skillful reading (i.e., reading and comprehending text accurately and effortlessly).

Reading Instruction for Students with Complex Communication Needs

As described previously, a significant proportion of individuals with ASD never develop functional speech (Lord & Paul, 1997; Mesibov, et al., 1997; Paul, & Lord, 2005), and those who do, often demonstrate significant delays in their speech and language skills (Kjelgaard & Tager-Flusberg, 2001; Tager-Flusberg & Joseph, 2003). Therefore, many individuals with ASD demonstrate complex communication needs. Although much of the reading research has focused on typically developing learners, at-risk learners, or learners with high-incidence disabilities (e.g., learning disabilities, emotional and behavioral disorders) (Browder et al., 2006), individuals with low-incidence disabilities (including autism, cerebral palsy, Down's Syndrome, moderate to severe intellectual deficits, etc.) also require instruction in phonemic awareness, letter-sound correspondences, decoding, fluency, vocabulary, and comprehension in order to develop conventional reading skills (Browder et al., 2007; Coleman-Martin et al., 2005; Conners, 1992; Fallon, et al., 2004; Flores, et al., 2004; Light & McNaughton, 2009a, 2009b; Millar, et al., 2004).

Given that many individuals with low-incidence disabilities demonstrate complex communication needs, it is important to consider how to effectively teach these individuals how to read (Browder et al., 2007). Typical reading instruction often requires

the learner to provide oral responses when identifying letter sounds and when blending sounds to read words; therefore, learners with complex communication needs often experience difficulty fully participating in traditional reading activities (Coleman-Martin et al., 2005; Heller, et al., 2002; Light & McNaughton, 2009a, 2009b). Perhaps for this reason, many reading programs designed for learners with low-incidence disabilities often focus on sight-word reading instruction and do not address the basic skills (e.g., phonemic awareness and phonics) that are critical to the development of comprehensive reading skills (e.g., reading fluency and reading comprehension). Sight-word instruction, alone, is typically insufficient for developing fluent and skillful reading. However, learners with complex communication needs often require adaptations in order to participate and learn from such instruction (Browder et al., 2006; Coleman-Martin et al., 2005; Fallon et al., 2004; Heller et al., 2002; Light & McNaughton, 2009a, 2009b; Millar et al., 2004).

Despite the challenges involved in providing reading instruction to learners with complex communication needs, instruction that focuses on letter sounds rather than a whole-word approach is critical not only for developing independent reading skills, but also for providing a means of communication for those who may rely on AAC (Beukelman & Mirenda, 2005; Heller et al., 2002; Light & McNaughton, 2009b). In addition to developing skills for early reading achievement (Adams, 1990; Ball & Blachman, 1991), instruction in letter-sound correspondences can serve as a starting point for developing early spelling skills (Adams, 1990; Ball & Blachman, 1991). Once learners acquire letter-sound correspondences, they can then learn how to apply this knowledge to read and spell words, which can potentially serve as an effective means of

communication for individuals with complex communication needs (Beukelman & Mirenda, 2005; Heller et al., 2002; Light & McNaughton, 2009a). Literacy skills can provide individuals with a powerful form of communication as it allows individuals to create novel messages rather than relying on a pre-selected symbols or words (Beukelman & Mirenda, 2005; Heller et al., 2002; Light & McNaughton, 2009a).

Presently, limited research exists on reading instruction for learners with complex communication needs. Research conducted by Light and McNaughton (Fallon et al., 2004; Light & McNaughton, 2009a; Light, McNaughton, Weyer, & Karg, 2008; Millar et al., 2004) has led to the development of reading instruction (i.e., *Accessible Literacy Learning [ALL]*) that combines bottom-up and top-down instruction to teach literacy skills to learners with complex communication needs. Specifically, the intervention (a) includes instructional content recommended by the National Reading Panel (2000), (b) utilizes evidenced-based teaching practices (e.g., explicit and systematic instruction, instructional scaffolding, immediate and corrective feedback, cumulative review and practice, etc.) (Hughes & Archer, in press; Rosenshine & Stevens, 1986), and (c) provides adaptations for learners with complex communication needs that eliminate the need for oral responses during instruction (e.g., providing learners with alternative means for responding such as selecting target letters and words rather than producing oral responses) (Light & McNaughton, 2009a, 2009b).

Purpose of this Study

Given that knowledge of letter-sound correspondences is a strong predictor for early reading achievement (Adams, 1990; Ball & Blachman, 1991), it is important to provide all learners with the opportunity to acquire this knowledge. However, there is

limited research on teaching phonics skills to learners with ASD, particularly for teaching young learners with ASD and demonstrate complex communication needs. Light and McNaughton (2009a) have provided case-study evidence that learners with ASD and complex communication needs have benefited from receiving specially-adapted reading instruction, including instruction on letter-sound correspondences; however, additional research is needed for learning more about providing effective instruction and establishing evidence-based practices for this population of students.

The current study focused specifically on teaching letter-sound correspondences to young learners with ASD. The primary research question that guided this study was: What is the effect of adapted instruction on the acquisition and maintenance of letter-sound correspondence skills by young children with ASD and complex communication needs? In addition, this paper provides information on the participants' generalization of the letter-sound correspondences they acquired. Finally, this paper also presents information on the perceptions of early intervention professionals regarding the effectiveness and acceptability of the intervention.

CHAPTER 2

Review of Related Literature

In recent years, there has been an increased focus in investigating evidence-based practices for providing effective instruction for all students. The reauthorization of the Individuals with Disabilities Education Improvement Act (IDEA) in 2004 (U.S. Department of Education, 2006) required schools to provide students with disabilities access to the general education curriculum. As a result, more individuals with ASD are receiving educational services, including reading instruction, within general education classrooms (Dunlap et al., 2001; Goodman & Williams, 2007). With this greater inclusion has come an increased need for implementing evidence-based practices for teaching academic skills to learners with significant disabilities, including individuals with ASD and complex communication needs (Browder et al., 2006).

With respect to academics, educators often identify reading as the most critical skill taught in schools (Heller et al., 2002). Currently, there is much attention surrounding evidence-based practices for teaching reading; however, much of the research on effective reading instruction has focused on typically developing learners, at-risk learners, or learners with high-incidence disabilities (e.g., learning disabilities, emotional and behavioral disorders) with limited research focusing on students with low-incidence disabilities (e.g., autism, cerebral palsy, Down's Syndrome, moderate to severe intellectual deficits, etc.) (Browder et al., 2006; Copeland & Calhoon, 2007). Given the limited research, it is important to investigate the impact of instructional methods for effectively teaching learners with low-incidence disabilities how to read.

Although low-incidence disabilities include a wide range of disabilities, the focus of this paper is on young learners with ASD. Specifically, the purpose of this paper is to examine the impact of an intervention on the acquisition of letter-sound correspondences for young learners with ASD and complex communication needs as a first step toward decoding. The remainder of this chapter will first discuss a theoretical framework for reading, followed by a review of five areas of the current literature that are relevant to providing effective reading instruction to young learners with ASD and complex communication needs: (a) elements of effective instruction, (b) evidence-based reading instruction, (c) early reading instruction for young learners, (d) reading instruction for learners with ASD, and (e) reading instruction for learners with complex communication needs.

Theoretical Framework for the Reading Process

Reading is a complex process (Adams, 1990; Golinkoff, 1975-1976; National Reading Panel, 2000) comprised of a number of component skills (e.g., phonemic awareness, phonics, fluency, vocabulary, and comprehension) (Adams, 1990; National Reading Panel, 2000). Mastery of these skills depends on subsets of preskills, all of which are critical to the reading process. When trying to teach these skills effectively, it is important to first consider how these different skills work together and then to think about how to provide instruction that supports the relationships between these skills.

In describing the reading system, Adams (1990) presented a framework for the reading process (i.e., *Orthographic processor*, *Phonological processor, Meaning processor*, and *Context processor*) (see Figure 1).

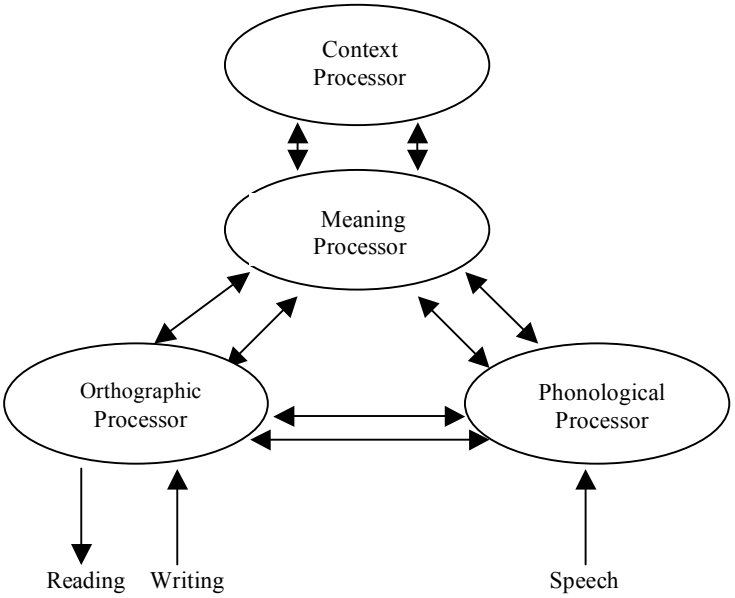

Figure 1. Modeling the reading system: Four processors (Adams, 1990, 2004)

As Adams (2004) noted, "The power of these models derives from the fact that they are neither top down nor bottom up in nature. Instead, all relevant processes…are simultaneously active and interactive…" (p. 1224). Therefore, all components are equally important to the reading system, each consisting of critical skills that work best when they interact and develop together. Adams (1990, 2004) added the term "processors" to highlight that each component is not a discrete area of reading, but that each component interacts to support the development of an effective reading system. The four processors in Adam's framework of reading include: (a) Orthographic processor, (b) Phonological processor, (c) Meaning processor, and (d) Context processor.

Orthographic processor. Within this framework, Adams described the *Orthographic processor* as the component of the reading system that focuses on the print that the reader encounters (Adams, 1990; 2004). In describing what skilled readers do, Adams reported that skilled readers process every letter they read. As learners repeatedly encounter letter combinations, they develop associations between adjacent letters and

learn common letter sequences. Therefore, as readers continue to encounter these sequences, the speed and accuracy in which they read words containing these letter patterns increases. As a starting point, Adams (1990) emphasized that readers must learn to identify letter-sound correspondences before beginning instruction on reading words; therefore, highlighting the importance of teaching learners about letters during the early stages of reading instruction.

Phonological processor. In addition to relying on the visual appearance of print, a skilled reader also depends on the *pronunciation* of print (Adams, 1990). As a reader processes text, the *Phonological processor* attaches pronunciation to the letter sequences. Adams (1990) described the interaction between the Phonological processor and the Orthographic processor as "running in both directions" (p. 157). In other words, the Orthographic processor "sends" the visual image of print to the Phonological processor, the Phonological processor attaches a pronunciation to this image, and "sends" it back to the Orthographic processor. Unlike the Orthographic processor, which receives information from print, the Phonological processor obtains information from speech (i.e., the more frequently a reader has connected a spelling pattern to a pronunciation, the more quickly the reader will process these patterns and recognize the word).

Meaning processor. By itself, the Orthographic processor receives information from print (Adams, 2004), but skillful reading does not rely solely on the appearance of words; it also depends on understanding the meaning of words (Adams, 1990). When readers process a familiar pattern of letters, the Meaning processor (if the meaning is known) is activated and attaches meaning to the word (Adams, 1990). It is important to note that the meaning processor does not necessarily have to attach meaning to an entire

word as one whole unit, but can attach meaning to letter combinations within syllables (e.g., prefixes, suffixes, root words) (Adams, 1990). When a reader attaches meaning to print (i.e., activating both the Orthographic processor and the Meaning processor) the speed in which a reader processes and recognizes a word increases.

Context processor. The *Context processor* works closely with both the Orthographic processor and the Meaning processor to facilitate word recognition and to ensure that accurate meanings are attached to the text (Adams, 1990). The interaction between the Orthographic processor and the Context processor can assist the reader in recognizing the word depending on the predictability of the context. For highly predictive contexts, the speed with which the reader processes the text is likely to increase, much like when a reader encounters familiar letter patterns. Similarly, highly predictive contexts also increase the speed with which the reader attaches meaning to the word, which further facilitates the reader's ability to recognize the appearance of the word and to comprehend its meaning. The Context processor also interacts with the Meaning processor by assisting the reader in attaching the correct meaning to a word. When considering the number of words that carry multiple meanings, it is often the context in which the word is used that allows the reader to accurately select the correct meaning (Adams, 1990). Therefore, the Context processor plays an important role both in increasing the reader's speed in recognizing text and in helping the reader attach accurate meaning to the text.

Adams emphasized that the Orthographic, Phonological, Meaning and Context processors are all connected and that all four interact simultaneously. Therefore, the speed and accuracy with which a reader recognizes words depends on the reader's

familiarity with (a) the letter sequences (i.e., Orthographic processor), (b) the pronunciation of the word (i.e., Phonological processor), (c) the meaning of the word (i.e., Meaning processor), and (d) the interpretation of the text surrounding the word (i.e., Context processor). The more information the reader can attach to the word, the more quickly the learner will recognize and comprehend the word, therefore, resulting in accurate and effortless reading (i.e., skillful reading) (Adams, 1990).

Based on this model of reading, it is critical to support the development and integration of these four processors through all stages of reading (i.e., from the beginning stage of learning to read to the advanced and skillful stage of reading). Furthermore, Adams (1990, 2004) emphasized that it is the interactive nature of the components within this model that supports learners in becoming skilled readers. In other words, reading should not be viewed as a system comprised of discrete components, but as a highly interactive process, and instructional methods should treat it as such.

Elements of Effective Instruction

Before focusing specifically on what effective reading instruction involves, it is important to first examine teaching techniques that have proven to be effective for students across a broad range of content areas and skills. A number of researchers have investigated the impact of specific teaching procedures on student achievement in order to determine which techniques resulted in the greatest gains in learning (Brophy & Good, 1986; Hughes & Archer, in press; Rosenshine & Stevens, 1986; Swanson, 1999; Vaughn, Gersten, & Chard, 2000). Based on their findings, effective instruction encompasses a number of elements including (a) providing explicit instruction (b) providing systematic instruction (i.e., sequencing skills logically), (c) providing immediate and corrective

feedback; and (d) providing cumulative practice and review (Brophy & Good, 1986; Carnine, Silbert, Kame'enui, Tarver, & Junjohann, 2006; Hughes & Archer, in press; Rosenshine & Stevens, 1986). This section will provide an overview of these elements of effective instruction. A more detailed description linking each of these principles to reading instruction will follow under the subsequent section, *Evidence-Based Reading Instruction*.

Providing explicit instruction. Explicit instruction is a clear and direct approach for presenting information to the learner (Carnine et al., 2006; Hughes & Archer, in press; Rosenshine & Stevens, 1986). After reviewing the research in a number of studies, Rosenshine and Stevens (1986) found that effective teachers provide (a) teacher demonstrations and (b) instructional scaffolding. Teacher demonstrations involve the teacher performing the target skill (i.e., modeling) so that the learner has the opportunity to observe how to complete the task. While demonstrating the task, the teacher uses clear, concise, and consistent language to explicitly explain the process to the student (Hughes & Archer, in press).

Instructional scaffolding provides learners with the opportunity to practice a target skill while receiving necessary support to maintain high rates of success (Hughes & Archer, in press). For example, after modeling the target skill, the teacher may present practice that requires the learner to complete part of the task while also providing the learner with verbal prompting and/or reminders for the remainder of the task. The teacher will gradually fade this support until the learner can successfully complete the task independently. Researchers investigating effective instruction have consistently reported that providing models ("I do"), guided practice ("we do"), and independent

practice ("you do") during instruction increases students' independence and success when learning new skills (Hughes & Archer, in press; Rosenshine & Stevens, 1986).

Providing systematic instruction. Systematic instruction involves careful analysis of the targeted instructional skill, and as necessary, the identification of important components (i.e., subskills) of the targeted skill (Carnine et al., 2006). Instruction in these skills and subskills is then provided in a logical and organized sequence. Additionally, systematic instruction typically involves teaching one new skill at a time and waiting to introduce the next skill until the learner reaches the set criterion for the targeted skill (Carnine et al., 2006). Limiting the amount of new information presented at one time decreases the complexity of the task by making the information more manageable to learn (Carnine et al., 2006; Hughes & Archer, in press). Therefore, systematic instruction can serve as an instructional technique for scaffolding content (e.g., as learners master new information the teacher can introduce the next skill) (Brophy & Good, 1986; Hughes & Archer, in press; Swanson, 1999). General sequencing guidelines for instruction include (a) teaching preskills first; (b) teaching easy skills before more difficult skills; and (c) separating information that is likely to be confused if introduced together (Brophy & Good, 1986; Carnine et al., 2006; Hughes & Archer, in press; Swanson, 1999).

When sequencing a lesson, researchers have found that a number of components resulted in an effective lesson including (a) reviewing previously learned skills relevant to the target task, (b) explicitly introducing the new skill by stating the lesson's goals and relevance (i.e., why it is important to learn), (c) modeling the target skill, (d) providing guided practice, and (e) providing independent practice (Brophy & Good, 1986; Hughes

& Archer, in press; Rosenshine, 1997; Rosenshine & Stevens, 1986). When teachers present organized and carefully sequenced lessons, they facilitate efficient learning by making explicit connections between prior knowledge and new information (Hughes & Archer; in press; Rosenshine, 1997).

Providing immediate and corrective feedback. When teachers provide immediate and corrective feedback, they promote high rates of success for their students; thereby reducing the likelihood of students making and practicing errors (Brophy & Good, 1986; Hughes & Archer, in press; Rosenshine & Stevens, 1986). Additionally, providing students with feedback requires teachers to closely monitor students' performance, which not only allows teachers to immediately correct errors, but also helps teachers provide appropriate instruction (e.g., reteaching skills when necessary) (Heward, 2003; Rosenshine & Stevens, 1986; Swanson, 1999).

When examining the relationship between teacher behavior and student achievement, Brophy and Good (1986) found that students learn more efficiently when teachers monitor students' performance and provide corrective feedback. Corrective feedback should include (a) immediately affirming a correct response (e.g., *"You are right! This letter says 'mmmm,'"*) or correcting an incorrect response by modeling and emphasizing the correct response (e.g., *"This letter says 'mmmm,'")* and (b) providing modeling, guided practice, and independent practice procedures (Carnine et al., 2006). When teachers incorporate modeling, guided practice, and independent practice as part of the correction procedures, they provide the learner with (a) a demonstration of the correct response, (b) assistance in providing the correct response, and (c) an opportunity to provide the correct response independently to ensure that the error has been corrected.

Providing cumulative review and practice. Finally, researchers have found that providing cumulative review and practice that is distributed over time is critical for student success (Brophy & Good, 1986; Hughes & Archer, in press; Rosenshine & Stevens, 1986; Swanson, 1999). After reviewing 180 intervention studies, Swanson (1999) found that providing many practice opportunities minimized the classroom performance difficulties for students with learning disabilities. Distributed and cumulative practice includes reviewing newly learned and previously learned information on a regular basis, which helps learners to retain information, as well as to develop connections between newly learned and previously learned information (Carnine et al., 2010). In addition to retaining information, cumulative practice also assists the learner in (a) generalizing target skills, (b) discriminating when to apply the target skill, and (c) achieving mastery and automaticity of the target skills (Hughes & Archer, in press; Rosenshine & Stevens, 1986).

Evidence-Based Reading Instruction

When examining evidence-based reading instruction, researchers have used elements of effective instruction to investigate effective procedures for teaching individuals how to read. In 1997, the National Reading Panel (2000) was created to conduct the largest evidence-based review to determine the most effective methods for teaching children how to read. After reviewing the existing research, the National Reading Panel (2000) identified three critical areas of reading that should be addressed during reading instruction: (a) *alphabetics*, which includes *phonemic awareness* (understanding that words are made up of individual sounds) and *phonics* (applying letter-sound correspondences and blending these sounds to decode words); (b) *fluency*

(reading text effortlessly and accurately), and (c) *comprehension* (deriving meaning from text), which includes *vocabulary* (understanding the meaning of individual words) and *text comprehension* (understanding the meaning of connected text). Based on these findings, the National Reading Panel provided instructional recommendations for supporting the development of the following reading skills: (a) phonemic awareness, (b) phonics, (c) fluency, (d) vocabulary, and (e) comprehension. Like the research on effective teaching practices, the National Reading Panel found that providing explicit and systematic instruction, combined with instructional scaffolding, teacher feedback, and repeated opportunities for practice, resulted in improved reading performance.

Explicit reading instruction. When looking specifically at explicit instruction in reading, many researchers agree that providing explicit instruction for teaching reading skills, particularly for teaching phonemic awareness and phonics, produces positive student outcomes (Adams, 1990; Ball & Blachman, 1991; National Reading Panel, 2000), and that such instruction can have a powerful impact on learners with disabilities (Denton, Vaughn, & Fletcher, 2003; National Reading Panel, 2000; Torgesen, Alexander, Wagner, Rashotte, Voeller, & Conway, 2001; Torgesen & Davis, 1996). The National Reading Panel (2000) concluded that explicitly teaching students that words are made up of sounds (i.e., phonemic awareness) and that sounds are represented by letters (i.e., knowledge of letter-sound correspondences) produced significant gains in students' reading skills.

Systematic reading instruction. The National Reading Panel (2000) reported that that systematic instruction also plays an important part in effectively teaching students how read. Systematic reading instruction involves lessons that include a planned

and logical sequence of skills (Carnine et al., 2010). The National Reading Panel emphasized the importance of systematic instruction throughout its report for all areas of reading, including for providing effective phonics interventions. According to the National Reading Panel, powerful phonics programs (i.e., programs that produced the greatest learning gains in letter-sound correspondence knowledge and decoding skills) included explicit *and* systematic instruction, a finding that is consistent among many researchers (Adams, 1990; Bond & Dykstra, 1967; Carnine, et al., 2010; Carnine et al., 2006; Chall, 1967; Chard, & Kame'enui, 2000). When providing an organized and logical sequence of instruction for teaching letter-sound correspondences, for example, Carnine and colleagues (2010) recommended that it is important to carefully select the sequence that will be introduced by considering the following guidelines: (a) separating visually and/or auditorily similar letters; (b) introducing uppercase letters that do not have the same appearance as their respective lowercase letters after most lowercase letters have been introduced; and (c) introducing more useful letters before less useful letters (pp. 63-64).

Immediate and corrective feedback in reading. As discussed previously, providing immediate and corrective feedback enhances students' learning and success (Brophy & Good, 1986; Heubusch & Lloyd, 1998; Hughes & Archer, in press; Rosenshine & Stevens, 1986). Providing immediate and corrective feedback prevents learners from practicing errors because they instantly learn whether their response is correct; thereby, reducing the likelihood that students will make the same error in the future (Brophy & Good, 1986; Hughes & Archer, in press; Rosenshine & Stevens, 1986). When considering how the components within the reading system rely on each other,

preventing a breakdown within a component is critical in supporting the system to work properly. For example, skillful reading depends on accurate word recognition; therefore, if an error is made while decoding a word, this can ultimately interfere with reading comprehension (Heubusch & Lloyd, 1998). Similarly, if a reader hesitates or struggles with recognizing a word, this interrupts reading fluency, which can also impede reading comprehension. Therefore, providing corrective feedback in reading is essential for supporting reading accuracy, which is necessary for proficient and skillful reading.

Cumulative review and practice in reading. Cumulative review and practice supports retention and automaticity for the target skills learned (Hughes & Archer, in press; Rosenshine & Stevens, 1986). Automaticity is critical for achieving reading fluency; therefore, providing opportunities for practice is critical for skillful reading. As Adams (1990) pointed out when describing the Orthographic processor, as readers continue to encounter letter sequences, the speed and accuracy in which they read words containing these letter combinations increases (Adams, 1990, 2004), which facilitates reading fluency and ultimately, reading comprehension. In order to support the Orthographic processor Adams (1990) recommended that "children should read lots and often," (p. 135); therefore, emphasizing the importance of continuous review and practice within the reading process.

Evidence-Based Practices for Teaching Early Reading Skills

When developing early reading skills for young children prior to entering school (i.e., 3 to 5 years of age), researchers have reported that there are "pre-reading" skills (i.e., emergent literacy skills) that precede conventional reading (Sulzby, 1994). Some of these skills include vocabulary knowledge, listening comprehension skills, understanding

of story structure, and concepts about print (Roth & Baden, 2001; Yaden, et al., 2000). Informal literacy experiences (e.g., reading stories during circle time, labeling items in the classroom, using words on the child's schedule) are often incorporated into young children's daily routines to help develop these early reading skills (Ehri & Roberts, 2006). Although these experiences are important in supporting young learners' early reading skills as well as in developing an appreciation of text and literacy-related activities (Adams, 1990; Ehri & Roberts, 2006), researchers have reported that formal instruction is necessary to ensure the acquisition of the skills that are critical to early reading achievement (Adams, 1990; Chall, 1967, 1989, 1996a, 1996b; Ehri & Roberts, 2006; Vellutino, 1991).

As described previously, researchers have consistently reported that knowledge of phonics is an important skill for reading achievement in the early grades (Adams, 1990; Bond & Dykstra, 1967; Chall, 1967; Tunmer, Herriman, & Nesdale, 1988). When readers learn about the sounds that letters make, this assists them in "breaking the code" by applying sounds to the corresponding letters and blending these sounds to read words. Therefore, children's early reading development relies heavily on knowledge of letter-sound correspondences (Chard & Osborn, 1999).

Researchers have consistently reported that explicit, systematic phonics has proven to be successful for teaching young learners how to read (Adams, 1990; Bateman, 1979; Wallach & Wallach, 1979; Williams, 1979). In fact, in its review on reading instruction, the National Reading Panel (2000) reported that systematic and synthetic phonics (explicitly teaching learners to convert letters into sounds and to blend sounds to read words) is more effective than other phonics programs or no phonics instruction at

all. Furthermore, the National Reading Panel found that providing synthetic phonics resulted in greater learning when presented in early school years and was especially effective for younger learners considered at-risk for reading difficulties as well as for learners with disabilities. This finding is consistent with other researchers who also have reported that children with disabilities (including young children) benefit from systematic and explicit instruction on letter-sound correspondences (Carnine, et al., 2010; Carnine et al., 2006; Chard, Simmons, & Kame'enui, 1998); therefore, providing evidence that early reading instruction on letter-sound correspondences and sound blending appear to be critical for supporting early reading achievement.

In addition to letter knowledge, phonemic awareness is another strong predictor of reading achievement in early grades (Adams, 1990; Ball & Blachman, 1991; National Early Literacy Panel, 2004; Share, Jorm, Maclea, & Matthews, 1984). Interestingly, researchers have found that instruction on phonemic awareness is even more effective when explicitly demonstrating the connections between phonemes and letters (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Ehri & McCormick, 1998; Hatcher, et al., 1994; Oudeans, 2004), again, demonstrating the importance of teaching the relationship between letters and their corresponding sounds.

Reading Instruction for Learners with Autism Spectrum Disorders

The majority of the reading research has examined the impact of instruction on typically developing learners, at-risk learners, or learners with high-incidence disabilities (e.g., learning disabilities, emotional and behavioral disorders) (Browder et al., 2006). However, individuals with significant disabilities (e.g., autism, cerebral palsy, Down's Syndrome, moderate to severe intellectual deficits, etc.) also require instruction in

phonemic awareness, letter-sound correspondences, and decoding in order to develop conventional reading skills (Browder, et al.; Coleman-Martin et al., 2005; Conners, 1992; Fallon, et al., 2004; Flores, et al., 2004; Light & McNaughton, 2009a; Millar et al., 2004). Individuals who develop effective literacy skills gain access to new opportunities in school (Nation & Norbury, 2005; Slavin et al., 1989), recreational activities (Wahlberg & Magliano, 2004), and the workplace (Fossett & Mirenda, 2006; Slavin et al., 1989). Therefore, providing effective reading instruction for all learners, including learners with ASD, is essential for their participation in academic settings as well as for their independence and success beyond school.

Much of the research on reading instruction for children with ASD has focused on sight-word reading instruction (Benedek-Wood & McNaughton, 2009; Browder, et al., 2006; Koppenhaver & Erickson, 2009). Although sight-word reading plays an important role in the reading process, as it is often required for reading irregular words where knowledge of letter-sound correspondences cannot be applied (Carnine et al., 2010), it is important to consider that many English words follow patterns that can be taught by applying phonics rules (Hanna, Hanna, Hodges, & Rudorf, 1966); therefore, phonics remains to be a critical skill for readers to learn.

When examining "what skilled readers do", researchers have found that these individuals (a) process every letter as they read (Adams, 1990; Adams, 2004; DeZuniga, Humphreys, & Evett, 1991), (b) develop connections between recurring letter patterns and their corresponding sounds (Ehri & McCormick, 1998), and recognize word patterns and/or whole words by sight after decoding several times (Adams, 1990; Ehri, 1995). This information suggests that learning how to decode words (i.e., applying letter-sound

correspondence knowledge and blending the sounds to read words) appears to be a critical component for developing fluent reading skills (Carnine et al., 2010; Ehri, 1992, 1995; Ehri & McCormick, 1998). Therefore, as Ehri (1992) noted, sight word reading is actually a process of reading words that one develops after practice in reading, rather than a specific method for teaching individuals how to read words.

It is important to keep in mind that reading comprehension, the ability to extract meaning from connected text (Gibson & Levin, 1975), is the ultimate goal of reading (Bursuck & Damer, 2007; Carnine, et al., 2010; Durkin, 1978-1979; Gibson & Levin). In order to "extract" information from connected text, the reader must be able to efficiently decode and attach meaning to the printed word. When learners receive reading instruction that focuses on memorizing whole words rather than learning a generalizeable decoding strategy, they are often limited to reading only those words targeted during instruction because they may not have the skills necessary to decode new and unfamiliar words (Adams, 1990; Carnine et al. 2010; Chall, 1989). If a reader cannot proficiently decode untaught words while reading text, this can reduce the individual's reading fluency and impede reading comprehension (Adams, 1990; Carnine et al.; Chall, 1989; Gough & Tunmer, 1986; Hoover & Gough, 1990). In other words, when a reader struggles with decoding a word (i.e., orthorgraphic processing), a reader is focusing so much on recognizing the orthography of the word that the other processors (i.e., phonological, meaning, and context) are less likely to be activated and meaning of the text is often lost.

Two research studies investigated the impact of explicit instruction on the decoding skills for learners with moderate to severe disabilities; each study included one

learner with autism (Coleman-Martin et al., 2005; Flores et al., 2004). The researchers in both studies measured students' accuracy in demonstrating targeted reading skills. Coleman-Martin et al. used one-to-one instruction to teach learners without functional speech how to decode single words. In this study, the researchers made use of an innovative approach to support the participation of students who experienced difficulty with speech during single-word decoding tasks (Coleman-Martin, et al., 2005). After presenting the target word to the learner, the teacher instructed the learner to say the following in "his/her head": (a) state the sound of each individual letter slowly, (b) state the consonant-vowel-consonant (CVC) word slowly by extending each individual sound, and (c) state the CVC word at a normal rate. The instructor then presented four word choices orally and asked the learner to identify the target word by indicating "yes" using an AAC device or gestures (Coleman-Martin et al., 2005). In the second study, Flores and colleagues (2004) implemented small-group instruction for learners who did not demonstrate knowledge of letter-sound correspondences, but who demonstrated functional speech. In this study, the researchers investigated the impact of using direct instruction for teaching four letter-sound correspondences to students with moderate disabilities.

In both studies, the authors found that the learners with autism demonstrated improvement in the targeted reading skills (Coleman-Martin et al., 2005; Flores et al., 2004). Flores and colleagues found that the one learner with autism included in their study demonstrated gains in letter-sound correspondence as well as in reading familiar CVC words. Coleman-Martin et al. reported that during baseline a learner with autism read 15 target words (three sets of five words) with 0 to 20% accuracy, but after receiving

decoding instruction for 1 to 3 sessions, the learner with autism read the target words with at least 80% accuracy. It is important to note that because the participants did not demonstrate generalization of the targeted reading strategy for reading untaught words, it is difficult to conclude that the learner with autism "decoded" the words rather than recognized the words by sight. However, the critical point that should be emphasized is that Coleman-Martin and colleagues (2005) provided instruction on applying and blending letter-sound correspondences to teach decoding skills to individuals with complex communication needs and that the participant with autism demonstrated an improvement in reading the targeted words after receiving the intervention.

Providing learners with instruction that focuses on identifying letter-sound correspondences teaches a generalizeable strategy that allows learners to read a wide range of words (Adams, 1990; Bursuck & Damer, 2007; Carnine et al., 2010). Presently, two intervention research studies focusing on teaching phonics skills included participants with ASD (for a total of two participants across two studies) (Coleman-Martin et al., 2005; Flores et al., 2004). Although these studies provide some initial evidence that instruction on letter-sound correspondences and single-word decoding can have a positive impact for learners with ASD, it is important to conduct more research for this population of students, including for individuals with ASD and complex communication needs.

Learners with ASD typically demonstrate (a) deficits in communication skills, (b) deficits in social skills, and (c) restricted and repetitive patterns of behaviors and interests (American Psychiatric Association, 2000). These characteristics can negatively impact the acquisition of reading skills for learners with ASD. In general, learners with speech

and language impairments are considered at-risk for developing reading disabilities and for experiencing reading difficulties and continue to remain at-risk even as they grow older (Bishop & Snowling, 2004; Fey et al., 1995; Nation & Norbury, 2005; Scarborough, 2005). Speech and language impairments may lead to difficulties in producing and/or comprehending language, which can impede a learner's ability not only in producing speech, but also in comprehending both oral and written language (e.g., comprehending oral directions, comprehending a story read aloud, independently reading and comprehending text, etc.). These difficulties are likely to have serious implications not only in learning how to read, but also in participating in reading activities. Given that the majority of learners with ASD demonstrate language delays (Kjelgaard & Tager-Flusberg, 2001; Leekam, 2007; Tager-Flusberg & Joseph, 2003) and that as many as 50% of learners with autism reportedly never develop functional speech (Lord & Paul, 1997; Mesibov, et al., 1997), this population of students is clearly at-risk for experiencing reading difficulties.

The limited language experiences of many children with ASD have serious implications for the development of literacy skills, and perhaps, has played a significant part in why children with ASD, particularly those with complex communication needs, are often excluded from the literacy activities that take place in the general education classroom (Kluth & Darmody-Latham, 2003). Children without disabilities acquire literacy skills through participation in a mixture of informal language experiences and structured reading activities (Adams, 1990); however, children with ASD, often have very different early experiences with language and reading (Kluth & Chandler-Olcott, 2008; Leekam, 2007; Mirenda, 2003) and many children with ASD are often at-risk for

developing reading difficulties (Nation & Norbury, 2005; Nation et al., 2006). Additionally, deficits in language skills can create challenges for providing reading instruction and for assessing the reading skills of students with ASD.

When evaluating the reading skills of learners with ASD, there has been evidence reported by researchers indicating that some individuals with ASD demonstrate unexpectedly strong decoding skills (Calhoon, 2001; Frith, 2003; Lord & Paul, 1997; Minshew, Goldstein, Taylor, & Siegel, 1994; Nation, et al., 2006; Tager-Flusberg et al., 2005). However, as noted by Nation and colleagues (2006), many of these studies included individuals who were considered as having "high functioning autism" and/or Asperger syndrome. In other words, the participants included in these studies did not demonstrate severe deficits in oral language, and based on the information provided, none of the participants demonstrated complex communication needs. Therefore, although these studies provide promising evidence that learners with ASD can benefit from decoding instruction, given the impact of oral language skills on reading acquisition (Bishop & Snowling, 2004; Fey, et al., 1995; Nation & Norbury, 2005; Scarborough, 2005), more research is needed on teaching early decoding skills to learners with ASD and complex communication needs.

Given that knowledge of letter-sound correspondences and phonological awareness are strong predictors for early reading achievement (Adams, 1990; Ball & Blachman, 1991; Tunmer et al., 1988) and that explicit and systematic instruction in phonics and phonemic awareness has consistently proven to be successful for teaching young learners how to read (Adams, 1990; Ball & Blachman, 1991; Bateman, 1979; National Reading Panel, 2000; Wallach & Wallach, 1979; Williams, 1979) it is important

to learn more about providing such instruction for this population of students. Furthermore, learning more about supporting the participation and the development of literacy skills for young children with ASD and complex communication needs is critical for effectively teaching these learners how to read as well as increasing their success in the classroom.

Reading Instruction for Learners with Complex Communication Needs

As discussed previously, learners with complex communication needs are at risk for experiencing reading difficulties. Many individuals with complex communication needs do not develop functional reading skills (Berninger & Gans, 1986; Foley, 1993; Foley & Pollatsek, 1999; Kelford Smith et al., 1989) and even fewer individuals with complex communication needs become skilled readers and writers (Koppenhaver & Yoder, 1992). Individuals with complex communication needs often lack literacy skills as a result of limited opportunities for participating in evidence-based literacy activities (Light & Kelford Smith, 1993; Light & McNaughton, 1993; Pierce & McWilliam, 1993).

Although the National Reading Panel (2000) recommends providing explicit instruction on phonemic awareness and phonics in order to develop independent decoding skills, much like the research on reading instruction for learners with ASD, limited research has focused on teaching phonics skills to learners with complex communication needs (Browder et al., 2006; Coleman-Martin et al., 2005; Heller et al., 2002). Researchers have noted that the lack of attention placed on phonics-based instruction for this population of students may result from the assumption (and misconception) that learners with moderate to severe disabilities who have complex communication needs cannot acquire a full range of reading skills (Browder et al., 2006;

Copeland & Calhoon, 2007). However, researchers have found that, with appropriate instruction, individuals with moderate and severe disabilities, including individuals with complex communication needs, can benefit from phonics instruction (Blischak, Shah, Lombardino, & Chiarella, 2004; Coleman-Martin et al., 2005; Connors, 1992; Flores et al., 2004; Light & McNaughton, 2009a; Nietupski, et al., 1979).

One factor that often limits the participation of learners with complex communication needs is the structure of typical reading programs, which often requires an oral and/or written response during instruction and assessment (Light & McNaughton, 2009a; 2009b). Because learners with complex communication needs typically demonstrate limited or no natural speech, they often experience difficulty participating in many of the reading programs frequently used in classrooms (Foley, 1993; Light & Kelford Smith, 1993). It is often necessary to provide adaptations for learners with complex communication needs in order to increase their participation during instructional tasks and to maximize their learning (Browder et al., 2006; Blischak et al., 2004; Coleman-Martin et al., 2005; Fallon et al., 2004; Light & McNaughton, 2009a, 2009b; Millar et al., 2004).

In one study, Blischak et al. (2004) provided adapted instruction to teach 10 letter-sound correspondences to learners with complex communication needs between the ages of 5 to 7-years-old. In this study, the researchers presented a speech sound orally to the participants. The participants were then asked to select the corresponding letter from a field of 10 letters. Next, the researchers provided corrective feedback for the participant's response. If the participant was incorrect, the researchers used a least-to-most hierarchy of prompts. First, the researcher repeated the target sound. If the

participant provided another incorrect response, the researcher then named the letter and its corresponding sound (e.g., "*T* says the sound /t/."). Finally, if the participant still provided an incorrect response, the researcher then modeled the correct response. Blischak and colleagues (2004) found that 2 of the 3 children acquired all 10 target letter-sound correspondences, but that one participant (who was 5-years-old) did not.

Research conducted by Light, McNaughton, and colleagues (Fallon et al., 2004; Light & McNaughton, 2009a; Light et al., 2008; Millar et al., 2004) has led to the development of the ALL Curriculum, a curricular approach that combines bottom-up and top-down instruction to teach literacy skills to learners with complex communication needs. The ALL curriculum includes (a) instructional content recommended by the National Reading Panel (2000), (b) evidence-based teaching practices, and (c) adaptations for learners with complex communication needs that eliminate the need for an oral response (e.g., providing learners with an alternative means for responding, such as selecting, rather than orally stating, a target letter or word) (Light & McNaughton, 2009a, 2009b). Light and McNaughton have found that providing evidence-based reading instruction that is adapted for learners with complex communication needs has resulted in significant gains in conventional reading skills (Fallon et al., 2004; Light & McNaughton, 2009a; Light, et al., 2008; Millar, et al., 2004).

In two studies conducted by Light, McNaughton, and colleagues (Fallon et al., 2004; Millar et al., 2004), the researchers provided direct instruction to teach letter-sound correspondences to learners with complex communication needs. Both studies included systematic instruction on the target letter-sound correspondences (i.e., a new letter-sound correspondence was not introduced until the participant demonstrated acquisition for the

previous letter-sound correspondence). During instruction, the researchers adapted the tasks so that the participants did not need to produce an oral response (e.g., the researcher stated the sound and asked the learner to select the target letter from a field of options). Additionally, the researchers provided explicit instruction with instructional scaffolding (i.e., model, guided practice, and independent practice) and provided a cumulative review of previously learned letter-sound correspondences.

Fallon et al. (2004) included five participants with complex communication needs, ranging in age from 9 to 14-years-old, and who had some knowledge of letter sounds. After receiving instruction on 14 letter-sound correspondences the five participants demonstrated 100% accuracy for all of the 14 letter-sound correspondences. The five students then received additional instruction to support the use of applying these letter-sound correspondence skills in decoding tasks. The authors found that all five participants reached criterion for decoding target words and that 3 of the 5 participants generalized reading skills by decoding new words that were not included in instruction, but that contained the targeted letter-sound correspondences.

In another study, Millar et al. (2004) provided direct instruction on early reading skills to three participants with complex communication needs, ranging in age from 7 to 10-years-old. The intervention included direct instruction on identifying five letter-sound correspondences and identifying the initial letter of targeted words. The participants selected target letters from a field of 31 letters on an adaptive keyboard during instructional tasks, and selected the target letter from a field of 4 letters during the probe tasks. Two of the participants reached criterion (at least 80% accuracy for two consecutive sessions) for (a) identifying the five target letter-sound correspondences and

(b) selecting the initial letter of a target word. After reaching criterion for these tasks, the two participants applied this knowledge in a writing activity by selecting the initial letter for a target word within the context of a story writing activity.

Both of these studies (Fallon et al., 2004; Millar et al., 2004) as well as additional research conducted by Light, McNaughton and colleagues (Light & McNaughton, 2009a; Light et al., 2008) suggest that implementing evidence-based instructional practices combined with adaptations can increase the acquisition of early reading skills for learners with complex communication needs. Providing adaptations that eliminate the need for an oral or written response allows learners with complex communication needs to participate in evidence-based literacy instruction and provides the opportunity for these individuals to learn reading strategies that promote skillful reading. Additionally, providing adaptations also assists teachers in effectively assessing students' performance, which can help teachers in providing more effective and individualized instruction for students with complex communication needs.

Summary

Although a number of researchers have investigated the impact of reading instruction on learners with ASD, limited research has focused on teaching phonics skills for this population of students (Benedek-Wood & McNaughton, 2009; Browder, et al., 2006; Koppenhaver & Erickson, 2009). Given that the ultimate goal of reading is to independently read and extract meaning from connected text (Bursuck & Damer, 2007; Carnine et al., 2010; Durkin, 1978-1979; Gibson & Levin, 1975), teaching generalizeable reading strategies (e.g., identifying letter-sound correspondences and blending letter-sound correspondences to read words) that can translate to reading a wider range of

words and texts is critical for supporting this goal (Adams, 1990; Bursuck & Damer, 2007; Carnine et al., 2010). In addition to supporting early reading achievement, learning letter-sound correspondences is also an important first step in the development of spelling and writing skills, which are especially important for individuals with complex communication needs, who may make use of these literacy skills as part of their AAC system.

Given the increase in the number of students with ASD included in general education classrooms (Dunlap et al., 2001; Goodman & Williams, 2007) and the limited amount of research that focuses on teaching phonics skills to individuals with ASD and complex communication needs (Benedek-Wood & McNaughton, 2009; Browder, et al., 2006; Koppenhaver & Erickson, 2009), investigating instruction on letter-sound correspondences for this population of learners appears to be an important next step in the research. The purpose of this study was to investigate the impact of adapted instruction on the acquisition of letter-sound correspondences by young learners with ASD and complex communication needs. Specifically, the primary research question that guided this research study was: What is the effect of adapted instruction on the acquisition and maintenance of letter-sound correspondence skills by young children with ASD and complex communication needs? In addition, this paper provides information on the participants' generalization of the letter-sound correspondences they acquired. Finally, this paper also presents information on the perceptions of early intervention professionals regarding the effectiveness and acceptability of the intervention.

CHAPTER 3

Method

The purpose of this study was to investigate the impact of instruction on the letter-sound correspondence skills of children with ASD and complex communication needs. Three young children, between the ages of 3 and 5, with ASD and complex communication needs participated in this study.

Participants

Participants were recruited from preschools in central Pennsylvania. As the first step in this process, the researcher contacted preschool directors in central Pennsylvania to determine whether the directors had students in their program who were eligible to participate in this study, and whether the directors were interested in the participation of their program. After receiving approval from the Institutional Review Board at the Pennsylvania State University (see Appendix A) and approval from the preschool's Board of Directors, the researcher recruited participants for this study from a preschool in central Pennsylvania that provided services for children with ASD.

The researcher requested nominations from teachers for children diagnosed with ASD and complex communication needs who might benefit from instruction on letter-sound correspondences. After obtaining parental permission for the nominated students (see Appendix B) participants who met the following selection criteria were included in this study: (a) had a diagnosis of ASD (determined by a formal diagnosis as stated in the child's current evaluation report), (b) were at least 3 years of age, (c) demonstrated speech skills that did not meet daily communication needs as reported by the teacher on

the Communication and Language Skills Questionnaire[1] (see Appendix C), (d) followed one-step directions as reported by the teacher in a Communication and Language Screener Questionnaire (see Appendix C), (e) demonstrated an interest in books and/or letters as reported by the teacher in an experimenter-created Preferred Activities and Interests Questionnaire (see Appendix D), (f) could sit and attend to preferred activities for at least 15 minutes, (g) selected target pictures from a field of at least four choices as determined by a Selection Task Screening Assessment (see Appendix E), (h) lived in homes in which English was the first language, and (i) demonstrated vision and hearing skills within normal limits as reported in the child's current Individual Education Plan and as reported by the student's teacher. As a final step in the selection process, the researcher assessed the potential participants' knowledge on 26 of the most common letter-sound correspondences (see Appendix F) by administering the Letter-Sound Correspondence Screening Assessment (see Appendix G for an excerpt from the script for assessing letter-sound correspondences). Before administering the Letter-Sound Correspondence Screening Assessment, the researcher had determined from the Selection Task Screening Assessment that the potential participants could manage the task using a field size of 6 cards. During Letter-Sound Correspondence Screening Assessment, the researcher stated the sound for a letter (e.g., *"sssss"*) and asked the participant to touch the letter that made that sound from a field of six printed letters. Participants who

[1] The questions and format presented in the Communication and Language Skills Questionnaire were adapted from a questionnaire created by Autism Matters (2007) (website: http://www.autismmatters.net/). The content of the questionnaire addressed four areas of expressive communication identified by Light (1997). Please see complete citations for both sources under *References*.

identified fewer than 10 of the most common letter sounds (see Appendix F) were eligible for participation in the study.

Three participants diagnosed with ASD met all of the selection criteria described previously and participated in this study. The three participants were from rural areas in central Pennsylvania and attended a preschool program that specialized in providing early intervention services to children with an ASD or a developmental delay. In order to protect the confidentiality of each participant, pseudonyms have been used for all participants. See Table 1 for the demographic information for each participant.

Table 1

Demographic Information of Participants

Participant	Age (year; month)	Gender	Disability	Communication Modes
Cameron	3; 6	M	ASD	Gestures, signs, line drawings, vocalizations, AAC device[a]
Zach	5; 6	M	ASD	Gestures, line drawings, natural speech
Cole	4; 11	M	ASD	Gestures, line drawings, vocalizations natural speech

[a]Detailed information of AAC device provided in the description of participants.

After identifying the participants in this study the researcher conducted two additional screening assessments in order to gather more information about the participants' current reading skills: (a) a Sound Blending Probe and (b) a Single-Word

Decoding Probe. For the Sound Blending Probe, the researcher presented a word with all of the sounds extended (e.g., *"mmmmoooommmm"*) and asked the participants to select a picture of the word (e.g., a line drawing representing the word *mom*) from a field of six pictures. The probe contained 10 trials and the chance level for selecting the correct response was 1 out of 6 (17%). For the Single-Word Decoding probe, the researcher presented the participants with a printed word (e.g., *cat*) and asked the participants to point to the picture of the word (e.g., a line drawing of representing the word *cat*) from a field of six pictures. The Single-Word Decoding Probe also contained 10 trials and the chance level for selecting the correct response was 1 out of 6 (17%). See Table 2 for the performance scores of participants for all three reading probes prior to the intervention. A more detailed description of each participant and of each assessment will follow.

Table 2

Reading Performance of Participants Prior to Intervention

Participant	Letter-Sound Correspondences[a]	Sound Blending[b]	Single-Word Decoding[b]
Cameron	3	6	1
Zach	5	4	1
Cole	7	5	1

[a] Scores reflect performance from a total possible score of 26. [b] Scores reflect performance from a total possible score of 10.

Cameron. Cameron was 3 years, 6 months old at the beginning of this study. He received a diagnosis of ASD when he was 2 years, 4 months old. Cameron attended an early intervention program for children ages 3 to 4-years-old for 5 hours per day, 4 days per week. Cameron enjoyed singing songs, playing educational games on the computer,

coloring pictures, and looking at books that included pictures of animals. When an adult would sing "If You're Happy and You Know It," he would smile and laugh and participate in the motions that corresponded with the song. When playing educational games on the computer he appeared to enjoy listening to the characters on the program and would often participate in the tasks (e.g., "Select the color blue"). When provided with the opportunity to choose a preferred activity, Cameron would often select coloring and appeared to enjoy coloring books that included characters from Sesame Street and Walt Disney. Cameron also seemed to enjoy looking at books that included pictures of animals. He especially liked pop-up books and books that had moveable pictures.

Cameron's teacher reported that, at the time the study began, Cameron would typically participate in group activities such as circle time and preferred small group activities (e.g., sensory, art, computer) for approximately 4 minutes independently and approximately 15 minutes with some assistance from an adult. Cameron's teacher also reported that he would transition between classroom activities using a visual schedule; make choices of preferred activities and items using pictures (e.g., photographs and line drawings), match and sort objects by colors and shapes; and identify and sequence the numbers 1 to 10. With respect to Cameron's knowledge of letter names, formal data was not available. Cameron's teacher reported that when she stated a letter name out loud to Cameron during informal activities (e.g., during circle time and while playing letter games) that that he would select the corresponding letter from a field size of 3 to 4 letters.

When asked to describe Cameron's receptive language skills, Cameron's teacher reported that he could follow familiar, oral one-step directions (e.g., *"sit down," "stand up," "put in," "get one,"*) and that he demonstrated understanding of the names of

members in his family (e.g., Mom, Dad, Grandma), names of some animals (e.g., *dog*, *cat*, *pig*), and names of body parts (e.g., *nose*, *eyes*, *toes*). His teacher also indicated that Cameron sometimes demonstrated understanding of his own name (e.g., he would turn to attend to an individual when his name was called).

Cameron's teacher indicated that the methods of communication that he most commonly used included using gestures (e.g., waving his hand to indicate *"no"* to a particular item or activity), making sign approximations for some words (e.g., *"help," "more," "all done,"*), and pointing to line drawings. Cameron also used a speech generating AAC device to request preferred items and to participate in learning activities when prompted by an adult. During the screening assessments, Cameron had access to a Mercury[2]. Prior to the start of the study, Cameron was provided with an Auggie[3] programmed with approximately 250 vocabulary items.

Cameron primarily used his AAC device during group activities (e.g., circle time) and for speech therapy sessions. The pages on his device included vocabulary items to support his participation during these activities. The vocabulary was represented by line

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[2] The Mercury is a computer-based AAC device with synthesized speech output that uses Windows-based computer software. The Mercury is manufactured by Tobii Assistive Technology, Inc. Address: 333 Elm Street, Dedham, MA. More information available at: www.tobiiati.com

[3] The Auggie is a computer-based AAC device with synthesized speech output that uses Windows-based computer software. The Auggie is manufactured by RJ Cooper & Associates, Inc. Address: 27601 Forbes Road, Suite 39, Laguna Niquel CA. More information available at: http://www.rjcooper.com/auggie/index.html

drawings, which included Picture Communication Symbols[4] (PCS) presented within a grid format and included approximately 250 vocabulary items across 15 pages within the device. The pages on his device contained several activity pages including a page for selecting activities and multiple pages for supporting Cameron's participation during specific activities (e.g., reading a story, singing a song, playing with toys, blowing bubbles, participating in circle time, etc.). Additional pages included a page containing common vocabulary words (e.g., *hi*, *come*, *play*, *eat*, *drink*, *like*, etc.), a page to support Cameron in selecting his clothes while getting dressed, and a page to support communicative interactions in his home. Each page included a grid that could hold as many as 36, 1 x 1-in. pictures. The number of pictures per page ranged from 7 to 35, but the pictures always remained the same size.

Cameron's teacher reported that he never initiated an interaction and that he mostly communicated to express his needs and wants and to respond to questions with prompting by an adult. In addition, Cameron's teacher reported that he did not typically communicate to share information, express social closeness, or to express social etiquette. In a typical interaction involving the use of his AAC device, Cameron would respond to a question from an adult (e.g., "What do you want?" by pointing to a picture in his system. Cameron relied on his adult partner to retrieve the correct page containing the desired vocabulary item. He was not observed to independently obtain and navigate his AAC device to communicate with others.

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[4] Picture Communication Symbols (PCS) are black and white or color line drawings developed by DynaVox Mayer-Johnson, Inc. for use in augmentative and alternative communication systems. DynaVox Mayer-Johnson, Inc. Address: 2100 Wharton Street, Suite 400, Pittsburgh, PA 15203. More information available at: www.mayer-johnson.com

Cameron's teacher reported that he did not use natural speech to communicate, except for vocalizations, which he used when he was excited or frustrated. Cameron typically obtained desired items independently and he demonstrated frustration (e.g., loud vocalizations and/or crying) when communication breakdowns occurred. Cameron's teacher indicated that her primary goals for Cameron's communication included "increasing his use of natural speech, increasing his independence in both making requests and asking questions, and increasing his use of picture vocabulary for independently labeling/identifying items."

Zach. Zach was 5 years, 6 months old when the study began. He received a diagnosis of ASD when he was 3 years, 2 months old. Zach attended an early intervention program for children, ages 4 to 6-years-old, for 3 hours per day, 4 days per week. Zach enjoyed playing with puzzles, coloring, playing games, playing with toy cars, looking at books, playing outside, and watching Sesame Street. He appeared to enjoy playing an educational game on the computer that included Elmo and Cookie Monster. Zach also enjoyed coloring and looking at books that included his favorite characters. Zach especially liked "Search and Find" books where he had to locate specific items within a picture. When provided with an opportunity to select a preferred activity, Zach would often choose to look at books, color, or play with puzzles or toy cars.

Zach's teacher reported that at the time the study began, Zach would typically participate in group activities such as circle time and preferred small group activities for approximately 10 minutes independently and for approximately 15 minutes with some assistance from an adult. Additionally, Zach would transition between classroom activities using a visual schedule; make choices of preferred activities and items using

line drawings; identify colors in response to a spoken request; and imitate drawing a smiley face and trace the letter "z" with minimal prompting. Formal data on Zach's knowledge of letter names was not available. Zach's teacher reported that when she stated a letter name out loud, that Zach could select the corresponding letter during informal activities (e.g., during circle time and while playing letter games).

When asked to describe Zach's receptive language skills, Zach's teacher reported that he could follow familiar one-step and two-step directions and that he demonstrated understanding of his own name, his family members' names (e.g., *Mom*, *Dad*, *brother*, *sister*), names of people in his classroom, and names of animals, body parts, and familiar objects (e.g., *chair*, *table*, *scissors*, *book*, *crayons*, etc.). His teacher also reported that he could respond appropriately within some conversational routines (e.g., he would say *"hi"* with prompting after someone initiated a greeting as well as say "*bye", "yes", and "no"* when prompted to do so). Additionally, Zach could respond to simple w-h questions (including questions such as *"What do you want?"* and *"Who is it?"*) by pointing to an appropriate line drawing.

Zach's natural speech consisted of one to two-word phrases (e.g., "hi," "look," and "that one") that were often repetitions of what people had said, but sometimes seemed to be used with communicative intent. His teacher described Zach's speech as difficult to understand and rarely self-initiated. Zach typically used his speech after extensive prompting from others or when participating in a familiar routine where Zach had heard a phrase used repeatedly (e.g., sometimes he would say "Zach's turn" during a task where he had heard an adult say "It is Zach's turn."). His teacher indicated that Zach

used his natural speech slightly more often during familiar tasks and routines, but that even during those times his speech was limited and often difficult to understand.

Zach's teacher reported that he benefited from using AAC, such as line drawings, in order to increase (a) his communicative attempts and (b) others' understanding of his message. Although Zach did not have a personalized AAC system, the teacher provided the students in the classroom with communication boards, which included 2 to 10 vocabulary items represented by line drawings presented within a grid format, to support their participation during specific activities such as circle time and snack time. Zach's teacher noted that the methods of communication that he most commonly used included using gestures (e.g., waving his hand to indicate "no" to a particular item or activity), pointing to line drawings, looking at objects that he needed and/or wanted, as well as using some natural speech.

According to his teacher, Zach rarely initiated interaction, and he mostly communicated to express needs and wants and to respond to questions. Although Zach did not have a specific method of communication to share information with others, he would smile and point to something that he liked. For example, when looking at a book with an adult, sometimes he would smile and point to a picture. Zach did not typically communicate to express social closeness or to participate in social etiquette routines, but as mentioned previously, he would imitate speech when prompted to do so. For example, he would follow instructions when asked to say *"bye"* or to say *"please."* Zach's teacher reported that his natural speech was often difficult for all communication partners to understand (including both unfamiliar and familiar communication partners), but that he did not demonstrate frustration when others did not understand him. Zach's teacher

indicated that her primary goals for his communication included "increasing his use of natural speech and his confidence in attempting to communicate."

Cole. Cole was 4 years and 11 months old at the beginning of this study. He received a diagnosis of ASD when he was 1 year, 10 months old. Cole attended a half-day preschool program for children between the ages of 4 and 6-years-old for 3 hours per day, 4 days per week. Like Zach, Cole enjoyed playing with puzzles and blocks, coloring, and looking at books. Cole also enjoyed singing songs, including his favorite song "If You're Happy and You Know It." Cole appeared to enjoy listening to others sing this song as he would always smile and participate in the corresponding motions (e.g., clap hands, stomp feet, etc.). When asked to select an activity of his choice, Cole would often choose to look at books or play with blocks. Like Cameron, Cole especially liked books that included moveable pictures.

Cole's teacher reported that, at the time the study began, Cole would participate in group activities such as circle time and preferred small group activities for a minimum of 5 minutes independently and for at least 15 minutes with some assistance from an adult. Cole would transition between classroom activities using a visual schedule; make choices of preferred activities and items using line drawings; identify colors and some shapes (e.g., circle, square, triangle, oval, heart, star) in response to a spoken request; identify the numbers 1 to 15; and imitate drawing a smiley face. Formal data on Cole's knowledge of letter names was not available. Cole's teacher reported that when she stated a letter name out loud, that Cole could select the corresponding letter during informal activities (e.g., during circle time and while playing letter games).

When asked to describe his receptive language skills, Cole's teacher reported that he could follow familiar one-step and two-step directions and that he demonstrated understanding of his own name, his family members' names, as well as names of people in his classroom, and names of animals, body parts, and familiar objects. His teacher also noted that he could respond appropriately within some conversational routines (e.g., he would say *"hi," "bye," "yes,"* and *"no"* when prompted to do so).

Cole's natural speech consisted mostly of speech approximations, which his teacher described as "almost never understood by others." Cole used his natural speech most often to respond to yes/no questions or to request the color "blue" (his favorite color). He also used his natural speech to imitate words when asked to do so. Cole's teacher reported that the methods of communication that he most commonly used included gestures (e.g., waving his hand to indicate "no" to a particular item or activity), pointing to line drawings, and some natural speech, but that his speech was very limited and almost never understood by others. Similar to Zach, Cole's teacher indicated that he benefited from using AAC, such as line drawings to support his communication skills. Cole did not have a personalized AAC system; however, he used the communication boards his teacher provided during activities to support his participation during the tasks. These communication boards included 2 to 10 vocabulary items represented by line drawings presented within a grid format,

Cole's teacher reported that he mostly communicated to express his needs and wants, respond to questions, and occasionally to share information with others. Additionally, Cole's teacher noted that he would often smile to express social closeness with others and would say *"hi," "bye,"* and *"thank you"* when prompted by an adult to

express social etiquette. Cole's teacher reported that he rarely initiated interaction and that he demonstrated frustration when not understood by others (e.g., loud vocalizations and/or crying, stomping feet, waving arms). Cole's teacher indicated that her primary goals for Cole's communication skills included "increasing his use of natural speech."

Setting

The study took place in a preschool setting that included two classrooms that specialized in early intervention services for children with a diagnosis of ASD between the ages of 3 and 6. The children attended the school 4 days per week for 3 to 5 hours per day, depending on whether they attended the partial-day program or the half-day program. The researcher conducted sessions inside each child's classroom. The teachers in each classroom provided the researcher with a table and a chair that were located in a corner of their classrooms. Although other children were present in the classroom, these children were participating in center activities located in other areas of the classroom; therefore, it was unlikely that these children could see and hear the intervention implemented by the researcher. The table and chair were appropriately sized so that the child could sit and participate in the sessions comfortably.

Each classroom used a schedule, which divided the day into 15-minute learning centers. Each center included one adult who was in charge of supervising the center. Some of the learning center activities included: sensory activities, art, games, computer, dramatic play, blocks/puzzles, gross motor activities, and fine motor activities.

The children were directed to work at a center for 15 minutes, and to transition to the next center when the teacher announced that it was time to *"check their schedules."* At this time, the children would leave the center in which they had been participating,

walk to their individual picture schedules listing the day's activities, look at the picture to see where they were to go next, take the picture representing the activity, and proceed to their next center. They would then "check in" by placing the picture in the designated "check in area." Both teachers used picture schedules, which included a combination of line drawings and photographs attached to a wall using Velcro. A photograph of the researcher was used to indicate when the children participating in the study were to work with the researcher. This allowed the sessions in this study to become one of the "centers" on the participating children's daily schedules.

In addition to their learning centers, the children participated in a daily circle time which included singing songs, listening to a storybook, and engaging in calendar activities (e.g., naming the days of the week). The students also participated in a literacy group for 25 to 50 minutes a week (the children in the younger group participated for 25 minutes, and the children in the older group participated for 50 minutes per week). The literacy group included storybook readings as well as informal instruction on letters, which took place within literacy-related activities (e.g., storybook readings, songs, crafts, etc.). The instruction on letters primarily focused on identifying the "letter of the week" by name, but also included some discussion of words that began with the targeted letter.

Materials

Each instructional session included (a) instruction, (b) an extension activity, and (c) a choice activity. All instructional materials used in this study were adapted from the instructional materials developed by Light and McNaughton (2009a)[5]. Instructional

[5] Light, J., & McNaughton, D. (2009a). *Accessible literacy learning: Evidence- based reading instruction for learners with autism, cerebral palsy, Down syndrome, and other disabilities*. Solana Beach, CA: Mayer-Johnson.

stimuli were based on the letter-sound correspondences targeted during instruction. Additional materials included experimenter-created letter-sound correspondence books, an *I-spy task*, and *color-and-paste* activities, which were used for letter-sound correspondence extension activities (a more detailed description of these activities will follow). Also, the researcher used puzzles, books, and stickers for choice activities. These activities were traditionally used in both classrooms to "reward" children for their participation at the end of an instructional activity. As the children demonstrated learning and increased interest in the literacy activities, the use of these activities was faded during instruction. The researcher shared all materials (including instructional materials, books, stickers, and puzzles) with the participants' teachers before beginning the study in order to verify that the all materials were appropriate for the students. Additionally, a video camera (Flip Video Ultra HD[6]) and tripod was used to record all sessions.

Selection task screening assessment. For the selection task, the researcher assessed whether the potential participants could select a target picture from a field of six choices (see Appendix E for the script and detailed procedures). The researcher used a

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[6] The Flip Video Ultra HD is a digital video camcorder created by Pure Digital Technologies and owned by Cisco Systems Inc. More information available at: www.TheFlip.com

[7] Boardmaker software is a database of graphics used for creating communication displays. Boardmaker software is manufactured by DynaVox Mayer-Johnson, Inc. Address: 2100 Wharton Street, Suite 400, Pittsburgh, PA 15203. More information available at: www.mayer-johnson.com

combination of PCS and other line drawings (all line drawings were in color), which were presented on a 3 x 3-in. card with a white background. The researcher created the line drawings using BoardMaker®[7]. This task required the participants to follow one-step directions (e.g., *"Touch the picture that shows 'cat,'"*) by listening to a target word and touching the picture that corresponded to the word. The researcher selected words for which the participants reportedly understood the meanings based on the teachers' reports (e.g., *cat*, *dog*, *pig*, *bus*, etc.). The researcher recorded the target words, response options, and students' responses using the Data Collection Form for Screening Assessments (see Appendix H). The format of the data collection form was adapted from the data collection forms developed by Light and McNaughton (2009a) for sound blending and single-word decoding tasks.

Letter-sound correspondence screening assessment. The researcher used 2 x 2-in letter cards to assess letter-sound correspondences. The letter cards included lowercase letters presented in black print using 83-point Arial font on a white background. The researcher laminated the cards so that the cards could be used repeatedly. The researcher recorded the target letter, response options, and the participants' responses using a Data Collection Form for Letter-Sound Correspondences adapted from Light and McNaughton (2009a) (see Appendix I).

In order to make the task interesting to the young children, the researcher created an "Elmo placemat" and decorated a shoebox with a picture of Elmo placed on the front. The placemat was created on yellow cardstock and included pictures of Elmo as well as six red squares. The researcher placed letter cards on the squares of the placemat. The Elmo box served as a discarding area for the cards after each trial. The researcher cut an

opening for Elmo's "mouth" so that the participants could "feed" Elmo the letters after each trial. The participants appeared to enjoy "feeding Elmo" after each trial. The same materials were used for the following letter-sound correspondence assessment activities: (a) screening, (b) baseline, (c) intervention, (d) maintenance, and (e) generalization on the Generalization Alphabet Probe. An additional generalization task, the Generalization Book Probe, was also developed to assess generalization, which presented the letters in a book-like format.

Additional reading assessments. Prior to beginning instruction the researcher administered two additional reading assessments: (a) Sound Blending Probe and (b) a Single-Word Decoding Probe. For the Sound Blending Probe, the researcher presented the participants with a field of six picture cards, each of which represented a consonant-vowel-consonant word. The picture cards included color, line drawings presented on a 3 x 3-in. card with a white background. The researcher obtained the line drawings using BoardMaker® or Google Images[8]. This task required the participant to listen to a word stated slowly (e.g., *"mmmmoooommmm"*) and to select the picture that corresponded to the word (e.g., *"mom"*). For these tasks the researcher presented only words for which the participant had demonstrated the correct response for during the Selection Task Screening Assessment (i.e., there was some evidence from this screening task that the participant understood the picture that corresponded to the target word).

For the Single-Word Decoding Probe, the researcher used picture cards as described previously, and also presented the participants with word cards. This task required the participant to read the word card and to select the picture (from a field of six

[8] http://www.google.com/imghp.

choices) that corresponded to the written word. The word cards included lowercase letters using black 83-point Arial font on a 5 x 1.5-in card with a white background. During both probes, the researcher recorded the target word, the field of options, and the participants' response using the Data Collection Form for Screening Assessments described previously (see Appendix H).

Letter-sound correspondence instruction. Instruction on letter-sound correspondences included the same materials described during the letter-sound correspondence assessment activities (letter cards, Elmo box and placemat, and data collection forms). The researcher followed the instructional procedures recommendations by Light & McNaughton (2009a) for teaching letter-sound correspondences (see Appendix J for an Excerpt from the script used for teaching letter-sound correspondences).

When introducing new letter-sound correspondence, the researcher also presented 3 x 3-in. picture cards, which were similar to the cards described for the Sound Blending and Single-Word Decoding Probes. The cards in this task included photographs, PCS symbols, or other line drawings that represented the words that began with the target letter sound (e.g., *octopus*, *ostrich*, *otter*, and *ox* for the letter-sound correspondence *o*. The pictures used during instruction were either obtained from BoardMaker® or from the Internet using the Google Images search engine. The researcher recorded the target letters, the field of options options, and the students' responses using the Data Collection Form for Letter-Sound Correspondences (see Appendix I).

Letter-sound correspondence extension activities. The researcher incorporated extension activities into the instructional sessions in order to provide the participants with

a range of literacy activities as well as the opportunity to apply knowledge of the letter sound(s) targeted during instruction within the context of a fun activity. Extension activities included: (a) a letter-sound book, (b) an I-spy task, and a (c) color-and-paste task.

Letter-sound book. The letter-sound book included color photographs or line drawings that represented words that began with the target letter sound. The researcher obtained pictures for the letter-sound book from BoardMaker® or from the Internet using the Google Images search engine. Each page included one photograph or line drawing, which was imported into a Microsoft® Office Word document with portrait orientation. Each page was placed in a clear sheet protector and a piece of hard Velcro was placed on the sheet protector below the picture. The researcher bound the pages together with a piece of string in order to create a "book-like format". This activity also included letter cards identical to the cards described previously except that these cards had a piece of soft Velcro attached to the back of each card. The Velcro allowed the participants to attach the target letter to the page of the book. The researcher stated the name of the picture, emphasizing the target sound at the beginning of the word (e.g., *"rrrrun"*). The task required the participant to look at the picture, listen to the word that the picture represented, and select the target letter that corresponded to the first sound in the target word.

I-spy task. The I-spy task included a page that presented a collage of items, which included letters "hidden" within the collage. This activity resembled an *I Spy*

book[9] (e.g., Marzollo & Wick, 2009). This allowed the students the opportunity to locate the target letters in a fun "search and find" activity.

Color-and-paste task. The researcher imported four coloring pictures from Google Images into a Microsoft® Office Word document with landscape orientation. To the right of each picture the researcher created a 1 x 1-in. square. This activity required the participants to listen to the words that the pictures represented (e.g., *"ooooctopus," "ooootter,"* etc.); select the target letter that corresponded to the first sound in the target word; paste the target letter in the squares; and color the pictures.

Independent Variable

The intervention in this study included instructional procedures recommended by Light and McNaughton (2009a, 2009b) for teaching letter-sound correspondences to learners with complex communication needs. These instructional procedures were based on three sources of information: (a) recommendations by the National Reading Panel (2000) for teaching phonics skills (e.g., explicit instruction on a prescribed set of letter-sound correspondences), (b) principles of effective instruction (e.g., teacher modeling, instructional scaffolding, immediate and corrective feedback, cumulative practice) (Hughes & Archer, in press; Rosenshine & Stevens, 1986), and (c) adaptations for participants with complex communication needs (e.g., eliminating the need for an oral response during instruction; providing multiple means of responding) (Light & McNaughton, 2009a).

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[9] Marzollo, J., & Wick, W. *(2009). I Spy A to Z: A Book of Picture Riddles*. New York: Scholastic Inc.

Dependent Variable

The primary dependent variable in this study was the participants' performance on a Letter-sound Correspondence (LSC) Probe, which included both acquisition and maintenance of the letter-sound correspondences targeted during the intervention. The LSC probe was conducted during (a) baseline, (b) intervention, and (c) maintenance phases, in order to measure the participants' performance (a) before intervention, (b) during intervention, and (c) after intervention respectively.

A LSC Probe included two trials for each of the six targeted letter-sound correspondences (*o*, *t*, *r*, *l*, *u*, *p*), which provided an opportunity of 12 correct responses. The researcher selected these six letter-sound correspondences from a pool of letters that none of the three participants demonstrated knowledge of during the Letter-Sound Correspondence Screening Assessment. From this pool of "unknown letters" the researcher used the sequencing guidelines recommended by Carnine et al. (2010) and Light & McNaughton (2009a), which include: (a) teach letters that are more frequently used letters (e.g., *a*, *m*, *t*, *s*, etc.) before less frequently used letters (e.g., *q*, *x*, *y*, *z*); (b) separate letters that are visually similar (e.g., *b* and *d*); and (c) separate letters that are auditorily similar (e.g., *g* and *k*).

In addition to measuring the number of correct responses on a LSC Probe, the researcher also collected information on (a) the number of correct responses for the target letter-sound correspondence demonstrated during instructional sessions, (b) the number of correct responses for previously learned letter-sound correspondences during independent practice sessions, and (c) the number of instructional sessions required to demonstrate acquisition of a target letter sound. Acquisition of a letter-sound

correspondence was defined as achieving a score of at least 80% accuracy for two consecutive independent practice sessions (Fallon et al., 2004; Light & McNaughton, 2009a; Millar et al., 2004). More detail regarding LSC Probes and instructional sessions will follow under the *Procedures* section.

When assessing the participants' performance, the researcher presented a letter sound orally (e.g., /l/, pronounced as "llllll" as in "log") and asked the participants to select the target letter from a field of choices. LSC Probes and independent practice always included a field of six choices. Light and McNaughton (2009a) recommend stating the target sound and asking the learner to select the corresponding target letter in order to provide learners with complex communication needs with an alternative method of responding—one that does not require the use of natural speech.

A selection during LSC Probes and instructional sessions was defined as the participant touching one letter card after the researcher presented the sound orally. Therefore, if the learner touched more than one card at the same time, this was scored as an incorrect response. For the LSC Probes and independent practice, a correct response was defined as an independent selection of the correct letter within 5 seconds of the researcher's presentation of the sound. In order for the response to be considered correct, the learner had to select the correct letter on the first attempt; therefore, self-corrections (i.e., touching an incorrect letter first, and then the correct letter without assistance) were scored as incorrect. Incorrect responses included (a) selecting an incorrect letter (even if the initial response is later self-corrected), (b) selecting more than one letter at one time, and (c) providing no response within 5 seconds.

Experimental Design

In the current study, the researcher employed a multiple-probe multiple baseline design replicated across three participants (Horner & Baer, 1978; Kennedy, 2005). The researcher selected a single-subject experimental design in order to evaluate the effect of the intervention on the participants, while also accounting for the heterogeneity of this population of students (i.e., children with ASD and complex communication needs). Specifically, this design allowed the comparison of (a) each participant's individual performance from baseline to intervention and (b) the performance of all participants in comparison with each other. A multiple-probe multiple baseline design was selected in order to decrease the likelihood of participant fatigue during baseline by presenting baseline probes at intermittent intervals rather than on a daily basis.

Procedures

After obtaining informed consent, the researcher conducted screening assessments in order to confirm that the participants met the selection criteria described previously. After the researcher completed screening, the researcher began the project, which involved four phases: (1) Baseline, (2) Intervention, (3) Maintenance; and (4) Generalization.

Screening assessments. The screening assessments were used to confirm that the participants met the selection criteria described previously. Screening assessments included (a) screener questionnaires, (b) selection tasks, and (c) letter sound correspondence tasks.

Screener questionnaires. The researcher interviewed the students' teachers and speech language pathologist using questions from a Communication and Language

Questionnaire (see Appendix C) to determine whether the potential participants' spoken language met their daily communication needs. The researcher adapted a questionnaire from Autism Matters (2007) by including four main goals of communication identified by Light (1997): (a) expressing needs and wants; (b) exchanging information; (c) developing social closeness; and (d) expressing social etiquette. Next, the researcher asked the teachers and parents to complete the experimenter-created Preferred Activities and Interests Questionnaire (see Appendix D) in order to assist the researcher in creating a positive and enjoyable learning experience by incorporating the child's preferred topics and activities during the sessions.

Selection task assessment. In order to determine whether the participants demonstrated the language skills that were necessary to participate in this study, the researcher presented a task that required the participants to select a target picture (i.e., a line drawing of a specified vocabulary item) from a field of PCS symbols and other line drawings. The researcher began the task by presenting a field of four pictures and then increased the field size to six (2 rows of 3 cards) after the participants demonstrated success with the smaller field size. The use of a larger field was investigated because a larger field size decreased the likelihood of a participant selecting a target item by chance.

The researcher used the information from the Communication and Language Questionnaire to identify line drawings of the target words that were reportedly familiar to the potential participants. The researcher presented the picture of the target word along with five non-target pictures (i.e., foils—also known as distractors). Next, the researcher stated, "Touch the picture of the _____." The researcher allowed the

participant up to 5 seconds to select the picture of the target word (see Appendix E for the script and procedures). Each participant was tested on 10 different vocabulary items. In order to participate in this study, it was required that the participant select a correct picture for at least 8 out of 10 trials. The researcher recorded the participants' responses using the Data Collection Form for Screening Assessments (see Appendix H).

Five participants demonstrated that they could complete the selection task with a field of six items with at least 80% accuracy. This assessment provided evidence that the participant (a) had some knowledge of vocabulary words (e.g., *pig*, *dog*, *bus*, etc.), and (b) could follow the directions that were necessary to complete the tasks included in this study. The researcher also provided participants with the opportunity to select an activity (e.g., storybooks, puzzles, blocks, stickers, coloring books, etc.) after the task to reward the children for their participation.

Letter-sound correspondence screening assessment. When assessing the participants' knowledge of letter-sound correspondences, the researcher presented the learner with six letter cards (one target letter and five foils). When introducing the task, the researcher said, *"I will say a sound. Then you will look at all of the letters and touch the letter that makes that sound."* The researcher also provided models to assist the participant in understanding the expectation of the task (see Appendix G an excerpt from for the script used in this study). Next, the researcher stated the letter sound, paused to provide the child with an opportunity to respond (up to 5 seconds), and recorded the child's response on the Data Collection Form for Letter-Sound Correspondence Data Collection Form (see Appendix I). The researcher did not provide the participant with

corrective feedback regarding the accuracy of the response, but did encourage and thank the participant for participating (e.g., *"Thank you for touching a letter!"*).

Given that the child had approximately a 1 in 6 (17%) chance of selecting the correct target letter, the researcher provided at least two trials for each letter. If the participant provided an incorrect response on both trials, the letter was considered "unknown" and became a potential letter-sound correspondence targeted during instruction. If the participant provided a correct response, the researcher provided additional testing on the letter-sound correspondence continued to help ensure that the participants' response was not a "chance" selection. If the participant was correct for at least 4 out of 5 trials (i.e., 80%), then the letter sound was considered "known" and was not included in the potential pool of target letter-sound correspondences.

The researcher randomized (a) the order of the letters presented, (b) the location of the target letter, and (c) the letters that served as foils in order to ensure that the participant was attending to the target letter and not using patterns or cues to prompt a response. If the participant correctly identified less than 10 of the 26 most common letter–sound correspondences (see Appendix F), then the participant was eligible to participate in the study. Based on the children's performance three of the six potential participants met the selection criteria to participate in this study.

The researcher selected the target letter-sound correspondences for this study based on the performance of the participants during the screening assessment. The researcher recorded the unknown letters for the three participants who met the screening criteria and then selected and sequenced six unknown letters for instruction using the guidelines recommended by Carnine et al. (2010) and Light & McNaughton (2009a) as

described previously. The researcher chose to use the same sequence of letters for all participants in order to ensure that each participant received instruction on letter-sound correspondences that were of equal levels of difficulty.

Additional reading assessments. Before beginning instruction on letter-sound correspondence, the researcher also presented one sound blending probe and one single-word decoding probe in order to gather more information about the participants' current reading skills prior to beginning the intervention. For both probes, the researcher presented the participants with a field of six pictures. As described previously, the sound blending task required the participant to listen to a word stated slowly (e.g., *"buuuussss"*) and to select the picture that corresponded to the word (e.g., *"bus"*). For the single-word decoding probe, the researcher presented the participant with a word card and asked the participant to read the word card and to select the picture that corresponded to the written word.

Baseline. In order to establish that any change in a participant's performance did not occur before receiving the intervention, baseline measures of the target letter-sound correspondences were gathered. The researcher collected baseline data for a minimum of six LSC Probes in order to ensure that a stable baseline was observed before beginning the intervention. As described by Tawney and Gast (1984) a minimum of three separate observation points are required to determine the stability of data. A stable baseline is one that demonstrates low variability (i.e., range in data points) and trend (i.e., direction of the slope) (Tawney & Gast, 1984). The researcher used visual inspection (Kennedy, 2005; Tawney & Gast, 1984) to ensure that each participant's baseline demonstrated stability before implementing the intervention. Given that the goal of this study was to

increase the target behavior (i.e., identifying letter-sound correspondences), a decelerating trend (i.e., data that demonstrated a slope in the opposite direction of improvement) was acceptable; however, a trend of increasing performance was not acceptable (Tawney & Gast, 1984).

Baseline probes for letter-sound correspondences used the same assessment procedures described for the screening assessments (see Appendix G) with the exception of the number of times each letter was presented and the letters included in the field of options. The LSC Probes during baseline included two trials for each of the six target letters, which provided 12 opportunities for the participant to respond. Additionally, the field of six letters always included the six target letters (i.e., *o*, *t*, *r*, *l*, *u*, *p*). The researcher recorded the participants' responses using the Data Collection Form for Letter-Sound Correspondence (see Appendix I). The researcher randomized the order in which the letters were presented, randomized the placement of the target letter, and randomized the placement of the five non-target letters (i.e., foils). Given that the number of correct responses during the LSC Probes was the primary dependent variable, the researcher waited to begin the intervention until a stable baseline for participants' performance on the LSC Probes was observed.

Once a stable baseline was achieved for Participant A, the researcher began the intervention with Participant A, while Participants B and C remained in baseline. Once Participant A demonstrated a treatment effect and Participant B demonstrated a stable baseline, the researcher began the intervention with Participant B. Demonstration of a treatment effect was determined by analyzing the data using visual inspection (Kennedy, 2005; Tawney & Gast, 1984). The researcher examined whether data demonstrated a

positive level change (i.e., at least a 2-point increase on the LSC Probe from the highest score achieved baseline) for a minimum of two consecutive probes after implementing the intervention. After Participant B demonstrated a treatment effect, the researcher followed the same procedures for Participant C.

Intervention. The instructional tasks and procedures were based on the recommendations of Light and McNaughton (2009a) for teaching letter-sound correspondences to learners with complex communication needs. The researcher provided two types of sessions including: *instructional sessions* and *LSC Probe sessions*. The instructional sessions included: *explicit instruction* on the target letter-sound correspondence and an *extension activity*. Each session lasted approximately 20 minutes, which included approximately 15 minutes of instructional activities (10 minutes of explicit instruction and practice, 5 minutes for the extension activity) and 5 minutes for choice activities, which included brief activities to promote the participants' engagement during the sessions. The choice activities included singing songs, looking at books, playing with puzzles, and selecting stickers.

The researcher provided instructional sessions 1 to 2 times per day, averaging five sessions per week. This study was conducted during the last two months of the school year; therefore, in order to accommodate the teachers' "end of the year" schedules as well as to ensure that all participants received an adequate number of instructional sessions before the end of the school year, the researcher provided two sessions on some days. The procedures of the intervention will be discussed in the following order: (a) explicit instruction, (b) extension activity, and (c) LSC probe.

Explicit instruction. The researcher provided explicit instruction on the target letter-sound correspondence using the guidelines developed by Light & McNaughton (2009a). The letter-sound correspondence targeted for instruction was either (a) a new letter-sound correspondence or (b) a recently introduced letter-sound correspondence that the learner had not yet acquired. *Acquisition* was defined as independently identifying the letter-sound correspondence (i.e., selecting the corresponding letter when presented with the targeted letter-sound correspondence) with at least 80% accuracy (8 out of 10 trials) for two consecutive independent practice sessions. Instructional activities for teaching letter-sound correspondences included the following steps: (a) introducing and modeling the letter-sound correspondence, (b) modeling the task, (c) providing guided practice, and (d) providing independent practice (see Appendix J for an excerpt from the script for teaching new letter-sound correspondences). The instructional components included in each session varied depending on the participant's performance. For example, one session may have consisted of (a) introducing a new letter-sound correspondence, (b) modeling the target letter-sound correspondence, and (c) providing guided practice for the new letter sound correspondence, while the next session may have consisted of (a) reviewing the recently introduced letter-sound correspondence and (b) providing independent practice.

Some sessions also included *booster instruction*. Booster instruction was presented when a participant missed both trials on a probe for a letter-sound correspondence that he had previously acquired. Booster instruction *was* presented before an instructional session began and simply included a model followed by practice trials before beginning the instructional sessions. The researcher worked with the

participant until he demonstrated three consecutive correct responses independently before moving into instruction.

Introducing the letter-sound correspondence. To introduce a new letter-sound correspondence, the researcher completed the following steps. First, the researcher presented the letter card, pointed to the letter, and stated its sound. If it was a continuous sound (e.g., /r/) the researcher elongated the sound (e.g., *"rrrr"*) and if it was a stop sound (e.g., /t/) the researcher emphasized the sound clearly without distorting the sound. Next, the researcher showed the participant picture cards of words that began with the target sound (e.g., octopus, ostrich, otter, ox, etc.) and emphasize the target sound (e.g., "rrrrun", "rrrred", "rrrrabbit", "rrrring").

Modeling the task. When modeling the task, the researcher presented two letter cards to the participant, which included the target letter (e.g., *o*) and a foil (e.g., *t*). The researcher then described the first step of the activity, by saying, *"I am going to say a sound."* The researcher stated the target sound, (e.g., *"oooo"*), and explained how to select the corresponding letter (e.g., *"Now I look at the letters and point to the letter that makes the sound "'oooo'"*). The researcher then modeled the next steps in the task by (a) looking at each of the letters, (b) pointing to the target letter, and (c) stating the target sound (e.g., "oooo"). During the first session in which a new letter was introduced, the researcher provided at least two models. During each model the researcher presented a different letter to serve as a foil (one of the 5 remaining non-target letters) and varied the location of the target letter. Selection of a letter was accepted, but not expected, during the modeling stage.

Providing guided practice. Next, the researcher provided guided practice so that the participant received supported opportunities to perform the task successfully. The researcher began the task by saying, *"Let's do one together."* The researcher then explained the task: *"I am going to say a sound. Touch the letter that makes that sound."* The instructor then stated the sound and paused. The researcher provided an opportunity for the participant to respond by pausing for 3 to 5 seconds before prompting the participant to select the corresponding letter. If the participant did not initiate a response, the researcher repeated the verbal prompt (e.g., "*Touch the letter that says, 'oooo,'"*) and modeled the correct response. After providing the correct response, the researcher prompted the participant to "touch the letter with me," and then prompted the participant to touch the target letter independently (e.g.*, "Now it's your turn. Touch the letter that says, 'oooo'"*).

During instructional sessions, the researcher provided instructional scaffolding to support correct methods of responding. Instructional scaffolding included using a smaller field size (i.e., only presenting two cards), pausing and looking expectantly for a response, reaching for (but not touching) the correct response, and lightly lifting the hand of the participant to indicate that a response was expected. The researcher provided corrective feedback based on the participant's response. As the participant demonstrated consecutive correct responses independently, the researcher gradually scaffolded support by (a) increasing the length of the pause provided for the participant to independently respond (up to 5 seconds) and (b) increasing the field size of options by one additional letter card until the learner could select the target letter from a field of six letters. When the participant provided an incorrect response, the researcher immediately provided

corrective feedback for the participant, which included (a) modeling the correct response, (b) prompting the participant to select the correct response with the researcher, and (c) asking the participant to select the correct response independently. If the participant continued to demonstrate incorrect responses, the researcher increased the amount of support to assist the participant in responding correctly (e.g., decreasing the field size; providing more prompts, decreasing the length of the pause before modeling the correct response for the participant, etc.). This support would, again, be faded as the participant demonstrated correct responses independently. This assisted the participant in maintaining high rates of success while also supporting the participant's independence in completing the task.

Guided practice for a new letter-sound correspondence always began with massed trials of the new letter-sound correspondence—that is, the participant would have multiple opportunities to practice selecting the most recently introduced letter-sound correspondence. As the participant demonstrated increasing accuracy with the recently introduced letter-sound correspondence, the researcher also presented trials with previously learned letter-sound correspondences. For example, if a participant had demonstrated acquisition for *o*, *t*, and *r*, and was learning *l*, the trials used during the guided practice might follow this sequence: *l, l, l, o, l, r, l, t, r, l, l, l, t, l, l.* Once the participant selected the target letter-sound correspondence from a field of six choices for three consecutive trials including the target letter, with minimal support from the researcher, the participant moved into the independent practice phase of instruction

Providing independent practice. Unlike guided practice, independent practice only consisted of trials that included a field of six letter cards and no prompts were

provided after the researcher presented the directions (e.g., "Touch the letter that says /t/").

Independent practice typically included 15 trials, which included 10 trials of the target letter-sound correspondence and five trials of any previously learned letter sounds[10]. Independent practice provided further review and practice for both the newly learned and previously learned letter-sound correspondences. The participant had to reach the criterion of at least 80% accuracy (8 correct trials out of 10 trials) for identifying the most recently introduced letter-sound correspondence for two consecutive independent practice sessions in order for the target letter-sound correspondence to be considered "acquired." Once a participant demonstrated that a newly introduced letter-sound correspondence had been acquired, the researcher introduced the next letter-sound correspondence.

Extension activity. Instructional sessions ended with an activity that provided the participants with an opportunity to practice learned letter-sound correspondences in the context of a "fun" activity. In addition to providing practice, the extension activities provided the participants with the opportunity to apply and generalize their knowledge of letter-sound correspondences to different materials and activities. These activities were designed to be interesting and fun so that they not only supplemented learning, but also served as an enjoyable activity for the participant. Because the purpose of the extension activity was to provide additional practice that was fun for the child, the researcher did not collect data during the extension activity. After providing explicit instruction, the

[10] For the independent practice sessions that included the first target letter-sound correspondence, *o*, there were no previously learner letters to review, so the participant received only 10 trials for the letter-sound correspondence *o*.

researcher presented two of the following activities: (a) letter-sound book, (b) an I-spy task, and a (c) color-and-paste task. The extension activity was typically 5 minutes in length.

Letter-sound book. During the letter-sound book activity the researcher and the participant looked at the book together. The researcher pointed to a picture on a page, stated the picture's name (emphasizing the target sound), and stated the target sound. For example, *"Look, Zach! It's an ooooctopus. The ooooctopus has eight legs. Touch the letter that says 'oooo'."* The researcher presented two letters to the participant and provided corrective feedback based on the participant's response. The researcher prompted the participant to attach the target letter below the corresponding picture in the book.

I-spy task. During the I-spy task the researcher presented the participant with a picture that included a collage of items and provided a verbal cue (e.g., *"I spy the letter that says 'oooo.' Touch the letter that says 'oooo.'"*). The researcher provided corrective feedback based on the participant's response.

Color-and-paste task. During the color-and-paste task the researcher presented a page containing four pictures that began with the target letter sound (e.g., *octopus, ostrich, otter, ox*). The researcher presented the participant with two letter cards and provided directions (e.g., *"Touch the letter that says, 'oooo.'"*). The researcher provided corrective feedback based on the participant's response. Next, the researcher prompted the participant to paste the target letter next to the picture (e.g., *"Now let's paste 'oooo' next to 'ooooctopus,'"*) The researcher repeated these steps for each of the four pictures. Next, the researcher directed the participant to color the pictures.

Letter-sound correspondence probe. The researcher presented an LSC Probe before every second instructional session. On a day that included a probe session, the probe was always delivered as the first task on that day. Thus the probe session was always a "cold assessment" of what the participant had retained from the previous instructional session. A probe was delivered before every second instructional session so as to maximize the amount of instructional time with the student (because of the students' other scheduled instructional activities, the researcher had only a limited amount of time with each child). The procedures for the LSC Probes used during the intervention were identical to those provided during baseline assessments (see Appendix G for an excerpt from the script). Like the baseline probes, each LSC Probe contained two trials for each of the six target letters (i.e., *o*, *t*, *r*, *l*, *u*, *p*), which equaled a total of 12 trials per probe. Additionally, the field of six letters always included the six target letters. For each trial, the researcher randomized the placement of the letters. The researcher recorded the target letters, the field of options, and the students' responses using the Data Collection Form for Letter-Sound Correspondences (see Appendix I).

Maintenance. The researcher also collected maintenance data on the LSC Probe task. Maintenance data were collected after the intervention was completed. The researcher collected these data 4 weeks after the intervention for Cameron and Cole and 5 weeks after the intervention for Zach (due to his limited availability) to determine if the participants continued to demonstrate acquisition of the letter-sound correspondences after the intervention had ended. The LSC Probes measuring maintenance were identical to the LSC Probes used during baseline and intervention.

Generalization. During the last week of the intervention, the researcher presented two generalization tasks to assess whether the participants could make generalized use of their letter-sound correspondence knowledge to new materials and task formats: (a) a Generalization Book Probe, which presented letter-sound correspondence in a book-like format and (b) a Generalization Alphabet Probe, which presented the target letter in a field of six letters that included letters that were randomly selected from the entire alphabet rather than from the six letters targeted during the intervention.

Generalization book probe. The Generalization Book Probe assessed generalization of skills across materials by presenting the six target letters in a book-like format. For each new trial, the participant turned a page so that all six target letters could be viewed at one time (three letters presented vertically on the left page and three letters presented vertically on the right page). The reason for including three letters on each page rather than six letters on each page was so that this task resembled a "book reading activity" activity. Presenting six letters across the two pages provided the participant with the opportunity to independently scan the letters during each trial and to turn the pages of the book for each new trial. The researcher provided the same directions presented in the LSC Probes (see Appendix G for an excerpt from this script). The only difference between this task and the usual LSC Probe was that the letters were presented within a book rather than on letter cards. The researcher assessed the participants' performance on this task on three occasions. The researcher recorded the target letters, field of options, and students' responses using the Data Collection Form for Letter-Sound Correspondences (see Appendix I).

Generalization alphabet probe. The Generalization Alphabet Probe was identical to the probes conducted during the intervention except that the researcher randomly selected letters from the entire alphabet to serve as foils rather than only using the letters targeted during the intervention. The Generalization Alphabet Probe mirrored the screening assessment for letter-sound correspondences because both tasks included letters randomly selected from the entire alphabet to serve as foils. The rationale for presenting the Generalization Alphabet Probe was to assess whether the participants could generalize their knowledge of letter-sound correspondences when presented with a wider range of letters from which to choose (not just the 6 target letters). The researcher provided the same directions presented in the LSC Probes (see Appendix G). The researcher assessed the participants' performance on this task on two occasions. The researcher recorded the target letters, field of options, and students' responses using the Data Collection Form for Letter-Sound Correspondences (see Appendix I).

Data Collector Training

To ensure the accuracy and consistency of both data collection and procedural integrity, all sessions were videotaped. After each session, the researcher reviewed the sessions to ensure that the data had been collected accurately. The researcher provided training to a research assistant (a doctoral level graduate student), who was not otherwise involved in the study, on the procedures for assessment, instruction, and data collection for both probe sessions and instructional sessions. Training sessions included instruction on how to collect data and how to evaluate the execution of procedures using the Procedural Integrity Checklist and Data Reliability forms (adapted from Fallon, 2001) for both probe sessions (see Appendix K) and instructional sessions (see Appendix L). After

completing scoring for three videos together, the researcher asked the research assistant to complete three checklists and three data forms independently followed by a discussion of the videos. On all training videos, the research assistant's data and the researcher's data were in agreement by 100%.

Interobserver Agreement

The researcher and research assistant met on a weekly basis to review the inter-observer agreement data. In order to calculate interobserver agreement, the researcher randomly selected 20% of the probe sessions and 20% of the instructional sessions on a weekly basis. The researcher randomly selected sessions on a regular basis throughout the course of the intervention in order to avoid observer drift (i.e., when a data collector strays from the original definition for the targeted dependent variable) (Kazdin, 1982; Kennedy, 1995). Next, the research assistant then viewed the videos for the selected sessions and recorded the students' responses using the data reliability forms for the probe sessions (see Appendix K) and the instructional sessions (see Appendix L) accordingly. For each probe session video, the researcher assistant was not informed whether the assessment was a baseline probe or an intervention probe in order to prevent scoring bias. The researcher then calculated interobserver agreement using the point-by-point agreement approach (Kazdin, 1982) by calculating the exact number of agreement across all trials, dividing this number by the total number of agreements plus disagreements, and then multiplying this number by 100 to obtain a percentage. Interobsever agreement was maintained at 99% throughout the intervention for both the probe tasks and the instructional sessions (ranging from 92% to 100% for each probe and 93% to 100% for each instructional session).

Procedural Integrity

The researcher and research assistant also met on a weekly basis to review the procedural integrity data of the sessions. In order to calculate procedural integrity, the researcher randomly selected 20% of the probe sessions and 20% of the instructional sessions on a weekly basis. The research assistant, who had scored data for the calculation of interobserver agreement, also assessed the procedural integrity checks for the selected sessions. While watching the sessions, the research assistant completed an experimenter-created checklist that listed the specific steps for assessment procedures for the probe sessions (see Appendix K) and the instructional sessions (see Appendix L). The researcher calculated procedural integrity by dividing the number of steps performed correctly by the total number of steps. The percent of steps completed correctly equaled 100%.

Social Validity

After the intervention was completed, the researcher distributed a questionnaire to three early intervention professionals (2-teachers and 1-speech-language pathologist), all of whom worked with the participants, in order to assess the social validity of the study. The questionnaire included a 5-point Likert Scale for three questions, and two open-ended questions (see Appendix M). The questionnaire asked the early intervention professionals to indicate their level of agreement (1-*strongly disagree* to 5-*strongly agree*) regarding their perceptions of the intervention and the participants' performance. Additionally, the questionnaire asked the teachers to describe any benefits of the intervention they observed and any aspects of the intervention they would change.

CHAPTER 4

Results

Results of this study are organized into three sections. The first section focuses on the participants' performance the LSC Probe. This includes results for the primary dependent variable (i.e., the number of correct responses on the LSC Probe) during (a) baseline, (b) intervention, and (c) maintenance (i.e., 4 to 5 weeks after instruction ended). In addition, results for the participants' performance on the generalization tasks will also be discussed (i.e., the number of correct responses on the Generalization Book Probe and the Generalization Alphabet Probe). The second section includes the results of the participants' performance during the independent practice phase of instruction including on (a) the number of trials for which the target letter-sound correspondence was identified correctly, (b) the number of trials for which the previously acquired letter-sound correspondences were identified correctly and (c) the number of sessions required for participants to reach criterion for acquisition of a letter-sound correspondence during independent practice (i.e., at least 80% accuracy on the targeted letter sound correspondence for two consecutive independent practice sessions). The third section describes the results from the Social Validity Questionnaire (see Appendix M).

Letter-Sound Correspondence Probe

Instruction on letter-sound correspondences resulted in an increase in the total number of correct responses provided by the three participants on the LSC probes. All three participants demonstrated an increase in the total number of correct responses provided on the LSC Probe after instruction began. Figure 2 presents the graphs representing the number of correct responses provided by the three participants on the

LSC Probe during (a) baseline, (b) intervention, and (c) maintenance phases. More detail regarding each participants' performance on the LSC Probes will follow.

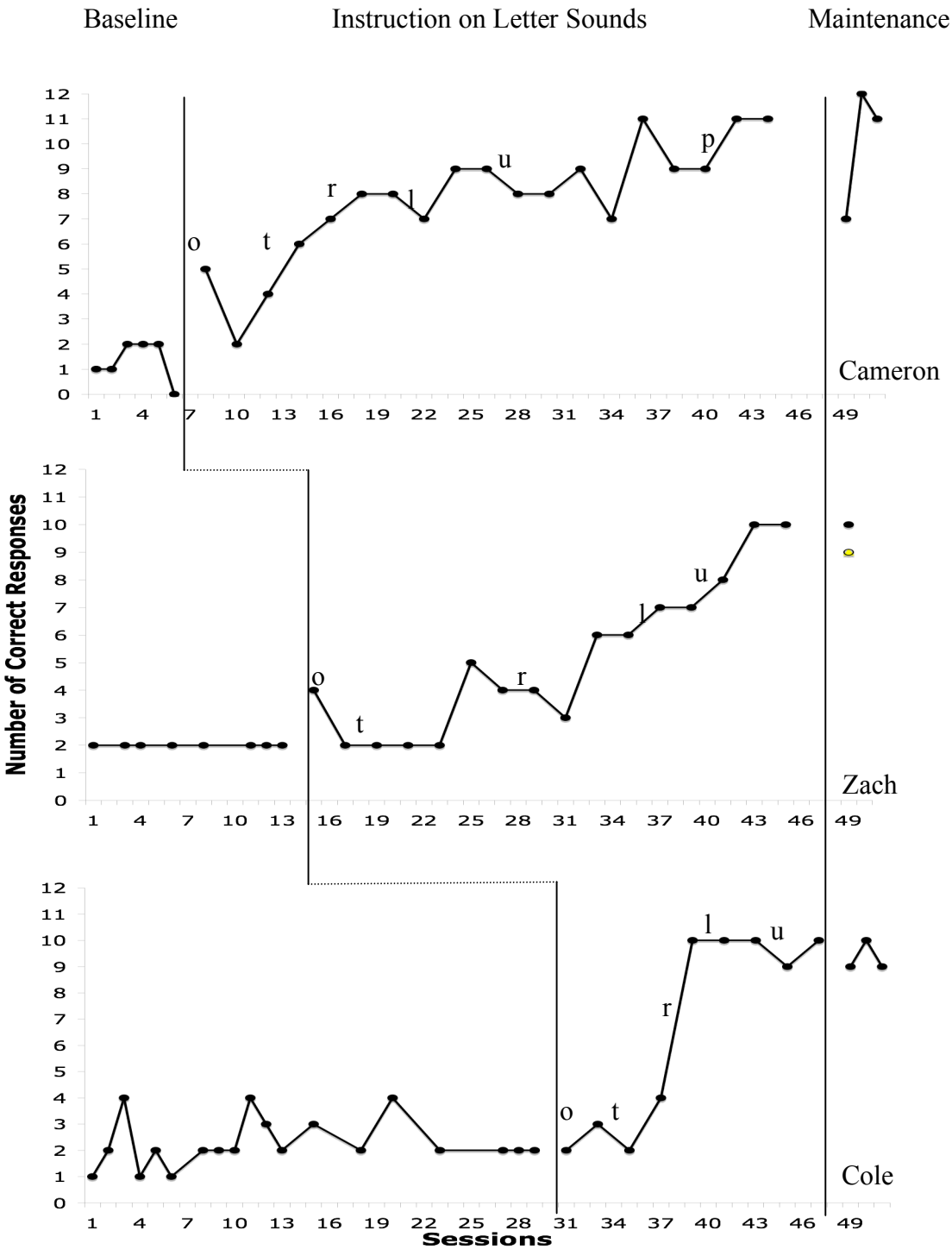

Figure 2. Number of correct responses on LSC Probes. The letters indicate when the letter-sound correspondence was introduced. Zach's maintenance data indicate 3 points collected on one day. The open circle indicates two separate data points representing the same value.

Cameron. During baseline, Cameron demonstrated an average score of 1.3 correct responses on the LSC Probes (11% accuracy). His average score of 1.3 trials correct was below chance levels (2/12, or 17%). After 6 instructional sessions (i.e., 3 probes), Cameron demonstrated an improvement and, overall, continued to demonstrate steady improvement as new letter-sound correspondences were introduced. By the end of the intervention, Cameron had received instruction for all 6 of the targeted letter-sound correspondences and he correctly provided correct responses for 11 of the 12 trials (92% accuracy) on the LSC Probe. Additionally, Cameron correctly identified 85% of the total trials that included letter-sound correspondences he had demonstrated acquisition for at the time the LSC Probe was administered. See Table 3 for an overview of Cameron's performance on previously acquired letter-sound correspondences on the LSC Probes.

Table 3

Cameron's Performance on Acquired Letter-Sound Correspondences on LSC Probes

Probe Session Number	Number of Intervention Sessions Completed	Letter(s) Acquired	Number of Correct Responses					
			o	t	r	l	u	% Correct
4	7	o	2/2					100%
5	9	o	2/2					100%
6	11	o, t	2/2	2/2				100%
7	13	o, t	2/2	2/2				100%
8	15	o, t, r	1/2	2/2	2/2			83%
9	17	o, t, r	2/2	2/2	2/2			100%
10	19	o, t, r,	1/2	2/2	2/2			83%
11	21	o, t, r,	1/2	2/2	2/2			83%
12	23	o, t, r, l	0/2	2/2	2/2	1/2		63%
13	25	o, t, r, l	1/2	2/2	2/2	1/2		75%
14	27	o, t, r, l	0/2	2/2	2/2	1/2		63%
15	29	o, t, r, l	2/2	2/2	2/2	2/2		100%
16	31	o, t, r, l	2/2	2/2	2/2	0/2		75%
17	33	o, t, r, l	2/2	1/2	2/2	2/2		88%
18	35	o, t, r, l, u	2/2	2/2	2/2	2/2	1/2	90%
19	37[a]	o, t, r, l, u	1/2	2/2	2/2	2/2	2/2	90%

[a] Cameron reached criterion for *p* during Session 36, but an additional session was provided in order to provide a consistent number of sessions before each probe.

Zach. During baseline, Zach demonstrated an average score of 2 correct responses on the LSC Probes (17% accuracy). It is important to note that during baseline and the initial intervention probes, Zach typically selected the letter *o* for every trial, which resulted in a score of 2 for every LSC Probe (every LSC Probe contained 2 trials for each letter). After receiving 7 guided practice instructional sessions on the letter-sound correspondence for *t*, Zach consistently provided at least 4 correct responses (33%) for the remaining intervention probes.

As new letter-sound correspondences were introduced, Zach continued to demonstrate improvement. By the end of the intervention, instructional data suggested that Zach had demonstrated acquisition for 4 letter-sound correspondences and that he provided correct responses for 10 out of the 12 trials (83%) on the LSC Probe. When reviewing Zach's performance during the later stages of instruction (including generalization and maintenance measures), it is important to take into consideration that 4 of the 12 trials included letter-sound correspondences for which Zach had not yet demonstrated acquisition (i.e., *u* and *p*), which included 2 trials for a letter-sound correspondence that the researcher had not yet introduced to Zach (i.e., *p*). When looking at Zach's performance on the letter-sound correspondences that he had demonstrated acquisition for at the time the LSC Probe was administered, he correctly identified the letter-sound correspondence for 97% of these trials. See Table 4 for an overview of Zach's performance on previously acquired letter-sound correspondences on the LSC Probes.

Table 4

Zach's Performance on Acquired Letter-Sound Correspondences on LSC Probes

Probe Session Number	Number of Intervention Sessions Completed	Letter(s) Acquired	Number of Correct Responses					% Correct
			o	t	r	l	u	
3	5	o	2/2					100%
4	7	o	2/2					100%
5	9	o	2/2					100%
6	11	o, t	2/2	2/2				100%
7	13	o, t	2/2	2/2				100%
8	15	o, t	2/2	2/2				100%
9	17	o, t	1/2	2/2				75%
10	19	o, t	2/2	2/2				100%
11	21	o, t	2/2	2/2				100%
12	23	o, t, r	2/2	2/2				100%
13	25	o, t, r	1/2	2/2				83%
14	27	o, t, r, l	2/2	2/2	2/2	2/2		100%
15	29	o, t, r, l	2/2	2/2	2/2	2/2		100%
16	31	o, t, r, l	2/2	2/2	2/2	2/2		100%

Cole. During baseline, Cole's performance demonstrated an average score of 2.26 trials correct on the letter-sound correspondence probes (19% accuracy). After instruction began, Cole demonstrated improvement on the fifth intervention probe with a

score of 10 correct responses (83% accuracy). Although he did not demonstrate immediate improvement on the LSC Probe, by the fifth LSC Probe, Cole had received instruction on three letter-sound correspondences (he had reached criterion for the letter-sound correspondences *o* and *t* and was currently participating in independent practice for the letter-sound correspondence *r*). His marked improvement in performance on the fifth LSC Probe during intervention reflects his demonstration of knowledge for the letter-sound correspondences for which he had received instruction. By the end of the intervention, Cole demonstrated acquisition for 4 letter-sound correspondences and he provided a correct response for 10 out of the 12 trials (83%) on the LSC Probe. Like Zach, it is important to keep in mind that 4 of the 12 trials on the LSC Probe included letter-sound correspondences for which Cole had not yet reached criterion for during the instructional sessions (i.e., *u* and *p*), including 2 trials on the LSC Probe for a letter-sound correspondence that the researcher had not yet introduced to Cole (i.e., *p*). Cole's correctly identified 87% of the total number of trials that included letter-sound correspondences that he had demonstrated acquisition for at the time of the LSC Probe. See Table 5 for an overview of Cole's performance on previously acquired letter-sound correspondences during the LSC Probes.

Table 5

Cole's Performance on Acquired Letter-Sound Correspondences on LSC Probes

Probe Session Number	Number of Intervention Sessions Completed	Letter(s) Previously Acquired	Number of Correct Responses					% Correct
			o	t	r	l	u	
3	o	0/2						0%
4	o	1/2	1/2					50%
5	o, t	2/2	2/2					100%
6	o, t, r	2/2	2/2	2/2				100%
7	o, t, r	2/2	2/2	2/2				100%
8	o, t, r, l	1/2	2/2	2/2	2/2			88%
9	o, t, r, l	2/2	2/2	2/2	2/2			100%

Summary of participants' acquisition of letter-sound correspondences. The three participants demonstrated an improvement from baseline performance after the intervention began. All of the participants received instruction on at least 5 letter-sound correspondences before the end of the school year. Again, it is important to note that Zach and Cole did not receive instruction on *p*, due to the fact that the school year ended before they demonstrated acquisition for *u*. Another important point to keep in mind is the fact that, at times, participants demonstrated performance above what would be expected based on the number of letter-sound correspondences for which instruction was provided. One possible explanation for this is due to the fact that participants had a 1 in 6

(17%) chance of providing the correct, which would be equal to approximately two trials per probe.

In addition to demonstrating an improvement in the total number of correct responses over the course of the intervention, all three participants continued to demonstrate a high percentage (82% to 100%) of correct responses for previously acquired letter-sound correspondences. See Table 6 for an overview of each participant's performance on the total number of previously acquired letter-sound correspondences.

Table 6

Summary of Participants' Performance on Acquired Letters on LSC Probes

	Percent Correct on Total Review Trials During Independent Practice						
Participant	o	t	r	l	u	Total Correct	% Correct
Cameron	72%	97%	100%	69%	75%	88/104	85%
Zach	93%	100%	100%	100%		64/66	97%
Cole	71%	92%	100%	100%		33/38	87%

Summary of participants' maintenance of letter-sound correspondence. The researcher implemented three LSC Probes to measure the participants' maintenance for identifying the letter-sound correspondences acquired during the intervention, 4 weeks after the instruction session for Cameron and Cole, and 5 weeks after the last instructional session for Zach. Maintenance data were collected as three separate probes after a set period of time. For Cameron and Cole, maintenance data were collected over three consecutive days, 4 weeks after the intervention ended. At this time, Zach had

started school at a different location so the researcher was unable to collect maintenance data during this time, but was able to collect maintenance data in Zach's home 5 weeks after the intervention ended. Because of Zach's limited availability, the researcher conducted three consecutive probe sessions in one day and provided a 10-minute break between each probe. It is important to note that these data were not collected to compare participants' maintenance across a range of times after intervention ended, but instead to present participants' performance on multiple probes for a set period of time after the intervention ended (i.e., 4 to 5 weeks).

Although both Cameron and Cole demonstrated a slight decrease in their scores on the LSC Probes, all three participants demonstrated evidence of maintenance 4 to 5 weeks after not receiving any instruction with scores ranging from 7 to 12 (Cameron: 7, 12, 11; Zach: 9, 10, 9; and Cole: 9, 10, 9). Although Cameron's first maintenance score was slightly lower than the other two, no instruction was provided between the first and second maintenance probe. Therefore, without any additional instruction or review since the last instructional session, Cameron demonstrated maintenance scores that were similar to his scores on the LSC Probes at the end of the intervention.

It is important to note that the maintenance scores reflect the total number of correct responses for all six letter-sound correspondences. However, Zach and Cole had only demonstrated acquisition for 4 of the 6 letter-sound correspondences included in the LSC Probes. When taking into account only the letters for which Zach and Cole had demonstrated acquisition, Zach scored 88%, 100% and 100% (an average of 96%), and Cole scored 100%, 100%, and 88% (an average of 96%). See Table 7 for an overview of

participants' performance during baseline, at the end of the intervention, and during maintenance.

Table 7

Summary of Participants' Performance on Maintenance LSC Probes

	Performance Mean During Baseline		Performance Mean During End of Instruction[b]		Performance Mean During Maintenance	
Student	Score	Percentage	Score	Percentage	Score	Percentage
Cameron	1.3	11%	10.3	86%	10	83%
Zach[a]	2	17%	9.3	78%	9.3	78%
			8[c]	100%[d]	7.7[c]	96%[c]
Cole[a]	2.3	19%	9.7	81%	9.3	96%[d]
			7.7[c]	96%[d]	7.7[c]	96%[d]

[a]Zach and Cole had reached criterion for 4 of the 6 letter –sound correspondences and had received instruction for 5 of the 6 letter sounds. [b]Performance scores at the end of the intervention is the average of the last 3 probes conducted before the intervention ended. [c]Adjusted scores on the maintenance LSC Probes reflect the number of correct responses for trials including acquired letter-sound correspondences. [d]Adjusted percentages reflect the adjusted percentage of correct responses for trials that include acquired letter-sound correspondences.

Summary of participants' generalization of letter-sound correspondences.

The researcher also administered generalization probes to measure the participants' generalization of letter-sound correspondence skills across materials and tasks. All three participants demonstrated evidence of generalization across materials and tasks during the generalization probes (see Table 8 for a summary of participants' performance on both generalization probes). The Generalization Alphabet Probe was identical to the LSC Probes during baseline and intervention except that the field of letters were randomly

selected from the entire alphabet rather than from the six target letters. As described previously, the Generalization Alphabet Probe closely resembled the LSC Screening Assessment. The key differences included that the Generalization Alphabet Probe presented only two trials per letter and that trials only included the six target letter sounds rather than all 26 of the most common letter sounds (see Appendix F). All three participants demonstrated scores between 9 and 12 trials correct on the Generalization Alphabet Probe (Cameron: 10, 12; Zach: 10, 9; Cole: 11, 12). The Generalization Book Probe was identical to the LSC Probes during baseline and intervention except that the field of letters was presented in a book format. All three participants demonstrated scores between 8 and 11 trials correct on the Generalization Book Probe (Cameron: 8, 11, 11; Zach: 9, 9, 10; Cole: 10, 10, 10).

The researcher administered the generalization probes at the end of the school year; therefore, as discussed previously Zach and Cole had not yet demonstrated acquisition for the letter *u* during instruction, and neither participant had received instruction on the letter *p*. This is important to take into consideration when reviewing the participants' scores because 4 of the 12 trials included letter-sound correspondences (i.e., *u* and *p*) for which Zach and Cole had not yet demonstrated acquisition (i.e., scored 80% or higher for 2 consecutive independent practice sessions) and 2 of the 12 trials included a letter-sound correspondence (i.e., *p*) that the researcher had not yet introduced. When only taking into account the trials for which Zach and Cole had demonstrated acquisition for, they both demonstrated scores of 100% (i.e., 8 out of 8) for every generalization probe. See Table 8 for a summary of the participants' performance scores on the generalization probes.

Table 8

Summary of Participants' Performance on Generalization Probes

	Cameron		Zach		Cole	
Assessment	Score	Percentage	Score	Percentage	Score	Percentage
Screening Assessment (n = 1)	1	8%	2	17%	3	25%
Baseline[a]	1.3	11%	2	17%	2.26	19%
Generalization Alphabet Probe (n = 2)	11	92%	9.5	79%	11.5	96%
			8[b]	100%[c]	8	100%[c]
Generalization Book Probe (n = 3)	10	83%	9.3	78%	8	83%
			8[b]	100%[c]	8[b]	100%[c]

Note. n = the number of probes for each assessment activity. The scores reported represent the participants' average score.
[a]The number of baseline probes varied for each participant (6 for Cameron; 8 for Zach, and 19 for Cole) [b]Adjusted score on Generalization Probes reflect the number of correct responses for trials including acquired letter-sound correspondences. [c]Adjusted percentages reflect the adjusted percentage of correct responses for trials that include acquired letter-sound correspondences.

Instructional Sessions

Each participant reached criterion for 4 to 6 letter-sound correspondences. The three children participated in a total of between 18 (Cole) to 36 (Cameron) instructional sessions. This equaled approximately 3 to 6 hours of explicit instruction and 1.5 to 3 hours of extension activities, which equaled approximately 4.5 (Cole) to 9 (Cameron) hours of total instructional time for each participant. More detail regarding the individual performance of each participant will follow.

Cameron. Cameron demonstrated acquisition for all 6 letter-sound correspondences after receiving 36 instructional sessions. Given that each session consisted of approximately 10 minutes of explicit instruction and 5 minutes of extension activities, Cameron acquired 6 letters after approximately 360 minutes of explicit instruction and 180 minutes of extension activities for a total of 540 minutes (9 hours) of instruction. Cameron's rate of acquisition for reaching criterion ranged from 3 to 12 instructional sessions. During independent practice, Cameron demonstrated an average of 82% accuracy on previously acquired letter-sound correspondences. See Table 9 for a detailed summary of Cameron's performance on the target letter-sound correspondences and the previously acquired letter-sound correspondences (i.e., review trials) during each independent practice session.

Table 9

Summary of Cameron's Performance on Acquired Letter-Sound Correspondences During Independent Practice

Session	Target Letter	Acquired Letters	Number of Correct Responses on Trials During Independent Practice[b] o	t	r	l	u	p	Review Trials Correct	% Review Trials Correct
1	t	o	5/5	8/10					5	100%
2	t	o	5/5	10/10					5	100%
3	r	o, t	1/2	3/3	8/10				4	80%
4	r	o, t	2/2	2/3	8/10				4	80%
5	l	o, t, r	2/2	1/1	0/2	8/10			3	60%
6	l	o, t, r	0/1	2/2	2/2	9/10			4	80%
7	u	o, t, r, l	1/1	1/1	1/1	1/2	8/10		4	80%
8	u	o, t, r, l	1/1	1/1	1/1	0/2	8/10		3	60%
9	p	o, t, r, l, u	1/1	1/1	0/1	1/1	1/1	9/10	4	80%
10	p	o, t, r, l, u	1/1	1/1	1/1	1/1	1/1	10/10	5	100%

Note. The number of trials per review letter varied, but always equaled a total of 5 trials for each session. The number of trials for target letter-sound correspondences always equaled 10.

Zach. Zach acquired 4 letter-sound correspondences after receiving 31 instructional sessions. During these sessions, Zach received instruction on 5 of the 6 of the target letter-sound correspondences. The school year ended before Zach demonstrated acquisition for the letter-sound correspondence, *u*, and before he received

instruction on *p*. Zach demonstrated acquisition for 4 letter-sound correspondences after approximately 260 minutes of explicit instruction and 130 minutes of extended activities for a total of 390 minutes (6.5 hours) of instruction. Zach's rate of acquisition for reaching criterion ranged from 4 to 9 instructional sessions for each letter-sound correspondence. During independent practice, Zach demonstrated 100% accuracy on previously acquired letter-sound correspondences. See Table 10 for a detailed summary of Zach's performance on the previously acquired letter-sound correspondences (i.e., review trials) during independent practice.

Table 10

Summary of Zach's Performance on Acquired Letter-Sound Correspondences During Independent Practice

			Number of Correct Responses on Trials During Independent Practice[b]							
Session	Target Letter	Acquired Letters	o	t	r	l	u	p	Review Trials Correct	% Review Trials Correct
1	t	o	5/5	9/10					5/5	100%
2	t	o	5/5	9/10					5/5	100%
3	r	o, t	3/3	2/2	10/10				5/5	100%
4	r	o, t	3/3	2/2	8/10				5/5	100%
5	l	o, t, r	1/1	2/2	2/2	10/10			5/5	100%
6	l	o, t, r	2/2	1/1	2/2	8/10			5/5	100%

Note. The number of trials per review letter varied, but always equaled a total of 5 trials for each session. The number of trials for target letter-sound correspondences always equaled 10.

Cole. Cole demonstrated acquisition for 4 letter-sound correspondences after receiving 18 instructional sessions. During these sessions, Cole received instruction on 5 of the 6 target letter-sound correspondences. The school year ended before Cole demonstrated acquisition for the letter-sound correspondence, *u*, and before receiving instruction on *p*. Cole acquired four letters after approximately 140 minutes of explicit instruction and 70 minutes of extended activities for a total of 210 minutes (3.5 hours) of instruction. Cole's rate of acquisition for reaching criterion ranged from 3 to 4 instructional sessions for each letter-sound correspondence. During independent practice, Cole demonstrated 100% accuracy on previously acquired letter-sound correspondences. See Table 11 for a summary of Cole's performance on previously acquired letter-sound correspondences (i.e., review trials) during independent practice.

Table 11

Summary of Cole's Performance on Acquired Letter-Sound Correspondences During Independent Practice

Session	Target Letter	Acquired Letters	Number of Correct Responses on Trials During Independent Practice[b] o	t	r	l	u	p	Review Trials Correct	% Review Trials Correct
1	t	o	5/5	10/10					5/5	100%
2	t	o	5/5	10/10					5/5	100%
3	r	o, t	3/3	2/2	10/10				5/5	100%
4	r	o, t	3/3	2/2	9/10				5/5	100%
5	l	o, t, r	2/2	1/1	2/2				5/5	100%
6	l	o, t, r	2/2	2/2	1/1				5/5	100%

Note. The number of trials per review letter varied, but always equaled a total of 5 trials for each session. The number of trials for target letter-sound correspondences always equaled 10.

Summary of participants' performance during instructional sessions. One participant, Cameron, demonstrated acquisition for all 6 letter-sound correspondences. Zach and Cole demonstrated acquisition for 4 letter-sound correspondences. Because the school year ended, Zach and Cole received a limited number of instructional sessions for *u* (5 for Zach, 4 for Cole) and did not reach criterion for this letter-sound correspondence during instructional sessions. Because Zach and Cole did not reach criterion for *u,* neither participant received formal instruction on the letter-sound correspondence *p*.

Acquisition rates for instructional sessions ranged from 3 to 12 instructional sessions for each letter-sound correspondence. See Table 12 for a summary of all participants' rates of acquisition for each letter-sound correspondence.

Table 12

Summary of Participants' Rate of Acquisition

	Rate of Acquisition for Each Letter (Number of sessions required to reach criterion)					
Participant	o	t	r	l	u	p
Cameron	5	5	4	7	12	3
Zach	4	9	9	4		
Cole	4	4	3	3		

As the participants acquired letter-sound correspondences, the researcher tested these acquired letter-sound correspondence during independent practice sessions. All participants demonstrated an average of at least 82% accuracy for previously acquired letter-sound correspondences during the independent practice sessions (i.e., review trials). This provides evidence that all three participants demonstrated some maintenance of previously acquired letter-sound correspondences during instructional sessions. See Table 13 for a summary of participants' performance on previously acquired letter-sound correspondences (i.e., review letters) presented during independent practice.

Table 13

Summary of Participants' Performance on Review Trials During Independent Practice

	Percent Correct on Total Review Trials During Independent Practice					
Participant	o	t	r	l	u	Percent of Review Trials Correct
Cameron	19/21	12/13	5/8	3/6	2/2	82%
Zach	18/18	7/7	4/4			100%
Cole	20/20	7/7	3/3			100%

Social Validity

After instruction was completed, the researcher provided a Social Validity Questionnaire (see Appendix M) to three early intervention professionals (2-teachers, 1-speech-language pathologist) all of whom worked with the participants. The questionnaire assessed the professionals' perceptions of the intervention and the participants' performance. In response to the statement, "The student's reading skills improved as a result of the intervention," 2 professionals indicated "strongly agreed" and 1 indicated "agreed". All 3 early intervention professionals indicated that they "agreed" with the following statements: (a) "The reading intervention could be implemented in the classroom or natural environment by a teacher/therapist," and (b) "The reading intervention would be beneficial for other children with autism."

When asked about the benefits of the intervention, 2 early intervention professionals discussed the positive performance of the students and another early intervention professional noted that the intervention was "systematic and structured"

which met the students' needs. When asked what they would change about the intervention they all reported that they would not change anything, but one early intervention professional noted that she would like to see more children from the preschool program involved in the study. Another early intervention professional reported that she would like to see the intervention implemented in a small group of 2 to 3 students.

CHAPTER 5

Discussion

The current study examined the effects of providing adapted reading instruction on the acquisition of letter-sound correspondences for young learners with ASD and complex communication needs. The results provide evidence that the three children who participated in this study learned new letter-sound correspondences, maintained their knowledge of the letter-sound correspondences after instruction was completed, and generalized this information to modified task formats.

The current study extends the previous research related to reading instruction for learners with ASD and learners with complex communication needs. Specifically, this study extends previous research by examining that the use of evidence-based instructional practices and adaptations (Fallon, et al., 2004; Light & McNaughton, 2009a, 2009b; Millar et al., 2004) for young learners (ages 3 to 5) with ASD and complex communication needs. Additionally, this study contributes to the literature by focusing specifically on the impact of teaching letter-sound correspondences as a first step toward early literacy skills for young learners with ASD.

Previous studies that focused on reading instruction for individuals with complex communication needs have typically included school-age children and young adults (Blischak et al., 2004; Coleman-Martin et al., 2005; Fallon et al., 2004; Foley, 2003; Heller et al., 2002; Millar et al., 2004). Because of the important role that literacy can play in the AAC systems of individuals with complex communication needs, a decision was made to examine the impact of instruction on very young children. The results from this study provide evidence that implementing adapted reading instruction to young

children with ASD and complex communication needs increased the students' acquisition of letter-sound correspondences.

This study suggests that evidence-based, adapted instructional techniques can be effective in teaching letter-sound correspondences as a first step toward the development of a wide range of literacy skills. In the remainder of this chapter the results of the participants' performance will be discussed in greater detail for both the LSC Probes and the instructional sessions. Next, based on the results of this study, classroom implications for teachers will be outlined. Finally, limitations of this study will be presented followed by future directions for researchers.

Participants' Acquisition of Letter-Sound Correspondences

The results of this study suggest that young learners with ASD and complex communication needs acquired targeted letter-sound correspondences after receiving adapted instruction. Specifically, the intervention included (a) instructional content recommended by the National Reading Panel (2000), (b) evidenced-based teaching practices (e.g., explicit and systematic instruction, instructional scaffolding, and immediate and corrective feedback), and (c) adaptations for participants with complex communication needs that eliminated the need for an oral response during instruction (e.g., providing learners with alternative means for responding such as selecting target letters and words rather than producing oral responses (Light & McNaughton, 2009a, 2009b).

In general, research has provided evidence that struggling readers benefit from systematic and explicit instruction (Adams, 1990; Carnine et al., 2010; 2006; National Reading Panel, 2000). Such approaches maximize instructional time by directly teaching

the skills necessary to meet the target goal while also taking into consideration the students' present levels of performance (Hughes & Archer, in press; Rosenshine & Stevens, 1986). Systematic and explicit instruction, therefore, provides teachers with an efficient approach to teaching that supports student success and promotes independent learning while minimizing student frustration. This study, like previous studies, provides evidence that systematic and explicit instruction on letter-sound correspondences produce positive outcomes for learners with disabilities and complex communication needs (Fallon et al., 2004; Light & McNaughton, 2009a; Millar et al., 2004).

Given the unique characteristics of individuals with ASD (deficits in communication skills, deficits in social skills, and restricted and repetitive patterns of behavior and interests), it is important to consider how the components included in this intervention may be beneficial for learners with ASD. First, the majority of learners with ASD demonstrate language delays (Kjelgaard & Tager-Flusberg, 2001; Leekam, 2007; Tager-Flusberg & Joseph, 2003) and as many as 50% of learners with autism never develop functional speech (Lord & Paul, 1997; Mesibov, et al., 1997); therefore, other individuals with ASD, like the participants included in this study, may benefit from instruction that eliminates the need for an oral response.

Second, because individuals with ASD often demonstrate difficulty interacting with others and demonstrate repetitive patterns of behavior and interests, theses individuals may experience difficulty attending to relevant information, comprehending abstract information, and generalizing skills (Olley, 1992). In fact, researchers have reported that providing highly structured interventions with predictable and direct teaching formats, have proven to be effective interventions for individuals with ASD

(Westwood, 2007). Given that explicit and systematic instruction includes instruction that is unambiguous, logically sequenced, and consistent, the results in this study appear to support using structured interventions for teaching reading skills to learners with ASD. These results are consistent with the findings of Coleman-Martin et al. (2005) and Flores et al. (2004) who also found that learners with ASD acquired phonics skills after receiving explicit and systematic instruction.

Summary of participants' performance on letter-sound correspondence probes. Although all three participants demonstrated an increase in the number of correct responses on the LSC Probe, there are a number of factors, which may have contributed to the pattern of results that was observed. With respect to the impact of instruction as observed on the LSC Probe, 2 of the 3 participants did not demonstrate an immediate treatment effect after the implementation of the intervention. In fact, both Cole and Zach did not demonstrate a consistent increase in performance on the letter-sound correspondence probes until the fifth and sixth intervention probe respectively. Learning letter-sound correspondences is a challenging task (Adams, 1990) particularly for learners with complex communication needs (Foley, 1993); therefore, it is not surprising that Zach and Cole took some time to demonstrate acquisition of new letter-sound correspondences on the LSC Probe.

It is important to note that the LSC Probes presented in this study were particularly challenging for a number of reasons. One factor contributing to the difficulty of this task was that the LSC Probes assessed newly learned and previously learned letters simultaneously; therefore, the probes required the participants to not only retain the information taught previously, but to also discriminate between newly learned and

previously learned letter-sound correspondences. When reviewing the participants' scores on previously acquired letter-sound correspondences, all three participants demonstrated evidence of maintenance for these letter-sound correspondences on the LSC Probes. The participants' performance, therefore, provides promising evidence regarding the strength of the intervention for teaching letter-sound correspondences to individuals with ASD and complex communication needs. In addition, due to the nature of the task, the participants were required to discriminate between six letters when matching the corresponding letter to the target sound.

Another important consideration when analyzing the performance of the participants is that the researcher always presented the LSC Probes prior to instruction on that day; therefore, each probe required the learners to apply the knowledge that they retained from the previous instructional session. Given that each probe was administered at least 1 day after the last instructional session (and sometimes 4 days after the last session if the probe was administered on the first day after a 3-day weekend), the probes required the learner to retain knowledge of the letter-sound correspondences taught during the previous instructional sessions. Therefore, these probes essentially provided a measure of participants' learning maintenance from session to session. Therefore, the LSC Probes in this study required the participants to (a) identify, (b) discriminate, and (c) retain the target letter-sound correspondences.

It is also of interest to note that both Zach and Cole remained in baseline for a longer time than Cameron, and that during this time both participants demonstrated distinct patterns for the responses they provided on the LSC Probe during baseline testing. For example, once baseline began Zach responded to each trial by selecting the

letter *o*, which resulted in a score of 2 for every probe during baseline. Cole also demonstrated patterns for his selections: he frequently selected *u* for the sound /t/, *r* for /l/, and *t* for /r/. Given that the participants did not receive corrective feedback during the probes (but did receive encouragement for participating), this may have resulted in a situation in which participants "practiced errors." When learners repeat mistakes, additional time is often required for students to "unlearn" these errors (Brophy & Good, 1986; Hughes & Archer, in press; Rosenshine & Stevens, 1986). Because of the requirements of this study, it was necessary for Zach and Cole to be tested during baseline without receiving corrective feedback during this time. In a typical classroom, there would be no need for a participant to be repeatedly tested on letter-sound correspondences without receiving any instruction. Therefore, there is some reason to think that other children with ASD and complex communication needs may actually demonstrate better performance than the children in this study, as they will not have to repeatedly practice providing responses for letters for which they have not received instruction.

Finally, the results reported here reflect a strict adherence to the scoring rules used in this study, which defined a response as the first letter touched by a participant. Especially in the early stages of instruction, participants would sometimes briefly touch a number of cards before picking one up, or would "straighten" or "align" the six cards in front of them before reaching for the desired letter. For example, Cameron often briefly touched a card immediately after hearing the target sound, and then appeared to reach more purposefully toward the correct card—to "self-correct" in a sense, as he was not provided with corrective feedback. However, because participants were scored on their

first response, these "self-corrections" and "adjustments" were counted as errors. The results reported here, therefore, may actually be an underestimate of the participants' letter-sound correspondence knowledge.

Summary of participants' maintenance performance. The researcher collected maintenance data for all three participants: 4 weeks after the intervention ended for Cameron and Cole, and 5 weeks after the intervention ended for Zach. After the school year ended, Zach had began attending a different school for the summer session; therefore, he was only available for a limited time 5 weeks after the intervention ended. All three participants demonstrated evidence of maintenance for the letter-sound correspondences acquired during instruction. Although the mean score on maintenance probes was slightly below the mean performance during the end of the intervention for two of the participants (Cameron and Cole), it was still within 5% of their mean score at the end of the intervention. In addition, each score on the maintenance probes reflected an increase of at least five correct responses compared to each baseline score. Therefore, these data provide evidence that all three participants demonstrated maintenance of the letter-sound correspondences that they acquired during the intervention.

The fact that all three participants demonstrated evidence of maintenance is an important point to consider when evaluating the components of the intervention implemented in this study. One component included cumulative review and practice of previously learned letter-sound correspondences. Researchers have consistently reported that providing cumulative review and practice helps learners to retain previously learned information (Brophy & Good, 1986; Carnine et al., 2006; Hughes & Archer, in press; Rosenshine & Stevens, 1986). Based on the results in this study it appears that providing

cumulative review and practice supported the participants' maintenance of the letter-sound correspondences acquired during the intervention.

During the maintenance probes, none of the participants performed below 80% accuracy for two consecutive sessions, therefore, a booster session was not implemented. It is important to keep in mind that both Zach and Cole did not reach criterion for two of the letter-sound correspondences, therefore, although the probe included 12 trials, Zach and Cole had only reached criterion for letter-sound correspondences presented in 8 of the 12 trials (67%). Both Zach and Cole's adjusted maintenance score (that is, the percentage of correct responses that included the letter-sound correspondences for which they had demonstrated acquisition) averaged 96% for all three maintenance probes.

Summary of participants' generalization performance. All three participants demonstrated generalization of letter-sound correspondence knowledge during two different tasks: (a) identifying letter-sound correspondences on the Generalization Book Probe, which presented the letters in a book-like format; and (b) identifying target letter-sound correspondences on a Generalization Alphabet Probe, which included a field of six letters selected randomly from the entire alphabet. All participants demonstrated mean scores that were above 75% accuracy for both tasks. Zach was the only participant who scored below 80% on the generalization probes (an average score of 79%). However, Zach had only received instruction on 5 of the 6 target letter-sound correspondences and he had only reached criterion for 4 of the letter-sound correspondences. Zach's adjusted generalization score—that is, his rate of success on both generalization tasks for the letters for which he had demonstrated acquisition—was 8 out of 8 (i.e., 100% accuracy). Like Zach, Cole also demonstrated acquisition for 4 letters and demonstrated an adjusted

acquisition score of 8 out of 8 (i.e., 100% accuracy) on both generalization probes. Cameron received instruction on all six letter-sound correspondences and scored an average of 83% and 92% on both generalization probes. Given that learners with ASD often demonstrate difficulty generalizing information across different contexts (American Psychiatric Association, 2000; Olley, 1992), the participants' performance on generalizing letter-sound correspondence skills across tasks and materials provides further evidence that this particular intervention was effective for these students.

Summary of participants' performance during instructional sessions. Each participant reached criterion for 4 to 6 letter sounds after receiving 18 to 36 instructional sessions respectively. As described previously, each session consisted of approximately 10 minutes of teacher-directed, explicit instruction and 5 minutes of extension activities (i.e., approximately 180 to 360 minutes of teacher-directed, explicit instruction and approximately 90 to 180 minutes of literacy-related extension activities) on four to six target letter sounds.

Rate of acquisition. The participants in this study demonstrated acquisition rates ranging from 3 to 12 sessions for each letter sound (i.e., 45 to 180 minutes). All participants demonstrated varied rates of learning for reaching criterion for acquisition of letter-sound correspondences: Cameron averaged 6 instructional sessions; Zach averaged 6.5 instructional sessions, and Cole averaged 3.5 instructional sessions.

Other researchers have investigated the effect of instruction on the acquisition of letter-sound correspondences for learners with significant disabilities (Blischak, et al., 2004; Fallon et al., 2004; Flores et al., 2004; Millar et al., 2004). Flores et al. (2004) implemented systematic and explicit instruction to teach letter-sound correspondences to

elementary students (7 to 13 years of age) with moderate intellectual disabilities, which included one learner with autism. These students reached criterion for identifying letter-sound correspondences after receiving approximately 3 to 16 instructional sessions per letter-sound correspondence. The student with autism (age 7) required 3 to 5 sessions per letter-sound correspondence. In another study, Millar and colleagues (2004) provided explicit instruction on five letter-sound correspondences. The researchers found that 2 out of 3 participants with complex communication needs (7 to 10 years of age) acquired 5 letter-sound correspondences after receiving 10 to 14 instructional sessions (i.e., ranging from 2 to 4 instructional sessions per letter).

It is important to note, however, that it is difficult to compare rates of acquisition across these studies for two reasons. First, the number of minutes focused on teaching letter-sound correspondences was not stated in the Flores et al. study; therefore, it cannot be determined if sessions were equal length. In the Millar et al. study, the researchers reported that a session typically included 30 to 45 minutes of instruction (which included instruction on letter-sound correspondences, identifying initial phonemes in words, and a writer's workshop-type activity). These sessions were 2 to 3 times as long as the sessions conducted in this study and provided instruction on additional reading skills; therefore, these differences should be taken into consideration when comparing the number of sessions required for participants to demonstrate the targeted skill.

A number of factors may have contributed to the differing rates for the acquisition of letter-sound correspondences found in this study. Past research suggests that different letters may be "easier" or "harder" for individuals to learn (Adams, 1990; Carnine et al., 2010; Carnine et al., 2006) and there is also some anecdotal evidence that helping a

student learn the relationship between letters and sounds can require extensive instruction. Cameron received instruction on all six letter-sound correspondences (*o*, *t*, *r*, *l*, *u*, *p*) over 36 instructional sessions. He demonstrated his slowest rate of learning for acquiring the letter-sound correspondence for *u* (12 sessions) followed by *l* (7 sessions). Some of this difficulty may have resulted from the challenge of discriminating the sound for newly introduced letter-sound correspondences. When the researcher introduced the letter-sound correspondence for *u*, Cameron demonstrated difficulty discriminating between the letter-sound correspondences for *o* and *u*. Similarly, Cole also demonstrated difficulty discriminating between these sounds. Given that the school year ended, Cole never reached independent practice with this letter-sound correspondence. When these letters were not presented together in a field of choices, both Cameron and Cole identified the correct letter-sound correspondence, but when presented with both *o* and *u*, they both demonstrated difficulty during the guided practice stage of instruction. Cameron and Cole's performance for discriminating between the letter-sound correspondences *o* and *u*, is consistent with the research of Carnine and colleagues (Carine et al., 2010; Carnine et al., 2006) who suggest that learners are more likely to demonstrate difficulty discriminating between letters that have similar sounds.

Another factor that may contribute to the varying acquisition rates across participants may be that some participants remained in baseline longer than others. As described previously, both Zach and Cole remained in baseline longer than Cameron and during this time, both participants demonstrated patterns in their responses during the baseline probes. Because no corrective feedback was provided during any of the LSC Probes, the participants did not have the opportunity to correct their errors until after they

completed several probes. Researchers have reported that when errors are not immediately corrected that "unlearning" these mistakes may take additional time as a result of "practicing errors" (Brophy & Good, 1986; Hughes & Archer, in press; Rosenshine & Stevens, 1986).

Cole and Zach received instruction on five letter-sound correspondences for 18 and 31 instructional sessions respectively. Zach acquired four letter sounds (*o*, *t*, *r*, *l*) after 26 sessions and Cole acquired these same four letters after 14 sessions. When examining Zach's performance, he demonstrated the slowest rate of learning for both *t* and *r* (9 sessions for each letter-sound correspondence). It is important to note that although Zach reached criterion for the letter-sound correspondence for *o* after four instructional sessions, like his performance on the LSC Probes, he selected the letter *o* for almost every trial during the instructional sessions. Although at first glance, Zach appeared to acquire the letter-sound correspondence for *o* after four instructional sessions, his performance may have been more of a reflection for his preference for the letter *o* rather than a true understanding of the relationship between *o* and its corresponding sound.

When reviewing Zach's instructional data, once the researcher introduced the letter-sound correspondence for *t*, Zach demonstrated accuracy percentages of 40%, 10%, 10% and 10% for *o* during the initial review trials. Therefore, although the data appear to provide evidence that Zach acquired *o* after four sessions, he may have just been indicating the letter *o* without really attending to the presence of a letter-sound correspondence between the letter *o* and its sound. It was only when the letter *t* was introduced that Zach truly learned that there was a unique relationship between specific

sounds and specific letters. The time that it took for Zach to demonstrate acquisition of the letter *t* (and then *r*) appears to represent his growing understanding of the relationship between letters and sounds. The letter *l* (introduced after Zach's acquisition of *t* and *r*) was learned more quickly than *t* or *r*, perhaps because Zach had a better understanding about the relationship between letters and their corresponding sounds. This provides some evidence that while Zach was learning the sound for *t* that he was also trying to learn the letter sound for *o* at the same time, which may have contributed to the number of instructional sessions required for acquiring *t*.

When reviewing the participants' rate of acquisition for learning letter-sound correspondences, it is also important to consider that all three participants demonstrated some knowledge of letter names. Researchers have reported that knowledge of letter names may facilitate learning letter-sound correspondences for a couple of reasons. First, knowing letter names provides the learner with a clear referent for the corresponding sound; therefore, making the concept of the letter and its sound concrete and potentially easier for the learner to understand (e.g., "'*a*' says aaaaa") (Adams, 1990; Ehri & Roberts, 2006). Second, there is some evidence that when learners know the names of letters that this can support their acquisition of letter-sound correspondences given that the letter names often resemble their corresponding sound (e.g., /p/ and *p*) (Adams, 1990; Ehri & Roberts). However, in some cases, knowing the letter names may also hinder acquisition of letter-sound correspondences as it may require the individual additional time to understand that the sound of the letter is different from its name. Although knowing letter names is certainly important, it is actually knowledge of letter-sound

correspondences that assists individuals in learning how to read (Adam, 1990; Carnine et al., 2010), which is an important point to consider when teaching early reading skills.

Maintenance of previously introduced letter-sound correspondences. All three participants demonstrated maintenance of previously learned letter-sound correspondences on LSC Probes and during independent practice. The researcher interspersed trials of previously acquired letter-sound correspondences during independent practice in order to assist the participants in retaining previously learned information as well as to promote discrimination between newly learned and previously learned letter sounds (Brophy & Good, 1986; Carnine et al., 2010; Hughes & Archer, in press; Rosenshine & Stevens, 1986). All three participants demonstrated an average score of 82% to 100% accuracy on previously acquired letter-sound correspondences presented during independent practice. Also, the participants improvement on the LSC Probes over time provides evidence that they learned new LSC and retained their knowledge of LSC that had been taught in earlier sessions. The participants' performance during independent practice provides additional evidence that young learners with ASD and complex communication needs maintained previously acquired letter-sound correspondences and accurately discriminated between the letter-sound correspondences after receiving an intervention that included (a) explicit and systematic instruction; (b) immediate and corrective feedback; and (c) cumulative review and practice.

Classroom Implications

The results presented in this study provide promising evidence regarding the effectiveness of the targeted intervention for teaching letter-sound correspondences to

young learners with ASD and complex communication needs. This study suggests that all three participants acquired and maintained the letter-sound correspondences targeted during instruction. Additionally, participants demonstrated generalization for identifying acquired letter-sound correspondences across tasks and materials. Finally, as demonstrated by the results of the Social Validity Questionnaire used in this study, early intervention professionals reported that (a) the participants in this study demonstrated improvement in reading performance, (b) other children with ASD would likely benefit from such instruction and (c) this intervention could be incorporated into classrooms. The results from this questionnaire provide some evidence that early intervention professionals viewed the intervention described in this study as effective, appropriate, and practical for teaching letter-sound correspondences to young learners with ASD and complex communication needs. In planning the implementation of this intervention in a classroom, there are several classroom implications to consider.

First, there is reason to think that the sequence of letter-sound correspondences selected for students should be determined on an individual basis. For research purposes, all three children in this study learned the same letters in the same order, however, the group of letters selected for this study may not be the ideal choice for all students. It is important to first assess learners' present level of performance in order to determine which letter-sound correspondences the learner may already know, and then to sequence the unknown letter-sound correspondences using the sequencing guidelines recommended by Carnine et al. (2010) and Light and McNaughton (2009a). Any letter-sound correspondences that the learner may already know prior to instruction should be used as part of the cumulative review and practice to ensure the learner retains this

information and learns to discriminate between previously learned letter-sound correspondences and newly introduced letter-sound correspondences (Carnine et al., 2010; Light & McNaughton, 2009a). As mentioned previously, the selection of letters used in this study was constrained by the need to use the same letters with all students. Developing individual sets of letters for instruction (and review) may have resulted in more rapid acquisition.

Second, although the instruction in this study focused specifically on the impact of instruction on letter-sound correspondences, it is important to remember that reading is a complex process that includes the integration of many skills (Adams, 1990). When it comes to providing reading instruction in the classroom, it is important to support the development of a variety of skills, including instruction on phonemic awareness. In fact, researchers have found that integrating instruction on letter-sound correspondences in phonemic awareness activities has resulted in even greater reading gains than teaching either skill in isolation (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Ehri & McCormick, 1998; Hatcher, et al., 1994; Oudeans, 2004). Single-word decoding skills depend not only on orthographic awareness (i.e., knowledge of letter-sound correspondences), but also on phonemic awareness, which includes phoneme segmentation and sound blending. Therefore, when providing instruction on letter-sound correspondences as a first step toward decoding skills, it is also important to include instruction on phonemic awareness skills.

When teaching reading skills to learners with complex communication needs, it is often necessary to adapt instruction in order for the learners to fully participate during the instructional tasks. A number of authors have suggested adaptations to support the

participation of individuals with complex communication needs during literacy activities (Blischak, 2004; Coleman-Martin et al., 2005; Fallon et al., 2004; Heller et al., 2002; Light & McNaughton, 2009a; Millar et al., 2004). Light and McNaughton (2009a) have developed specific adaptations and procedures that eliminate the need for an oral response. For example, asking learners to select the corresponding letter when presented with a sound or to select the corresponding PCS symbol that represents the target word during a single-word decoding task. When providing reading instruction to individuals with complex communication needs, it is critical for teachers to consider what adaptations will effectively support each student's participation and learning.

Last, although it was not investigated in this study, teachers may consider including small-group instruction to teach letter-sound correspondences. The literature on best-evidence teaching practices indicates that the greatest gains in student achievement result from small group instruction (Hughes & Archer, in press; Vaughn et al., 2000; Rosenhine & Stevens, 1986). Small-group instruction increases the amount of instructional time for students by allowing each child to receive more instruction at an appropriate instructional level (Brophy & Good, 1986; Hughes & Archer, in press). Additionally, small-group instruction allows learners to receive more opportunities for interacting with peers, taking turns, and listening to others (Hughes & Archer, in press). Considering that individuals with ASD often demonstrate deficits in social skills, small-group instruction may be beneficial for these individuals as it provides an opportunity for them to interact with their peers and practice appropriate social behavior. Some researchers have investigated the impact of small-group reading instruction that focused on teaching sight words to learners with ASD (Collins & Stinson, 1994; Kamps &

Walker, 1990; Ledford, Gast, Luscre, & Ayres 2008; Rehfeldt, Latimore, & Stromer, 2003). These researchers found that the learners with ASD demonstrated acquisition of some reading skills by observing their peers perform the target reading task; therefore, these studies provide some evidence that this population of students may benefit from small-group reading instruction.

Limitations

The current study's investigation of teaching letter-sound correspondences to young children with ASD and complex communication needs, offers important information regarding the instructional techniques and the participants' performance both during and after the intervention. However, there are limitations that should be considered. First, this study only included three children with ASD and complex communication needs; therefore, more research is required to determine the generalizability of these results to other young learners with ASD and complex communication needs.

A second limitation of this study is that the instructional program implemented included a packaged intervention consisting of explicit instruction and extension activities. Therefore, in this study it is not possible to tease out the effects of one instructional task from the other. In order to determine the impact of each task on the learners' acquisition of letter-sound correspondences, further researcher would need to be conducted examining the specific effect of each instructional activity.

Third, the sequence of the letter-sound correspondences selected for this study was based on all three participants' knowledge of letter-sound correspondences. In order to ensure that each participant's experience was similar to that of the other participants,

letter-sound correspondences identified correctly by any of the three participants prior to instruction were not included in the intervention. After determining the letter-sound correspondences that were unknown to all three participants, the researcher used the sequencing guidelines recommended by Carnine et al. (2010) and Light & McNaughton (2009a) to determine an appropriate instructional sequence for the target letter-sound correspondences. Although this was an appropriate sequence for introducing new letter-sound correspondences a more individualized sequence may have been more beneficial for each participant.

Fourth, due to the fact that the school year ended, 2 of the 3 participants (Zach and Cole) did not receive instruction on all six of the targeted letter-sound correspondences. Although Zach and Cole received instruction on 5 of the 6 letter-sound correspondences, the school year ended before either participant had the opportunity to demonstrate acquisition for *u*; therefore, neither participant had the opportunity to receive instruction on *p*. However, as described previously, it is important to keep in mind that the intervention implemented in this study should only be viewed as the very beginning stage of instruction for teaching early reading skills and that it is critical for instruction to continue for these participants.

Finally, although it was the specific purpose of this study to focus solely on teaching letter-sound correspondences, it is important to note that teaching other reading skills (e.g., phonemic awareness skills) is appropriate and often recommended. As described previously, researchers have found that integrating phonemic awareness tasks with instruction on letter-sound correspondences has shown to have positive effects on student outcomes (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Ehri &

McCormick, 1998; Hatcher, et al., 1994; Oudeans, 2004; Simmons & Kame'enui, 1998). Additionally, once learners master phoneme segmentation, sound blending, and 4 to 6 letter-sound correspondences, instruction on single-word decoding can begin (Carnine et al., 2010; Light & McNaughton, 2009a). As described previously, based on the theoretical framework presented in this paper, skillful reading is a system comprised of many components that interact and develop together, and classroom instruction should support this interactive and integrated process.

Future Research Directions

When considering reading instruction for young learners with ASD and complex communication needs, the results of the current study suggest several potential directions for future research in this area. First, in order to increase evidence that these results will generalize to other young learners with ASD and complex communication needs, conducting additional research that investigates the impact of this intervention on a similar population of students is necessary.

Second, as described previously, teaching letter-sound correspondences is the first step toward single-word decoding. Therefore, it is essential to investigate instruction on other early reading skills (e.g., phoneme segmentation, sound blending, single-word decoding) for young learners with ASD and complex communication needs. Given the limited research on decoding instruction for learners with ASD, it is important to conduct additional reading research that focuses on teaching other components that are necessary for supporting skillful reading.

Another important direction for future research is investigating the impact of a similar intervention delivered to a small group of students (i.e., 2 to 4 students).

Examining the effect of small-group reading instruction for young learners with ASD and complex communication needs may provide helpful insights on how these students perform in small groups as well as any differences that may occur in how to effectively deliver this intervention compared to one-to-one instruction.

In addition to investigating small-group instruction, it is also important to examine the impact of this intervention when delivered by a variety of educational personnel. Although this study provides evidence that this intervention is effective when delivered by a researcher, it is important to examine its efficacy when implemented by teachers, speech-language pathologists, paraprofessionals, and parents. Therefore, establishing a training program for education professionals and examining the instructor's delivery as well as the students' performance may provide helpful information on how to effectively train education professionals on successfully implementing this intervention in their classrooms.

Conclusion

The current study contributes to the existing literature base on providing letter-sound correspondence instruction to both learners with ASD and to learners with complex communication needs. Results of this study provide evidence that implementing evidence-based instructional practices with adaptations for learners with complex communication needs resulted in an increase in the learners' knowledge of letter-sound correspondences. The results of this study also provide evidence that young learners with ASD (as young as 3-years-old) can acquire letter-sound correspondences using the intervention described in this study. This is a particularly promising finding considering that the participants in this study had both a diagnosis of ASD and demonstrated complex

communication needs. Once learners acquire letter-sound correspondences, they can then learn how to apply this knowledge to read words (Adams, 1990; Ball & Blachman, 1991). In addition to developing early reading skills, learning letter-sound correspondences at a young age can support the development of spelling and writing skills, which individuals with complex communication needs may be able to make use of as part of their AAC system (Beukelman & Mirenda, 2005; Heller et al., 2002; Light & McNaughton, 2009a). Finally, teaching early reading skills to young learners with ASD and complex communication needs may also increase their participation in the general education classroom, and ultimately support their academic participation and success.

Literacy skills play an essential role in the lives of all individuals, not only for achieving academic and work-related goals, but also for communicating, interacting, and developing relationships with others. Utilizing literacy skills for communication purposes is especially important for individuals with complex communication needs, as this may be the only method in which these individuals can effectively communicate with others. This study is the first step toward developing literacy skills for young learners with ASD and complex communication needs.

There are adults with complex communication needs who become skilled readers and writers, but this is typically only achieved with appropriate instruction and opportunities to learn and practice these skills. Bob Williams (2000), an adult with complex communication needs wrote about the importance of literacy skills on the lives of individuals with complex communication needs. In the following quotation, Williams describes the powerful impact that literacy can have on the lives of individuals with

complex communication needs and the importance in providing young learners with the opportunity to learn literacy skills:

> When I look over my own life…I am thankful for one other gift I received early on in life which most people can take for granted: the gift of literacy—of reading and writing, of making sense out of the world and having the reciprocal ability of letting the world make sense out of you and come to respect you for all that you have to offer and contribute. This to me is the true gift and power of literacy in each of our lives (p. 247).

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APPENDIX A

Institutional Review Board Research Approval Letter

PENNSTATE

Vice President for Research
Office for Research Protections

The Pennsylvania State University
The 330 Building, Suite 205
University Park, PA 16802-3301

(814) 865-1775
Fax: (814) 863-8699
www.research.psu.edu/orp/

Date: February 15, 2010

From: XXXXX X XXXXX, Compliance Coordinator

To: Janice C. Light

Subject: Results of Review of Proposal - Expedited **(IRB #32955)**
Approval Expiration Date: February 1, 2011
"Evidence-Based Literacy Instruction for Learners with Complex Communication Needs"

The Institutional Review Board (IRB) has reviewed and approved your proposal for use of human participants in your research. By accepting this decision, you agree to obtain prior approval from the IRB for any changes to your study. Unanticipated participant events that are encountered during the conduct of this research must be reported in a timely fashion.

Attached are the dated, IRB-approved informed consent forms to be used when recruiting participants for this research. Participants must receive a **copy** of the approved informed consent form to keep for their records.

If signed consent is obtained, the principal investigator is expected to maintain the original signed consent forms along with the IRB research records for this research at least three (3) years after termination of IRB approval. For projects that involve protected health information (PHI) and are regulated by HIPAA, records are to be maintained for six (6) years. The principal investigator must determine and adhere to additional requirements established by the FDA and any outside sponsors.

If this study will extend beyond the above noted approval expiration date, the principal investigator must submit a completed Continuing Progress Report to the Office for Research Protections (ORP) to request renewed approval for this research.

On behalf of the IRB and the University, thank you for your efforts to conduct your research in compliance with the federal regulations that have been established for the protection of human participants.

Please Note: The ORP encourages you to subscribe to the ORP listserv for protocol and research-related information. Send a blank email to: L-ORP-Research-L-subscribe-request@lists.psu.edu

XXX/XXX
Attachment
cc: David B. McNaughton
Elizabeth A. Wood

APPENDIX B

Parental Consent Form

PENNSTATE

Informed Consent Form for Social Science Research
The Pennsylvania State University

Title of Project:	Evidence-Based Literacy Instruction for Learners with Complex Communication Needs
Principal Investigators:	Dr. Janice Light, Distinguished Professor 401H Ford Building University Park, PA 16802 (814) 863-2010; jcl4@psu.edu Dr. David McNaughton, Professor 227A CEDAR Building University Park, PA 16802; (814) 865-7159; dbm2@psu.edu
Other Investigators:	Elizabeth Benedek-Wood, Doctoral Candidate 123 CEDAR Building University Park, PA 16802 (814) 571-8371; eab172@psu.edu

1. **Purpose of the Study:** The purpose of this research study is to investigate evidence-based literacy instruction for children with special needs.

2. **Procedures to be Followed:** Your child will be asked to participate in an instructional activity that focuses on teaching literacy skills. Instructional sessions will take place in your child's school during a time suggested by the teacher to ensure that your child will not miss other instructional activities. The instruction will include evidence-based practices that have been found to be effective with other children. Instructional sessions will include one-to-one instruction that will focus on teaching literacy skills to help your child learn how to read. The sessions will also include activities such as reading books, singing songs and playing games to help your child identify letters and read words. Each session will be videotaped for the purpose of data collection.

   Because every child's learning experiences are different, we are committed to working with your child for at least 12 weeks to help your child learn early reading skills. After this 12-week period, we may ask your permission to continue working with your child. We will provide you with monthly updates on your child's progress and we encourage you to ask any questions you may have throughout the course of this project.

3. **Discomforts and Risks:** There are no risks in participating in this research beyond those experienced in a classroom. However, the child will be asked to participate in a one-to-one instructional activity with a researcher; therefore, this would be a new interaction for your child. The researcher is an experienced special education teacher who has worked extensively with young children. The researcher also will provide opportunities for your child to become familiar with the researcher before asking your child to participate in instructional activities, so as to reduce discomfort. Your child will always be given the choice of whether or not he/she would like to participate. Instructional sessions will last approximately 20 minutes; however, the researcher will frequently provide breaks that will allow your child to participate in an activity of his/her choice (e.g., play games, sing songs, etc.) in order to increase his/her motivation. The researcher's goal is to make the instructional session as enjoyable as possible for your child.

4. **Benefits:** Your child will participate in evidence-based literacy instruction that is adapted to meet his/her individual needs. The instruction can potentially increase your child's literacy and language skills. The study may also provide teachers with information about providing and adapting effective literacy instruction for students with special needs.

5. **Duration:** Each session will last approximately 20 minutes, and sessions will be provided 2 to 4 times per week. Because every child's learning experiences are different, we are committed to working with your child for at least 12 weeks to help your child learn early reading skills. After this 12-week period, we may ask your permission to continue working with your child.

6. **Statement of Confidentiality:** Your child's participation in this research is confidential. The data and videotapes will be coded, stored, and secured in Ford Building in a locked file. Only the investigators listed above will have access to the data and videotapes. In the event of a publication or presentation resulting from the research, no personally identifiable information will be shared. The Pennsylvania State University's Office for Research Protections, the Institutional Review Board and the Office for Human Research Protections in the Department of Health and Human Services may review records related to this research study.

7. **Right to Ask Questions:** Please contact Dr. Janice Light at (814) 863-2010 with questions, complaints, or concerns about this study. You can also call this number if you feel this study has harmed you or your child. If you have any questions, concerns, or problems about your rights, your child's rights as a research participant, or would like to offer input, please contact The Pennsylvania State University's Office for Research Protections (ORP) at (814) 865-1775. The ORP cannot answer questions about research procedures. Questions about research procedures can be answered by the research team.

8. **Voluntary Participation:** Your decision to allow your child to be in this research is voluntary. You or your child can stop at any time. You and your child do not have to answer any questions you do not want to answer. If you or your child choose not to participate, this decision will have no impact on the instruction the school provides

for your child or your child's relationship with the school. Please keep a copy of this form for your records.

I give permission for my child, _____, to participate in this research study.

_____ _____
Parent Signature Date

_____ _____
Parent Signature Date

_____ _____
Person Obtaining Consent Date

9. **Recordings:** Each session will be videotaped for the purpose of data collection. Recording sessions allows us to verify that data is recorded accurately. The recordings are stored and secured in a locked file located in our research lab. Only the Principal Investigator, Co-Principal Investigator, and Project Coordinator will have access to this file. We typically archive recordings for a period of 3 years so that we can analyze these sessions at a later date.

   We also are involved in providing educational training for pre-service and in-service professionals. During these training activities, we like to show positive examples of children demonstrating reading skills. If we would like to use a video clip of your child, we would contact you again to ask for your specific permission to use a video clip for this purpose.

_____ I give permission for my child's recordings to be archived for use in the following way: to be considered for possible use in educational activities for pre-service and in-service professionals. I understand I will be contacted before the videotapes are used for training purposes, and I will have an opportunity to provide permission if the researchers would like to use a video clip for educational purposes.

_____ I **do not** give permission for my child's recordings to be archived for use in the following way: to be considered for inclusion in other educational activities. I understand the recordings will be destroyed within 30 days after my child's participation in the intervention has ended.

_____ _____
Parent Signature Date

_____ _____
Parent Signature Date

APPENDIX C

Communication and Language Skills Questionnaire
(Questionnaire adapted from Autism Matters, 2007;
Areas of expressive communication based on Light, 1997)

Child's name _____ Date: _____

Expressive Communication

1. What is the primary method(s) the child uses for communicating his/her **needs and wants**? (Check all that apply, but please indicate if one method is used more often.)

___ looking at objects ___ pointing at objects

___ gestures ___ handing the object to you

___ speech

___ augmentative and/or alternative system (pictures, symbols, signs, high tech systems, etc.) communication (AAC)

Please list words, phrases, and/or sentences the child uses to communicate his/her <u>needs and wants</u> (please use back if necessary):

_____

_____

_____

_____

Please list the system(s) the child uses to communicate <u>needs and wants</u> (please use other side if necessary):

_____

_____

_____

_____

___ other (**Please explain):**
_____

_____

2. What is the primary method(s) the child uses for **sharing information**? (Check all that apply, but please indicate if one method is used more often.)

___ looking at objects ___ pointing at objects

___ gestures ___ handing the object to you

___ speech

___ augmentative and/or alternative communication (AAC) system (pictures, symbols, signs, high tech systems, etc.)

Please list words, phrases, and/or sentences the child uses to <u>share information</u> (please use other side if necessary):

_____

_____

_____

_____

_____

_____

Please list the system(s) the child uses to <u>share information</u> (please use other side if necessary):

_____

_____

_____

_____

_____

_____

___ other (**Please explain):**

_____

_____

_____

3. What is the primary method(s) the child uses for expressing **social closeness**? (Check all that apply, but please indicate if one method is used more often.)

___ looking at objects

___ pointing at objects

___ gestures

___ handing the object to you

___ speech

___ augmentative and/or alternative communication (AAC) system (pictures, s symbols, signs, high tech systems, etc.)

Please list words, phrases, and/or sentences the child uses to express <u>social closeness</u> (please use other side if necessary):

_____

_____

_____

_____

_____

_____

Please list the system(s) the child uses to express <u>social closeness</u> (please use other side if necessary):

_____

_____

_____

_____

_____

_____

___ other (**Please explain):**

_____

_____

_____

4. What is the primary method(s) the child uses for expressing **social etiquette**? (Check all that apply, but please indicate if one method is used more often.)

___ looking at objects

___ pointing at objects

___ gestures

___ handing the object to you

___ speech

___ augmentative and/or alternative communication (AAC) system (pictures, s symbols, signs, high tech systems, etc.)

Please list words, phrases, and/or sentences the child uses to express <u>social etiquette</u> (please use other side if necessary):

_____

_____

_____

_____

_____

_____

Please list the system(s) the child uses to express <u>social closeness</u> (please use other side if necessary):

_____

_____

_____

_____

_____

_____

___ other (**Please explain):**

_____

_____

_____

5. Which of the following best describes the child's natural speech?

___ easy for everyone to understand

___ difficult for unfamiliar communication partners to understand

___ difficult for unfamiliar and familiar communication partners to understand

___ almost never understood by others

6. Which of the following statements best describes the child's reaction to his/her natural speech?

___ is easily frustrated when not understood

___ does not seem aware of speech/communication problem

___ tries to say sounds or words more clearly when asked

___ will attempt to use an alternative form of communication if the original method fails (e.g., child reverts to using a picture to communicate when you do not understand what he/she says)

___ other: _____

7. What are your primary concerns regarding the child's speech, language and/or communication skills? (Please use other side to complete response if necessary.)

_____

_____

_____

_____

_____

_____

_____

_____

_____

Receptive Communication

8. Which of the following do you think the child understands?

___ his/her own name ___ family names

___ names of people ___ names of animals

___ names of objects ___ names of body parts

___ conversational speech ___ simple questions

___ simple directions ___ complex directions

___ one-step directions ___ three-step directions

___ two-step directions ___ more than three-step directions

9. Please list the words, phrases, and/or sentences the child understands (please use other side if necessary):

_____

_____

_____

_____

_____

_____

_____

10. Please list the conditions when the child best understands language. This may include settings, people, activities, and/or materials (i.e., materials that may augment understanding such as pictures):

_____

_____

_____

APPENDIX D

Preferred Activities and Interests Questionnaire

(Please use the other side of this paper to complete responses if necessary.)

Child's name _____I am the child's: Teacher / Parent

1. Please list the child's favorite activities (e.g., puzzles, blocks, books, songs, etc.):
   _____
   _____
   _____

2. Please list the child's favorite toys:
   _____
   _____
   _____

3. Please list the child's **likes** (e.g., dogs, music, cars, etc.):
   _____
   _____
   _____

4. Please list the child's **dislikes**:
   _____
   _____
   _____

5. Please list the child's favorite movies, TV shows, books, characters, and songs:

Movies	**TV Shows**	**Books**

Characters (e.g., Mickey Mouse, Curious George, Elmo, etc.)	**Songs** (e.g., The Wheels on the Bus, Old MacDonald, etc.)

APPENDIX E

Script and Procedures for Selection Task Screening Assessment

(Based on the recommendations of Light & McNaughton, 2009a)

Introduce the task

1. *"I am going to ask you to find the picture that matches the word I am going to say."* (Place four cards in front of the learner).

2. *"I am going to say a word."* (Say a word. E.g., say *"cat."*)

Model the task

3. *"Now I look at all of the pictures. I am going to touch the picture that that shows 'cat.'"* (Look at each of the pictures. Touch the picture that shows "cat". Say the word *"cat.*")

4. *"I touched the 'cat' because this is the picture that shows 'cat.'"*

Present the task

5. *"Now it's your turn. I am going to say a word. Listen to the word. Then look at the pictures. Touch picture that shows the word."* (Place picture cards in front of the learner. Vary location of the correct response. Say a word. E.g., say "*pig*.")

6. *"Touch the picture that shows 'cat.'"*
   (Pause for up to 5 seconds, to provide the learner with an opportunity to respond. Do not provide corrective feedback.)

APPENDIX F

Pronunciation Guide for the Most Common Letter-Sound Correspondences

(Based on the recommendations of Light & McNaughton, 2009a)

Letter	Pronunciation of Letter-Sound Correspondence	Sounds like
a	aaaaaaa	/**a**/ in **a**lligator
b	b	/**b**/ in **b**oy
c	c	/**c**/ in **c**up
d	d	/**d**/ in **d**ad
e	eeeeeee	/**e**/ in **e**lephant
F	fffffff	/**f**/ in **f**an
g	g	/**g**/ in **g**o
h	h	/**h**/ in **h**ot
i	iiiiiii	/**i**/ in **i**gloo
j	j	/**j**/ in **j**og
k	k	/**k**/ in **k**ite
l	lllllll	/**l**/ in **l**og
m	mmmmmmm	/**m**/ in **m**ud
n	nnnnnnn	/**n**/ in **n**ut
o	ooooooo	/**o**/ in **o**ctopus
p	p	/**p**/ in **p**anda
q	kw	/**q**/ in **q**ueen
r	rrrrrrr	/**r**/ in **r**ed
s	sssssss	/**s**/ in **s**ad
t	t	/**t**/ in **t**op
u	uuuuuuu	/**u**/ in **u**nder
v	vvvvvvv	/**v**/ in **v**est
w	wwwwwww	/**w**/ in **w**in
x	ks	/**x**/ in bo**x**
y	yyyyyyy	/**y**/ in **y**es
z	zzzzzzz	/**z**/ in **z**oo

APPENDIX G

Excerpt from Script for Assessing Letter-Sound Correspondences

(Based on the recommendations of Light & McNaughton, 2009a)

Model the task

1. *"I am going to listen to the sound."*
   (Place letter cards in front of the learner. Say a sound. E.g., say *"zzzz")*

2. *"Now I look at all of the letters. I am going to touch the letter that makes the sound 'zzzz.'"*
   (Look at each of the letters. Touch the letter that makes the sound /z/. Say the sound, *"zzzz.")*

3. **"**I touched this letter because this letter says 'zzzz.'**"**

4. "*Now it's your turn. I am going to say a sound. Listen to the sound. Then look at the letters. Touch the letter that makes that sound.*"

APPENDIX H

Data Collection Form for Screening Assessments

(Adapted from Light & McNaughton, 2009a)

Student _____ Date _____

Target Skill

Selection Task	Sound Blending	Single-Word Decoding

Target Word	**Field of Options**						**Student's Response**
	1 Top Left	**2** Top Middle	**3** Top Right	**4** Bottom Left	**5** Bottom Middle	**6** Bottom Right	
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

APPENDIX I

Data Collection Form for Letter-Sound Correspondences

(Adapted from Light & McNaughton, 2009a)

Student _____ Date _____

PROBE TYPE

Screening Probe	Baseline Probe	Intervention Probe	Generalization: *Book*	Generalization: *Modified*	Maintenance probe

OR

INSTRUCTIONAL PHASE

Teacher modeling	Guided practice	Independent practice

DATA

Target Letter	**Field of Options**						**Student's Response**
	1 Top Left	**2** Top Middle	**3** Top Right	**4** Bottom Left	**5** Bottom Middle	**6** Bottom Right	
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							

APPENDIX J

Excerpt from Script for Teaching Target Letter-Sound Correspondences

(Based on the recommendations of Light & McNaughton, 2009a)

Provide Guided Practice (this would be presented after modeling the task)

1. "*Now let's do one together. I am going to say a sound. Listen to the sound. Then look at the letters and touch the letter that makes the sound with me.*
   (Say the target sound. E.g., say '*oooooo*'". Pause for 1-2 seconds to provide an opportunity for the learner to respond. If the learner responds, provide corrective feedback. If the learner does not respond, model continue with script.)

2. "*Let's touch the letter that says 'oooo.*'"
   (Point to the target letter and ask the learner to point with you. Say the sound.

E.g., say '*oooooo*'".)

Scaffold Support

As the learner responds correctly

- increase field size
- increase the length of the pause before providing answer (up to 5 seconds)
- decrease prompting

Appendix K

Procedural Integrity Checklist and Data Reliability: Probe Sessions

(Adapted from Fallon, 2001)

GENERAL	PROCEDURES
Introduces task	_____
Models task (using non-target letters)	_____
Varies placement of all letters	_____
Varies order of letters presented	_____
Provides 2 trials for each letter	_____

	TARGET	PROCEDURES	DATA
1.	_____		
	• places six letters in front of the learner	_____	
	• positions stimuli appropriately	_____	
	• provides directions	_____	
	• states target sound	_____	
	• provides no corrective feedback	_____	
	• records data accurately		_____
2.	_____		
	• places six letters in front of the learner	_____	
	• positions stimuli appropriately	_____	
	• provides directions	_____	
	• states target sound	_____	
	• provides no corrective feedback	_____	
	• records data accurately		_____
3.	_____		
	• places six letters in front of the learner	_____	
	• positions stimuli appropriately	_____	
	• provides directions	_____	
	• states target sound	_____	
	• provides no corrective feedback	_____	
	• records data accurately		_____
4.	_____		
	• places six letters in front of the learner	_____	
	• positions stimuli appropriately	_____	
	• provides directions	_____	
	• states target sound	_____	
	• provides no corrective feedback	_____	
	• records data accurately		_____

TARGET	PROCEDURES	DATA
5. _____		
• places six letters in front of the learner	_____	
• positions stimuli appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides no corrective feedback	_____	
• records data accurately		_____
6. _____		
• places six letters in front of the learner	_____	
• positions stimuli appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides no corrective feedback	_____	
• records data accurately		_____
7. _____		
• places six letters in front of the learner	_____	
• positions stimuli appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides no corrective feedback	_____	
• records data accurately		_____
8. _____		
• places six letters in front of the learner	_____	
• positions stimuli appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides no corrective feedback	_____	
• records data accurately		_____
9. _____		
• places six letters in front of the learner	_____	
• positions stimuli appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides no corrective feedback	_____	
• records data accurately		_____

TARGET	PROCEDURES	DATA
10. _____		
• places six letters in front of the learner	_____	
• positions stimuli appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides no corrective feedback	_____	
• records data accurately		_____
11. _____		
• places six letters in front of the learner	_____	
• positions stimuli appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides no corrective feedback	_____	
• records data accurately		_____
12. _____		
• places six letters in front of the learner	_____	
• positions stimuli appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides no corrective feedback	_____	
• records data accurately		_____

Procedural Integrity: _____/65 _____% **Probe Data Reliability:** _____/12 _____%

Appendix L

Procedural Integrity Checklist and Data Reliability: Instructional Sessions
(Adapted from Fallon, 2001)

GENERAL	PROCEDURES	
Introduces task	_____	
Scaffolds support as needed	_____	
Varies placement of letters	_____	
Intersperses previously learned letters when appropriate	_____	
Provides extension activity	_____	

TARGET	PROCEDURES	DATA
1. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
2. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
3. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
4. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____

TARGET	PROCEDURES	DATA
5. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
6. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
7. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
8. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
9. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____

TARGET	PROCEDURES	DATA
10. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
11. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
12. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
13. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____
14. _____		
• provides appropriate level of instruction	_____	
• positions letters appropriately	_____	
• provides directions	_____	
• states target sound	_____	
• provides corrective feedback	_____	
• records data accurately		_____

	TARGET	PROCEDURES	DATA
15.	_____		
	• provides appropriate level of instruction	_____	
	• positions letters appropriately	_____	
	• provides directions	_____	
	• states target sound	_____	
	• provides corrective feedback	_____	
	• records data accurately		_____

IF MORE THAN ONE LETTER HAS BEEN INTRODUCED:

Procedural Integrity: ___/80 ___% **Instructional Data Reliability:** ___/15 _____%

Target Data Reliability: ___/15 _____%

Review Data Reliability: ___/15 _____%

IF ONLY ONE LETTER HAS BEEN INTRODUCED:

Procedural Integrity: ___/55 ____% **Instructional Data Reliability:** ___/10 _____%

Appendix M

Social Validity Questionnaire

1) The student's reading skills improved as a result of the intervention.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

2) The reading intervention could be implemented in the classroom or natural environment by a teacher/therapist.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

3) The reading intervention would be beneficial for other children with autism.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

4) What (if anything) would you change about the intervention?

5) What (if anything) do you feel was the major benefit of the intervention?

Vita

Elizabeth Benedek Wood

EDUCATION

2007 – present	Doctoral student in Special Education, The Pennsylvania University
2004	Master of Education in Special Education, The Pennsylvania State University
2002	Bachelor of Arts in Psychology, The Pennsylvania State University
2002	Bachelor of Arts in English, The Pennsylvania State University

PUBLICATIONS

Mason, L. H., Benedek-Wood, E., & Valasa, L. L. (2010). Teaching low-achieving students to self-regulate persuasive quick write responses. *Journal of Adolescent and Adult Literacy, 53, 313-322*.

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PROFESSIONAL EXPERIENCE

2008 – present	Graduate Teaching Assistant, The Pennsylvania State University
2008	Pre-student Teaching Supervisor, The Pennsylvania State University,
2007 – present	Graduate Research Assistant, The Pennsylvania State University
2004 – 2007	Special Education Teacher, Morrisdale PA; Spring Mills, PA