Fall 12-18-2014

Effects of Theory of Mind Training on the False Belief Understanding of Deaf and Hard of Hearing Students in Prekindergarten and Kindergarten

Stacey L. Tucci

ACCEPTANCE

This dissertation, EFFECTS OF *THEORY OF MIND* TRAINING ON THE FALSE BELIEF UNDERSTANDING OF DEAF AND HARD OF HEARING STUDENTS IN PREKINDER-GARTEN AND KINDERGARTEN, by STACEY LYNN TUCCI, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

____
Susan Easterbrooks, Ed.D.
Committee Chair

____
Paul Alberto, Ph.D.
Committee Member

____
Judith Emerson, Ph.D.
Committee Member

____
Laura Fredrick, Ph.D.
Committee Member

____
Committee Member

____
Date

____
Laura Fredrick, Ph.D.
Chairperson, Department of Department of Educational Psychology, Special Education, and Communication Disorders

____
Paul Alberto, Ph.D.
Dean
College of Education

AUTHOR'S STATEMENT

By presenting this dissertation as a partial fulfillment of the requirements for the advanced degree from Georgia State University, I agree that the library of Georgia State University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote, to copy from, or to publish this dissertation may be granted by the professor under whose direction it was written, by the College of Education's Director of Graduate Studies, or by me. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this dissertation which involves potential financial gain will not be allowed without my written permission.

____

Stacey Lynn Tucci

NOTICE TO BORROWERS

All dissertations deposited in the Georgia State University library must be used in accordance with the stipulations prescribed by the author in the preceding statement. The author of this dissertation is:

Stacey Lynn Tucci, M.Ed.
30 Pryor St
Suite 850
Atlanta, GA 30302

The director of this dissertation is:

Dr. Susan R. Easterbrooks
Department of Educational Psychology, Special Education, and Communication Disorders
College of Education
Georgia State University
Atlanta, GA 30303

CURRICULUM VITAE

Stacey L. Tucci

ADDRESS:

EDUCATION:

Ph.D.	2014	Georgia State University Department of ESC – Students with Exceptionalities
M. Ed.	2010	Georgia State University Department of EPSE – Multiple and Severe Disabilities
B.S. Magna Cum Laude	2008	Georgia State University Dual Certification: Early Childhood & Special Education (P-12)

PROFESSIONAL EXPERIENCE:

2014 – Present	Research Associate *Center on Literacy and Deafness (CLAD)*, Georgia State University
2013 – Present	Nationally Certified Visual Phonics Trainer International Communications Institute (ICLI)
2011 – 2014	Cognitive Development Specialist *Foundations for Literacy Grant,* Georgia State University
2009 – 2011	Teacher for Deaf and Hard of Hearing Students – Kindergarten Cobb County Schools
2008 – 2009	Mathematics Teacher – 8th Grade Cobb County Schools

PRESENTATIONS:

Tucci, S. & Lederberg, A. (2014, September). *Foundations for Literacy: An Early Literacy Curriculum for Deaf and Hard of Hearing Preschoolers*. Professional development for Atlanta Metro Deaf and Hard of Hearing Administrators, Atlanta, GA.

Tucci, S., & Huston, S. (2014, August). *Foundations for Literacy: An Early Literacy Curriculum for Deaf and Hard of Hearing Preschoolers.* Professional development workshop for IES Grant: Foundations for Literacy, Atlanta, GA.

Tucci, S., Gremp, M., & Huston, S. (2014 – June). *Key Components for Literacy Achievement among DHH Children*. Institute Designed for Educating All Students (IDEAS) Conference, St. Simons, GA.

Tucci, S. (2014, May). *Effect of Theory of Mind Training on the False Belief Understanding of Deaf and Hard of Hearing Students in Pre-Kindergarten and Kindergarten*. Georgia State University Language and Literacy Initiative – Dr. Henry Wellman, Atlanta, GA.

Tucci, S., Easterbrooks, S., Lederberg, A., & Stanzione, C. (2013, February). *Development of an Intervention for Theory of Mind in Deaf and Hard of Hearing Preschoolers*. Presentation at the Association of College Educators: Deaf & Hard of Hearing, Santa Fe, NM.

Miller, E., Lederberg, A., Easterbrooks, S., & Tucci, S. (2012, November). *Emergent Literacy and Phonological Instruction for Children Who Are Deaf and Hard of Hearing.* Presentation at the American Speech-Language-Hearing Association Annual Conference, Atlanta, GA.

Goldberg, H., Crume, P., Lederberg, A., Easterbrooks, S., Tucci, S., Glover, M., & Stultz, K. (2012, November). *Narrative Development in Deaf and Hard of Hearing Preschoolers: An Exploratory Intervention Study*. Presentation at the American Speech-Language-Hearing Association Annual Conference, Atlanta, GA

Miller, E., Lederberg, A., Easterbrooks, S., Tucci, S., Stanzione, C., & Goldberg, H. (2012, August). *Foundations for Literacy: An Early Literacy Curriculum for Deaf and Hard of Hearing Preschoolers.* Professional development workshop for IES Grant: Foundations for Literacy, Atlanta, GA.

Easterbrooks, S., & Tucci, S. (2011, February). *Struggles for Education, Dignity and Survival of Deaf and Hard of Hearing Students in Two African Countries*. Poster session at the Association of College Educators: Deaf & Hard of Hearing, Ft. Worth, TX.

Tucci, S. (2013, July). *Foundations for Literacy: An Early Literacy Curriculum for Deaf and Hard of Hearing Preschoolers.* Professional development workshop for IES Grant: Foundations for Literacy, Atlanta, GA.

Tucci, S. (2013, October). *See-the-Sound: Visual Phonics*. Professional Development for Cobb County Teachers for Deaf and hard of Hearing Students. Kennesaw, GA.

Tucci, S. (2013, July). *See-the-Sound: Visual Phonics*. Professional Development for IES Grant: Foundations for Literacy and Metro-Atlanta Teachers for Deaf and Hard of Hearing Students, Atlanta, GA.

Tucci, S. (2012, July). *Foundations for Literacy: An Early Literacy Curriculum for Deaf and Hard of Hearing Preschoolers.* Professional development workshop for IES Grant: Foundations for Literacy, Atlanta, GA.

Tucci, S. (2011, July). *Foundations for Literacy: An Early Literacy Curriculum for Deaf and Hard of Hearing Preschoolers.* Professional development workshop for IES Grant: Foundations for Literacy, Atlanta, GA.

Tucci, S. (2014, March). *Deaf Education - Classroom Settings and LRE, Communication Modalities, and Teaching Philosophies*, Reading and Writing Instruction for Students Who are Deaf or Hard of Hearing (EXC 7390), Georgia State University, Atlanta, GA.

Tucci, S. (2013, March). *Foundations for Literacy Curriculum*, Reading and Writing Instruction for Students Who are Deaf or Hard of Hearing (EXC 7390), Georgia State University, Atlanta, GA.

Tucci, S. (2013, February). *What Speech Language Pathologists Need to Know About Working with Clients with Hearing Loss*, Clinical Practicum in Communication Disorders, (EXC 7910), Georgia State University, Atlanta, GA.

Tucci, S. (2012, September). *Preparing an Instructional Unit for Use in a DHH Classroom*, Reading and Writing Instruction for Students Who are Deaf or Hard of Hearing (EXC 7390), Georgia State University, Atlanta, GA.

PUBLICATIONS:

Easterbrooks, S., & Tucci, S. (2014). *Young Children with Special Needs – Chapter 8* (6th ed.). Upper Saddle River, NJ: Merrill Prentice Hall

Schwab, J., Tucci, S., & Jolivette, K. (2013). Integrating schema-based instruction and response cards for students with learning disabilities and challenging behaviors. *Beyond Behavior*, *22*(3), 24-30.

Tucci, S. L. & Easterbrooks, S. R. (2013). A syllable segmentation, letter-sound, and initial sound intervention with students who are deaf and hard of hearing and use sign language. *The Journal of Special Education*. doi: 10.1177/0022466913504462

Tucci, S. L., Trussell, J. W., & Easterbrooks, S. R. (2014). A review of the evidence on strategies for teaching children who are DHH Grapheme-phoneme correspondence. *Communication Disorders Quarterly*, *35*(4), 191-203. doi: 10.1177/1525740114523776

PROFESSIONAL SOCIETIES AND ORGANIZATIONS

2011 – Present	Council for Exceptional Children – Families and Research Committee (CEC)
2011 – Present	Association of College Educators – Deaf and Hard of Hearing (ACE-DHH)
2013	American Speech-Language and Hearing Association (ASHA)

EFFECTS OF THEORY OF MIND TRAINING ON THE FALSE BELIEF UNDERSTANDING OF DEAF AND HARD OF HEARING STUDENTS IN PREKINDERGARTEN AND KINDERGARTEN

by

STACEY L. TUCCI

Under the Direction of Susan R. Easterbrooks, Ed.D.

ABSTRACT

Data from a growing number of research studies indicate that children with hearing loss are delayed in Theory of Mind (ToM) development when compared to their typically developing, hearing peers. While other researchers have studied the developmental trajectories of ToM in school-age students who are deaf and hard of hearing (DHH), a limited number have addressed the need for interventions for this population. The present study extends the current research on ToM interventions to the PreKindergarten and Kindergarten levels. This study used a single-case multiple-baseline multiple-probe across skills design with replications across classrooms to examine the effects of a ToM intervention on participants' false belief understanding as well as outcomes on a near generalization measure (i.e., Sally-Anne Task, Baron-Cohen, Firth, Leslie, 1985) and a far generalization measure (i.e., five-task ToM developmental scale, Wellman &

Liu, 2004). A thought bubble intervention (i.e., a visual representation of what people are thinking) developed by Wellman and Peterson (2013) was modified in key areas: (a) participants were substantially younger than the population in the original study and thus required a pre-teaching phase addressing vocabulary and materials, (b) manipulable materials were created from the description provided in the Wellman and Peterson (2013) study along with parallel materials used in assessment probes, (c) a certified teacher of DHH children provided direct instruction to participants in a small group setting, (d) study length was increased to 25 weeks, and (e) methodological design change (i.e., group design to single-case design). These modifications addressed the need for evidence-based ToM interventions that are both proactive and easily implemented by teachers in a classroom setting. Results from the single-case design portion of the study indicate a functional relation between the thought bubble intervention and the participants' acquisition of the targeted skills in each stage, although progress was not uniform. Results from the pre-post assessments indicate that the children did make progress up the scale, however, children who used spoken language tended to proceed faster through the stages than those who used sign language. These results inform the field in regard to the efficacy and feasibility of a ToM intervention for young DHH children.

INDEX WORDS: Deaf/hard of hearing, False belief understanding, Theory of mind, Thought bubbles, Visual representations

EFFECTS OF THEORY OF MIND TRAINING ON THE FALSE BELIEF UNDERSTANDING OF DEAF AND HARD OF HEARING STUDENTS IN PREKINDERGARTEN AND KINDERGARTEN

by

STACEY L. TUCCI

A Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Doctor of Philosophy

in

Education of Students with Exceptionalities

in

the Department of Educational Psychology, Special Education, and Communication Disorders

in

the College of Education

Georgia State University

Atlanta, GA

2014

DEDICATION

This dissertation is dedicated to my daughter, Ahmya Tucci. Without her inspiration, I would never have embarked on this profound journey.

ACKNOWLEDGMENTS

This dissertation would not have been possible without the invaluable support and guidance of many people. To my employer and advisor, Dr. Amy Lederberg, thank you for the introduction to Theory of Mind and for all of the hard-fought lessons. To my colleagues, Elizabeth Miller, Dr. Christopher Stanzione, and Dr. Jessica Trussell, thank you for the single case graphing sessions, the hastily-printed research articles, the shoulders upon which I cried, and the Starbucks and wine. To my mentor, Dr. Susan Easterbrooks, my chakra-cleanser, my personal editor, my compass through the unsettled waters of deaf education research, my gratitude could never be justly relayed through words…I can only hope my work makes you proud. Unending thanks to my family, especially to my husband, who put up with late-night writing sessions and weekly doc student breakdowns for four long years. You are my rock. Finally, a very special thanks to the teachers and parents who permitted me to work with their incredibly inspiring children. They are the reason I am so very passionate about this work.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ASL	American Sign Language
CASE	Conceptually Accurate Signed English
DB	Diverse Beliefs
DD	Diverse Desires
DHH	Deaf and Hard of Hearing
DoD	Deaf Children of Deaf Parents
DoH	Deaf Children of Hearing Parents
FB	False Belief
K	Kindergarten
KA	Knowledge Access
PreK	PreKindergarten
SimCom	Simultaneous Communication
SP	Social Pretend
TC	Total Communication
TD	Typical Development
ToM	Theory of Mind

1 THEORY OF MIND INSTRUCTION WITH DEAF AND HARD OF HEARING STUDENTS: A REVIEW OF THE LITERATURE

Major developmental changes in language and Theory of Mind occur during the early childhood years. Theory of Mind (ToM) refers to the perspective one has regarding another's thoughts. ToM and language abilities are typically thought to develop concomitantly. However the precise nature of the relationship between language and ToM remains unclear. Children who are Deaf and Hard of Hearing (DHH) have often been included in ToM studies in an effort to understand better the role of language in ToM development. Specifically this population provides an interesting perspective in that they experience profound limitations in their language abilities when hearing status between parent and child is incongruent (i.e., Deaf or hard of hearing child with hearing parents - DoH), but not when hearing status is matched (i.e., Deaf child of Deaf parents - DoD) (Mitchell & Karchmer, 2004; Quittner, Leibach, & Marciel, 2004). When examined comparatively these subgroups (i.e., DoH and DoD) acquire ToM along similar developmental sequences but at different developmental rates (Peterson, Wellman, & Lui, 2005; Peterson & Wellman, 2009; Peterson, Wellman, & Slaughter, 2012). DoD children progress through the ToM sequence in a manner comparable to their typically developing hearing peers (Peterson & Wellman, 2009; Peterson et al., 2005; Peterson et al., 2012). In contrast, a lack of early language experience and exposure to less linguistically rich environments creates a considerable disadvantage for language development and, as is suggested by studies of DoH children, significantly slows the developmental pacing of ToM (de Villiers & de Villiers, 2000, 2012; de Villiers & Pyers, 2002; Figueras-Costa & Harris, 2001; Woolfe, Want & Siegal, 2002; Ziv, Most, Cohen, 2013).

The majority of DoH children do not have full access to fluent language during the early years most critical to language acquisition (Blamey, 2003; Lederberg, 2003; Spencer & Marschark, 2010). These children begin learning language later than those peers who share a common language with early caregivers (Lederberg, Schick, & Spencer, 2013; Meadow-Orlans, Spencer, & Koester, 2004). A significant amount of language is learned incidentally (e.g., over-hearing conversations of others, television and internet exposure), and children with hearing loss fail to benefit from incidental sources of linguistic information. As a result, DHH children often enter school without a fully formed primary language. Because DHH children's initial exposure to fluent language models often occurs after children enter formal schooling (e.g., preschool programs, kindergarten), there is a need for evidence-based ToM interventions specific to this population that are both proactive and easily implemented by teachers in a classroom setting. The guiding questions for this literature review are: What is the existing research base for ToM development in regard to DHH children? Is ToM instruction an evidence based practice for the preschool and kindergarten-aged DHH population? To answer these questions, the author reviewed the extant literature in the following areas: ToM, ToM and language, the theoretical framework for ToM, the developmental sequence of ToM, the development of ToM in the DHH population as compared to typically developing (TD) children as well as those with autism, and ToM interventions.

The author identified a set of search terms (e.g., ToM, ToM developmental sequence, perspective-taking, joint attention, false belief, etc.) and cross-referenced these with terms related to hearing loss (deaf, hard of hearing, hearing loss, hearing impaired, cochlear implant, American Sign Language) across multiple search engines (Academic Search Complete, Ebsco Host, ERIC, Linguistics and Language, Psych Lit, Wilson, PsycNet) and included the literature from the

1990s to 2014. The author included all data-based articles that used field-approved design methodologies (Odom et al., 2005) including: single-case designs (Horner et al., 2005), case studies (Baxter & Jack, 2008), quasi-experimental (Shadish, Cook, & Cambell, 2002) and experimental designs (Gersten et al., 2005). The rationale for inclusion of an article in the table is that it presented an actual ToM intervention for children who are typically developing or who are deaf and hard of hearing and that it met the standards of rigor established in the above sources. Intervention studies conducted with children with Autism were purposely excluded from the table as this population's developmental trajectory differs in both order and pacing from TD and DHH children.

Review of the Literature

Theory of Mind

ToM encompasses the various ways in which humans attempt to make sense of the mental life of other people (Want & Gattis, 2005). This includes an understanding that one may think or believe differently from another and that behavior is motivated by a person's knowledge or beliefs. Understanding mental states (e.g., beliefs, desires, and intentions) and the way in which these invisible states govern human behavior allows one to possess many skills including the ability to learn from others (i.e., social learning), to distinguish deliberate and accidental acts, and to determine the motives and perspectives of others. The development of a functioning ToM is important for school-age children as such understanding may support children's ability to engage in appropriate interactions with others and to comprehend narrative passages (e.g., character perspective, internal and external dialogue, cause and effect).

Theory of Mind and Language

While the interconnectivity of language and ToM is widely accepted, the precise role of language in the development of ToM is contested. Some researchers argue that language facilitates the cognitive processes of executive functioning and working memory that contribute to ToM (Ashington & Jenkins, 1999). Others suggest that language is the primary way children gain information (e.g., explicit mental explanations of behavior, vocabulary for unseen abstract concepts) necessary to ToM development (Ashington, 2001; Muller, Liebermann-Finestone, Carpendale, Hammond, Bibok, 2012). Access to and engagement in everyday conversations may be an important source of information about intentions, beliefs, and knowledge (de Rosnay & Hughes, 2006; Ruffman, Slade, & Crowe, 2002) and the linguistic environment of the child has been linked to the understanding of false beliefs (Cutting & Dunn, 1999). Additionally, researchers have found that children who overhear discussions about the mental states of others, either in statement or question form, significantly improve in their False Belief (FB) understanding (Gola, 2012). Additional researchers have proposed that grammatical structure, specifically sentential complements (e.g., *Jaclyn thinks that her mother is angry*.), influences the development of ToM in that the structure permits a linguistic representation of a state of the world seen through another's eyes (de Villiers, 2005) or that more general language enables children in constructing representations of complex and abstract concepts (Ruffman, Slade, Rowlandson, Rumsey, & Garnham, 2003). Because most ToM studies focus on a single aspect of linguistic development, it remains unclear how the semantic, syntactic, and pragmatic aspects of language contribute independently and/or interdependently to the development of ToM (Fernandez, 2013).

As previously stated, young DHH children are often studied in the child development literature in an attempt to ascertain the role of language in ToM development. This population provides researchers with two subgroups (i.e., DoD and DoH) that acquire language and experience the linguistic environment in wholly different ways. This dissimilarity results in two distinct ToM developmental trajectories where DoD children develop typically and DoH children develop atypically (Peterson, Wellman, & Lui, 2005; Peterson & Wellman, 2009; Peterson, Wellman, & Slaughter, 2012). Numerous studies have found that language ability including access to fluent models is a significant predictor of DHH children's ToM development (Gonzalez, Quintana, Barajas, & Linero, 2007; Macaulay & Ford, 2006; Meristo & Hjelmquist, 2009; Morgan & Kegl, 2006; Pyers & Senghas, 2009; Tomasuolo, Valeri, Di Renzo, Pasqualetti, & Volterra, 2013; Van Staden, 2010). Studies attempting to explain the effects of language ability on ToM development in DHH children emphasize three significant areas: linguistic structures, specifically sentential complements (e.g., *Stacey thinks that her mother is mad.*, *The boy thinks that his friend is lying*.) (de Villiers, 2005; de Villiers & de Villiers, 2012; Schick, de Villiers, de Villiers, & Hoffmiester, 2007), exposure to mental state vocabulary (e.g., *think*, *know*, *don't know*) (Peters, Remmel, & Richards, 2009; Ruffman et al., 2003), and socio-communicative exchanges including shifts in perspective (Courtin & Melot, 2005; Howley & Howe, 2004; Meristo et al., 2012; Wellman & Peterson, 2013; Ziv, Mier, Malky, 2013). Rightly so, Garfield, Peterson, and Perry (2001) assert that "adequate language and adequate social skills are jointly causally sufficient and individually causally necessary to the development of ToM" (p. 1).

Theoretical Framework of ToM

Since the 1980s, a number of different theoretical perspectives have been proposed to explain the ToM developments occurring during the preschool years. Two main theories dominate the literature: (1) *theory theory,* which suggests that our knowledge about the mind involves an informal, everyday framework that develops through the acquisition of new information (Gopnick, 1993; Wellman, 1990) and (2) *simulation theory,* which suggests that children understand the mental states of others through a role-taking or simulation process that becomes increasingly accurate with continued use (Harris, 1992; Shanton & Goldman, 2010). Theory theorists and simulation theorists agree that both language and experience play a major role in children's development of ToM, which has led the field to a hybrid theory that integrates elements of the two theoretical perspectives as well as others (e.g., executive functioning, modular theory) in an attempt to explain the mind as a set of skills and dispositions that depend on four sources of mediators including the brain, the body, social practices, and technological artifacts (i.e., human action shapes the design and function of technology and the resulting artifacts are culturally constructed and interpreted) (Brinkmann, 2011). This inclusive theory permits researchers to understand the various contributors to ToM development, why it is that certain populations develop ToM atypically (e.g., lack essential linguistic skill and/or experiential knowledge), and why within these atypical populations developmental trajectories vary. If we can pinpoint the major mediators that affect the development of ToM in DHH children (e.g., linguistic environment, language exposure and use, quality of social interactions), then we can address these deficit areas with targeted interventions.

Developmental Sequence of Theory of Mind

The most widely known developmental sequence proposed by Wellman and Liu (2004) addresses the skills that occur during the preschool years (i.e., 3 to 5 years of age). More complex skills such as second-order false belief understanding, metaphors, irony, double deceptions, and complex narratives are developed in later school years (i.e., 6+ years) and as such are not represented within this initial sequence. The following table provides a brief description of each stage within the developmental sequence as well as the common age of mastery for typically developing, hearing children.

Table 1. *Theory of Mind Developmental Sequence*

Stage	Age of Mastery	Task Description
Diverse Desires	3.0-4.0 yrs	Child is given a choice of two snacks (e.g., carrots and cookies). Child picks favorite snack. Another character (e.g., doll) chooses the opposing snack as her favorite. Child is asked what the character will choose to eat. Child must inhibit his desire and choose the opposing snack to score correctly.
Diverse Beliefs	3.0-4.0 yrs	Child is given a choice of two locations for a missing cat. Child picks the location where he thinks the cat is hiding. Another character chooses the opposing location. Child is asked where the character will look for the cat. Child must inhibit his desire and choose the opposing location to score correctly.
Social Pretend	4.0-4.5 yrs	Child and assessor pretend to paint a blue cup green. Another character not involved in the pretend play enters the situation. Child is asked what color the character thinks the cup is. Child should say the initial color of the cup (i.e., blue) to score correctly.
Knowledge Access	4.6 yrs	Child is shown a nondescript box with a random object inside (e.g., toy dog). Toy is concealed inside the box, and another character (who has not seen inside the box) enters the situation. Child is asked what the character thinks is inside the box. Child must say the character doesn't know to score correctly.
Unexpected-Contents False Belief	5.0 yrs	Child is shown a recognizable box (e.g., M&M box) and asked what they think is inside. Child should say candy. Contents of the box are revealed. It is something other than what the outside of the box would suggest. (e.g., toy fish). Object is placed into the box and another character enters the situation. Child is asked what the character thinks is inside the box. Child should say candy to score correctly.

Wellman, H. M., & Liu, D. (2004). Scaling of theory of mind tasks. *Child Development, 75*(2), 523-541.

Wellman and Lui (2004) used a Guttman analysis to validate their proposed ToM sequence with hearing preschoolers. Guttman scalogram analysis is normally used to establish developmental sequences (Fischer, Knight, & Van Parys 1992; Green, 1956; Guttman, 1944). In a Guttman scale, items are ranked in difficulty such that if a child responds correctly to a given item, that child must respond correctly to all earlier items. Theoretically a given score on a

Guttman scale can be achieved through only one pattern of response. Therefore, if one knows a child's total score, one also knows the child's responses to all items within the scale.

The sequence was further validated with preschoolers with disabilities (i.e., DoD signers, deaf late signers, children with Autism) as well as typically developing, hearing preschoolers (Peterson et al., 2005). The initial sequence used in the 2004 and 2005 studies included five tasks: (a) diverse desires, (b) diverse beliefs, (c) knowledge access, (d) contents false belief, and (e) real versus apparent emotion. A sixth task was later added in Peterson and Wellman's (2009) modified sequence. This additional social pretend task became the third task in the developmental scale (between diverse beliefs and knowledge access) for hearing children and the majority of the DHH children participating in the study. A small subgroup of DHH children was assessed using an alternate version of the scale in which the social pretend task became the final task. The placement of the social pretend task presented no developmental differences in either subgroup of DHH children, however DHH children understood social pretend at an earlier step in the scale than hearing children although at a later chronological age. This finding is relevant to questions about universal developmental progressions and how the developmental progression might provide information on the effects of biological (e.g., hearing loss) and socio-cultural (e.g., language) factors in the pacing of ToM development.

Subsequently Peterson, Wellman, and Slaughter (2012) examined yet another modified six-task scale in which the social pretend task was removed and a sarcasm task was added to the end of the sequence (i.e., as the sixth task). These researchers assessed children with typical hearing and development, deafness, autism, and Asperger syndrome, following the modified scale. After controlling for age and language ability, the children with disabilities did not master the tasks within the sequence at rates comparable to their TD peers. TD children up to nine years of age failed the new task giving merit to the task's sensitivity to post-preschool ToM growth.

Theory of Mind Development in Various Populations

The study of ToM in various populations of young children has provided useful information about the neurobiological and socio-cultural factors that contribute to the atypical development of ToM skills. TD children demonstrate a functioning ToM (as evidenced by mastery of false belief understanding) between four and five years of age (Wellman, Cross & Watson, 2001). Joint attention is thought to be a precursory skill necessary for ToM development as it affords children awareness of others through shared experiences (Charmin et al., 2000). DoD children develop ToM along the same sequential progression with the same chronological pacing as their TD peers (Courtin, 2000; Peterson, Siegal, 1998, 1999; Peterson & Slaughter, 2006; Russell, 1998; Wolfe, Want & Siegal, 2002). DoH children regardless of language modality (i.e., signed or spoken) develop ToM at a delayed pace (i.e., master ToM task at later chronological ages) (Courtin, 2000; Peterson, 2004; Peterson & Siegal, 1998, 1999; Peterson & Slaughter, 2006; Remmell, Betteger, & Weinberg, 2001; Russell et al., 1998; Woolfe et al., 2002) although one study found children with cochlear implants using spoken language to have pacing similar to their hearing peers (Peterson & Siegal, 1999). A significant number of studies used verbal tasks to assess children's ToM skills, and it is possible that performance on these assessments reflects general language limitations. However, children still demonstrated delayed ToM skills in later studies using low verbal or nonverbal tests of reasoning about mental states (de Villiers & de Villiers, 2000, 2012; de Villiers & Pyers, 2002; Figueras-Costa & Harris, 2001; Woolfe et al., 2002; Ziv et al., 2013).

Because children with Autism or Asperger Syndrome present a wide spectrum of functional behavior, they exhibit different outcomes on ToM assessments (Baron-Cohen, Leslie, & Firth, 1985; Peterson & Siegal, 1998, 1999; Peterson & Slaughter, 2006; Peterson et al., 2012). Some children with high-functioning Autism or Asperger's syndrome have developmental patterns similar to DoH children (Peterson & Siegal, 1998, 1999; Peterson & Slaughter, 2006). However, other studies have found the sequence to differ in that false belief replaces hidden emotion as the most difficult skill for children to master (Peterson et al., 2012); children with Autism may never develop a fully functioning ToM (Baron-Cohen et al., 1985).

Theory of Mind Interventions

Only those ToM interventions (i.e., training studies) conducted with children who are typically developing or children who are deaf and hard of hearing are included in this section as these populations progress through similar developmental sequences with the exception of pacing. Interventions conducted with children who have other disabilities (e.g., Autism) are excluded as these populations present dissimilar developmental trajectories.

TD children between four and five years of age are able to pass tasks involving false belief requiring an understanding that people can possess beliefs that conflict with reality (Cross & Watson, 2001). In one of the earliest ToM training studies, Dockett (1998) examined the effects of play on false belief and appearance versus reality aspects of ToM development. Thirty-three children with an average age of 4.2 years and typical hearing were assigned to one of two groups (i.e., treatment and control) in a quasi-experimental design. Children participated in a 10-week study in which the treatment group received 3 weeks of strategic play aimed at facilitating complex shared pretense play. Posttest scores on ToM tasks including appearance versus reality (AR) and False Belief (FB) and observational codings of children's shared pretense play (i.e., Play Observation Scale and Smilansky Scale [Rubin, 1989] for Evaluation of Dramatic and Sociodramatic Play [Smilansky & Shefatya, 1990]) were used to determine the specific effects of strategic shared play on young children's ToM development. Dockett found that strategic, adult-guided experience in complex shared pretense play positively influenced children's performance on tasks requiring a representational understanding of the mind. This suggests that guided play interactions involving shared social interactions and verbal communication can be used to increase young children's ToM understanding.

In a seminal ToM training study (Hale & Tager-Flusberg, 2003), researchers examined the effects of language development on ToM in preschool-aged children with typical hearing. Participants were native English speakers aged 36 to 58 months from diverse racial and socio-economic backgrounds. Sixty participants comparable in age, gender, and pretest scores were assigned randomly to one of three training groups: changed-location False Belief (FB), sentential complements (SC), and relative clauses (RC). Children were given 3 pretests in random order and were administered a changed-location FB task. In a changed-location FB situation, a short sketch is enacted in which a girl takes a marble and hides it in a basket. The girl then "leaves" the room. While she is away, a different girl takes the marble out of the initial basket (i.e., location one) and puts it in her own box (i.e., location two). The first girl is then reintroduced and the child (being assessed) is asked the key question: "Where will the girl look for her marble?" The child must indicate that the girl will look for her marble in the basket (i.e., location one). A child without ToM and thus unable to take an alternative perspective will indicate that the girl will look in the changed location (i.e., location two – box).

Two training sessions consisting of four trials each were scheduled within one week of each other. Similar props were used in all training groups. Children received feedback and correction in a total of eight training sessions. In the FB training, the researcher enacted a location-change story and asked the child to predict where the character would look for the moved object. In the relative clause training, a scene was enacted with identical twins and a third character. Children were asked to identify which of the twins received one of the actions. In the sentential complements training, the researcher presented a story about a boy who does an action to one character while expressing he does the action to a different character (i.e., He kisses Big Bird, but says, "*I kissed the Cookie Monster*."). Children were asked to answer one of two questions: (a) What did the boy say? and (b) Who did he say he ____ (e.g., kissed)? Children were posttested three to five days after the second training session. Posttest results indicated that the group trained on sentential complements (i.e., sentences consisting of a main and an embedded clause such as "*I see that you are happy*.") acquired the targeted linguistic knowledge and significantly increased their scores on a range of ToM tasks. In contrast, FB training improved children's ToM scores but had no influence on language. The control group, trained on relative clauses, showed no improvement on ToM posttests. Researchers concluded that the acquisition of the specific linguistic structure of sentential complements contributed to the development of ToM in hearing preschoolers.

Melot and Angeard (2003) conducted a study to examine the direct and indirect (i.e., transfer) effects of FB training on multiple dimensions of ToM. Ninety-three children with typical hearing ranging from 3.6 to 4.4 years of age were divided into three equivalent groups using pretest scores on ToM measures for appearance-reality and false belief tasks. Participants were assigned to one of three training conditions: (a) appearance-reality (AR) with feedback, (b) false belief (FB) with feedback, and (c) a combination of appearance-reality and false belief without feedback (control group). In the appearance versus reality group, children were shown deceptive objects (e.g., a sponge that looked like a rock) and asked to identify what the object appeared to be versus what it actually was. In the false belief group, children were shown classic changed-location FB skits and asked to predict where characters would look for their possessions. In the control group, children received demonstrations from both training conditions. Each participant received 4 individual sessions; pre- and posttesting occurred in sessions 1 and 4 while training occurred in sessions 2 and 3. In each training session, participants were tested twice and given feedback specific to their task responses with the exception of the control group. The control group received one test in each dimension (i.e., one AR test and one FB test) and no feedback. Training groups with feedback had a direct effect on the trained task (e.g., FB training increased FB posttest performance) and an indirect effect (i.e., transfer) on the untrained task (e.g., FB training increased AR performance). Training in an already mastered ToM task transferred to the untrained ToM task (e.g., participant passed AR at post-test but was assigned to the AR training group. AR training increased FB performance). No post-test performance changes were found in either ToM dimension for the control group. Results from this study indicate that (a) preschool-aged children can improve their performance on ToM measures after training, (b) training in one dimension of ToM transfers to untrained dimensions, and (c) explicit feedback during training is essential to children’s ToM learning.

Meltzoff and Brooks (2008) examined Level 1 perspective taking (i.e., blocked sensory access precludes seeing and knowing) in typically developing hearing infants aged 12 and 18 months across two experiments. Experiment 1 was conducted with infants aged 12 months. Infants were randomly assigned to one of three groups: (a) experience (opaque cloth), (b) experience (windowed cloth), and (c) baseline familiarization. Infants engaged in one of three experiences with an opaque or windowed piece of cloth. Then infants observed the looking behaviors of a blindfolded adult. Phase One differed for all three groups. Infants in the opaque cloth group experienced the cloth obstructing their view of an object. Infants in the windowed cloth group experienced the opaque cloth and the windowed cloth, which did not obstruct their view of the object. Those in the baseline group played with the cloth on the table in order to gain familiarity with the cloth. In Phase Two, the examiners measured whether infants would follow the heads of the blindfolded adult as a function of their prior experience with the blindfold. The examiners measured the length of each child's gaze to generate a "looking score." Infant's gaze followed the blindfolded adult significantly less after experience with the opaque cloth than with the windowed or baseline experiences. Experiment Two included infants aged 18 months following the procedures of Experiment One with a single exception: the windowed cloth was replaced with a see-through (trick) blindfold. Infant's gaze followed the blindfolded adult significantly more often after experience with the see-through cloth than after the opaque or baseline experience, demonstrating that infants' first-person experience influences their understanding of others. This is an important notion in the development of ToM because it indicates that children begin very early to relate their perspectives to the perspectives of others. Systematic training on how obstructors influence their own visual perception changes infants' interpretation of the visual behavior of others. This experiment presents an interesting approach for examining a precursory skill necessary for ToM (e.g., joint attention) that occurs prior to the acquisition of language. DoD mother-child dyads and DoH mother-child dyads interact in qualitatively different ways when securing joint attention with their children (Lederberg & Everhart, 2000; Nowakowski, 2009). This lack of joint attention between hearing/deaf dyads plays a role in the development of both the language and the pragmatic experiences necessary to the development of ToM (Charman et al., 2000; Moeller & Schick, 2006).

In a follow-up study to the Hale and Tager-Flusberg study (2003), Rakoczy, Tomasello, & Striano (2010) examined the effects of the explicit use of the complement structure, *pretends that*, on the ToM development of preschool-aged children. A sample of 60 children aged 40-44 months with typical hearing were quasi-randomly assigned to one of three groups as age was controlled for such that each group had the same age range and mean age. Children received 4 training sessions within a period of two weeks in one of three groups: pretend play including explicit mental state discourse (i.e., pretends that) (treatment), pretend play including implicit discourse about actions or events (treatment), and functional play such as imitation games (control). Posttest measures included: (1) two combined AR and pretense versus reality (PR) tasks, (2) two Moe tasks (children determine if a character is pretending), and (3) Pretend-Really Doing (PR-D) and Try-Really Doing (T-RD) differentiation tasks. The explicit mental state discourse group benefited from training over the other two groups in two ways: (a) increased children's ability to distinguish between pretense and reality (PR task) and (b) increased children's ability to understand pretending (intentionally acting as-if) versus accidentally behaving as if (pretending-trying distinction). No significant differences were found among the three groups on any other posttest measures. Researchers suggest that the "*pretends/thinks that*" complement structure though necessary is not singularly sufficient for the development of mental state understanding.

The purpose of an intervention by Gola (2012) was to investigate how another aspect of language, specifically mental state verb input, influences preschoolers' ToM. Seventy-two preschool students ranging from 3.0 to 4.8 years of age with typical hearing were randomly assigned to one of six video training groups: (a) overheard first person statement, (b) overheard first person question, (c) overheard other person statement, (d) overheard other person question, (e) interactive other person statement, and (f) interactive other person question. All participants received 4 individual training sessions across a 3 week period. Posttest performances on a six-task ToM scale including DD, DB, SP, KA, FB – unexpected contents, and FB – emotion task (Wellman & Liu, 2004) were used to determine treatment effects. Children's understanding of DD, DB, and KA did not improve after exposure to mental state verb input. (This was possibly due to a ceiling effect at pretest for these tasks.) However, specific mental state verb use did improve children's FB understanding, specifically when second or third person perspectives were present in a natural context. Perspective taking in the videos did not need to be directed to, or about, the child to improve FB understanding as significant improvements resulted from "overhearing" conditions. Researchers concluded that exposure to mental state language, specifically when the language is "overheard" in an intact socio-conversational exchange, increases children's FB understanding rather than a disrupted exchange in which the child is directed to respond to a direct question.

The role of early language in ToM development, specifically mother-child discourse, was examined by Taumoepeau and Reese (2013). One hundred and two mother-child dyads participated in the study in which mothers were trained to engage their children in reminiscing conversations using elaborative talk. Child participants were 19-months at the start of study and 44-months at end of study; all had typical hearing. Mother-child dyads were randomly assigned to one of two groups (i.e., training or no training) after being matched on child language (i.e., MacArthur-Bates Communicative Development Inventory: Words and Sentences [MCDI:WS]), mother education levels (i.e., presence or absence of tertiary education) and maternal open-ended elaborative questions (i.e., coding of mother-child past event conversations in the pretest session). The study comprised 6 sessions. Pre- and posttesting were completed in sessions 1, 5, and 6 and reminiscing training was completed every four months in sessions 2 (i.e., child at 21 months), 3 (i.e., child at 25 months) and 4 (i.e., child at 29 months). Mothers in the training group were taught to engage their children in reminiscing conversations using elaborative talk that included asking open-ended wh- questions, rephrasing questions (that did not receive a child response) with new information, praising child responses, and following up with additional questions. Post-test scores on six ToM tasks (Welch-Ross, 1997) including three FB (i.e., appearance-reality, unexpected contents, changed location) and three Knowledge Access (i.e., see-know, see-tell, informative views) as well as changes in mother-child talk (i.e., elaborative and non-elaborative talk and mental state language) were used to determine training effects. A training effect was found between language and ToM. This relation was conditional on whether mothers were trained in elaborative reminiscing, regardless of their use of mental state language. Child participants with low-language benefited more from training than those with higher language initially. This study provides support for early intervention programs targeting parent-child discourse (i.e., elaborative reminiscing) as a strategy for increasing children's ToM understanding.

Benson, Sabbagh, Carlson and Zelazo (2012) conducted a quasi-experimental, correlational study with trainings modeled after the changed-location FB paradigm established by Hale and Targer-Flusberg (2003). Researchers sought to explain the variance in training effect through children's initial response conflict-executive functioning (RC-EF) scores. Twenty-four children with a mean age of 3.8 years and typical hearing received 4 training sessions across 2 to 3 weeks. The correlation between training and posttest performance on FB (i.e., changed-location, misleading contents), appearance-reality, and deceptive pointing tasks was, in part, explained by children's initial levels of executive functioning. Children with stronger RC-EF benefited more from the training and realized those benefits more quickly. Initial ToM knowledge was also positively associated with children's FB explanation scores. Results from this study provide support that domain-general cognitive skills (i.e., RC-EF) facilitate preschoolers' abilities to construct an understanding of FB from relevant experiences.

Allen and Kinsey (2013) implemented a training study with 38 children ranging from 36 to 52 months of age all with typical hearing. A quasi-experimental, comparison group pre-/posttest design was used. Participants were assigned to one of two groups: (a) a pretense play group including role imitation and pretending and (b) nonpretense, peer-interactive play group (e.g., hopscotch). Each group received training in 15 minute sessions, 3 times per week for 4 weeks. Researchers examined posttest scores on three ToM tasks (False Belief [FB], Appearance-Reality [AR], and Emotion Recognition [ER]) and found no significant difference in FB performance between the groups. However, the pretense play training group made significant gains on the AR and ER posttests as compared to the nonpretense play group. Researchers concluded that some aspects of ToM (i.e., AR and ER) can be taught through pretense play while other aspects (i.e., FB) need additional training (e.g., increased duration and communicative development).

Of the published ToM intervention studies, only one has attempted to provide an intervention for DHH children who are delayed in ToM. Wellman and Peterson (2013) used visual manipulatives containing thought bubbles (i.e., a visual representation of what people are thinking) to teach concepts related to false belief understanding. Participants included 43 Australian signing DoH children aged 5-13 years. Children in the thought bubble training group were compared to two control groups: a baseline control and a visual-representation training control. The baseline group controlled for spontaneous gains over time and the visual representation group controlled for general benefits from extended practice and discussion regarding visual representations. While participants were not randomly assigned to treatment and control groups, there were no significant differences reported for gender, age, hearing loss, communication modality (i.e., signed communication, Signed English or Auslan Sign), teacher characteristics, or educational placement and programming. Children's general language levels were measured using the Sentence Structure subtest from Clinical Evaluation of Language Fundamentals-Preschool test (CELF-P) (Wiig, Secord, & Semel, 1992), and no significant differences among groups were found. ToM understanding has been measured using various ToM batteries: (a) a three item false belief composite (TFBI) including two changed-location False Belief items and a misleading container False Belief item (i.e., child is presented with a familiar box, typically a box of candy and asked what they believe to be inside). After the child indicates the candy, she is shown that the box in fact contained a spoon. The spoon is then placed back inside the box and the child is asked what she thinks another person, who has not been shown the true contents of the box, will think is inside. The child passes the task if she responds that another person will think that there is candy in the box, but fails the task if she responds that another person will think that the box contains a spoon.), and (b) Wellman and Liu's (2004) five-task scale including Diverse Desires (DD), Diverse Beliefs (DB), Knowledge Access (KA), misleading container False Belief (FB), and Hidden Emotion (HE). Again, no significant differences were found on any of the ToM measures (i.e., total scale level and individual scale task level). Training materials for the ToM thought bubble intervention focused on changed-location FB. Two-dimensional cardboard materials were designed to differ from the three dimensional stimuli used in the ToM pretests and posttests (Wellman & Liu, 2004). During the training and assessment phases, a certified interpreter presented a signed translation of the researcher's spoken instructions. Participants received individual instruction on a weekly schedule, however total training time per participant varied as training continued in each stage until mastery criterion was met. Training time increased as participants moved through the intervention stages. DHH children receiving thought bubble training made more significant gains along the ToM developmental sequence than those who did not.

Table 2. *Intervention Study Summaries*

Source	Participants	Methodology	Intervention and Duration	Dependent Variable	Outcomes	Implications
Dockett (1998)	33 children, average age of 4.2 years, typical hearing	quasi-experimental (2 groups: control and treatment)	10 total weeks with 3 weeks of strategic play (in the treatment group) aimed at facilitating more complex shared pretend play	posttest scores on ToM tasks (appearance versus reality [AR] and False Belief [FB]) and observational coding of children's shared pretense play (i.e., Play Observation Scale and Smilansky Scale [Rubin, 1989] for Evaluation of Dramatic and Sociodramatic Play [Smilansky & Shefatya, 1990])	Strategic experience in complex shared pretense positively influences children's performance on tasks requiring a representational understanding of the mind.	Guided play interactions involving shared social interactions and verbal communication can be used to increase young children's ToM understanding.
Hale & Tager-Flusberg, (2003)	60 preschool-aged children, typical hearing	randomized control trial (3 groups)	8 training sessions in one of three treatment groups: changed-location False Belief (FB), sentential complements (SC), and relative clauses (RC)	posttest scores on ToM tasks and specific linguistic structures	Children trained in FB increased their ToM posttest scores. Children trained in SC increased ToM scores and learned the linguistic structure. Children trained in RC did not increase ToM scores but did learn the linguistic structure.	Acquisition of the specific linguistic structure (SC) contributes to the development of ToM in hearing preschoolers.
Melot & Angeard (2003)	93 children ranging from 3.6 to 4.4 years of age, typical hearing	quasi-experimental (3 equivalent groups)	2 training sessions in one of three groups: appearance versus reality (AR) with feedback, FB with feedback, AR/FB without feedback (i.e., control group)	posttest scores on ToM measures for AR and FB	Training groups with feedback had a direct effect on the trained task (e.g., AR training increased AR posttest performance) and an indirect effect (i.e., transfer) on the untrained task (e.g., AR training increased FB performance). Training in an	Preschool-aged children can improve their performance on ToM measures after training. Training in one dimension of ToM transfers to untrained dimensions. Explicit feedback during training is essential to learning.

					already mastered ToM task transferred to untrained ToM task.	
Meltzoff & Brooks (2008) Experiment 1	96 12-month-olds, typical hearing	randomized control trial (3 groups)	1 training session in one of three groups: experience (opaque cloth), experience (windowed cloth), and baseline familiarization	looking scores on a gaze-following trials	Infant gaze followed the blindfolded adult significantly less in the opaque cloth group.	Infants' first-person experience influences their understandings of others. Systematic training on how occluders influence their own visual perception changes infants' interpretation of the visual behaviors of others.
Meltzoff & Brooks (2008) Experiment 2	72 18-month-olds, typical hearing	randomized control trial (3 groups)	1 training session in one of three groups: experience (opaque cloth), experience (trick cloth), and baseline	looking scores on a gaze-following trials	Infant gaze followed the blindfolded adult significantly more in the trick cloth group.	Further support for the influence of first-person experiences on the understanding of another's behavior.
Rakoczy, Tomasello, & Striano (2010) Study 2	60 children aged 40-44 months with a mean age of 42 months, typical hearing	quasi-random assignment – age was controlled for such that each group had the same age range and mean age (3 groups: two treatment and one control)	4 sessions within a period of two weeks in one of three groups: pretend play including explicit mental state discourse (i.e., pretend that) (treatment), pretend play including implicit discourse about actions or events (treatment), and functional play such as imitation games (control)	Posttest performances on three tasks: (1) two combined AR and pretense versus reality (PR) tasks,(2) two Moe tasks (children determine if a character is pretending), and (3) Pretend-Really Doing (PR-D)and Try-Really Doing (T-RD) differentiation tasks	Only the explicit training group benefited from training in two ways: (1) increased the ability to distinguish between pretense and reality (PR task) and (2) increased their ability to understand pretending (intentionally actin as-if) versus accidentally behaving as if (pretending-trying distinction).	The "that" complement structure though necessary is not, alone, sufficient for the development of mental state understanding.
Gola (2012)	72 preschool	randomized control	4 training sessions	posttest scores on a	Children's understanding	Exposure to mental

	students ranging from 3.0 to 4.8 years of age, typical hearing	trial (6 groups)	across a 3 week period in one of six groups: overheard first person statement, overheard first person question, overheard other person statement, overheard other person question, interactive other person statement, interactive other person question	six-task ToM scale (Wellman & Liu, 2004)	of DB, DD, and KA did not improve after exposure to mental state verb input. Possibly due to ceiling effect at pretest for these tasks. Specific mental state verb use did improve children's FB understanding, specifically when second or third person perspectives were present in a natural context. Perspective taking did not need to be directed to, or about, the child to improve FB understanding. Significant improvements resulted from "overhearing" conditions.	state language, specifically when the language is "overheard" in an intact socio-conversational exchange, increases children's FB understanding.
Wellman & Peterson (2013)	43 school-aged children ranging from 5 – 13 years of age, all with prelingual severe to profound loss, approximately half used CIs, all used Signed English or Auslan	quasi-experimental (3 groups not randomly assigned)	6 training sessions across 5-7 weeks in one of three groups: changed-location FB, non-ToM art, and baseline	posttest scores on a five-task ToM scale and a near generalization changed-location FB task (i.e., Sally Anne Task)	DHH children receiving thought bubble training made more significant gains along the ToM developmental sequence than those who did not.	Systematic training on changed-location FB influences DHH children's ToM development.
Benson, Sabbagh, Carlson, & Zelazo (2012)	24 children with a mean age of 3.8 years, typical hearing	quasi-experimental (one group, correlational)	4 training sessions were conducted within 2 to 3 weeks with a minimum of 2 days between each ses-	posttest scores on FB tasks (i.e., changed-location, misleading contents), appearance-reality, deceptive	Children with stronger RC-EF benefited more from the training and realized those benefits more quickly.	Preliminary support that domain-general cognitive skills (i.e., RC-EF) facilitate preschoolers' abilities to

			sion; all trainings modeled after changed-location FB training paradigm (Hale & Tager-Flusberg, 2003)	pointing, and response conflict executive functioning (RC-EF) tasks	Initial ToM knowledge and RC-EF were positively associated with children's FB explanation scores.	construct an understanding of FB from relevant experiences.
Taumoepeau & Reese (2013)	102 children aged 19 months at start of study and 44 months at end of study, typical hearing	randomized control trial (2 groups)	3 training sessions at 21, 25 and 29 months, mothers were trained to engage children in reminiscing conversations using elaborative talk (i.e., asking open-ended *wh*-questions, rephrasing questions with new information, praising child responses and following up with additional questions)	post-test scores on six ToM tasks (Welch-Ross, 1997) including three FB (i.e., appearance-reality, unexpected contents, changed location) and three Knowledge Access (i.e., see-know, see-tell, informative views); changes in mother and child talk (i.e., elaborative and non-elaborative talk and mental state language	The relation between language and ToM was conditional on whether mothers were trained in elaborative reminiscing, despite their use of mental state language. Children with low-language benefited more from training than those with higher language.	Support for early intervention programs targeting parent-child discourse (i.e., elaborative reminiscing) as a strategy for increasing children's ToM understanding.
Allen & Kinsey (2013)	38 children ranging from 36 to 52 months, typical hearing	quasi-experimental comparison group pretest/posttest design (2 groups)	15 minutes, 3 times per week for 4 weeks, in one of two groups: pretense play including role imitation and pretending and non-pretense, peer-interactive-related play (e.g., hopscotch)	posttest scores on three ToM tasks (False Belief [FB], Appearance-Reality [AR], and emotion recognition [ER])	No difference was found in FB performance between the groups. However, the training group made significant gains on the AR and ER posttests.	Some aspects of ToM (i.e., ER) can be taught through pretense play while other aspects (i.e., FB) need additional training (i.e., increased duration and communicative development).

Future Directions

We know that the ToM delays experienced by school-aged DHH children are not intractable (Morgan & Kelg, 2006). Early exposure to fluent language models and linguistically-rich environments during the years most critical to language acquisition are paramount to the development of ToM and have implications for multiple dimensions of development. If DHH children experience targeted aspects of language including: linguistic structures (i.e., sentential complements), vocabulary (i.e., mental state verbs) and socio-communicative exchanges, they are likely to develop ToM comparable to their TD hearing peers. Interventions that target the increased use of mental state vocabulary through storybook reading, adult-child conversations on ToM-related topics, and the concretization of abstract ToM ideas via pictorial representations (e.g., thought bubbles) are certainly worthy of future research. In summary, the limited number of published ToM interventions appears to provide emerging evidence supporting their use with DHH children. Additional replications and extensions of the aforementioned interventions within the context of real classrooms might make a greater range of tools available to teachers.

Conclusion

The purpose of this review was to examine the extant literature regarding ToM development in DHH children and to examine further what works (i.e., evidence-based practices) and what the field still needs to accomplish to provide appropriate support to teachers of DHH children. While past research has revealed some evidence of effective strategies to help DHH children master ToM, much work needs still needs to be done to address the need for evidence-based practices that are both proactive and easily implemented by teachers in a classroom setting.

REFERENCES

Allen, J. R., & Kinsey, K. (2013). Teaching theory of mind. *Early Education and Development, 24*, 865-876. doi: 10.1080/10409289.2013.745182

Astington, J. W., & Jenkins, J. M. (1999). A longitudinal study of the relation between language and theory-of-mind development. *Developmental Psychology, 35*, 1311-1320.

Astington, J. W. (2001). The future of theory-of-mind research: Understanding motivational states, the role of language, and real-world consequences. Commentary on 'Meta-analysis of theory-of-mind development: The truth about false belief.' *Child Development, 72*, 685-687.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*, 544-559.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind.* Cambridge, MA: MIT Press/Bradford Books.

Benson, J. E., Sabbagh, M. A., Carlson, S. M., & Zelazo, P. D. (2012). Individual differences in executive functioning predict preschoolers’ improvement from theory-of-mind training. *Developmental Psychology, 49*, 1615-1627. doi: 10.1037/a0031056

Blamey, P. J. (2003). Development of spoken language by deaf children. In M. Marschark & P. E. Spencer (Eds.), *Oxford handbook of deaf studies, language, and education* (pp. 232–246). New York, NY: Oxford University Press.

Brinkmann, S. (2011). Towards an expansive hybrid psychology: Integrating theories of the mediated mind. *Integrative Psychological and Behavioral Science, 45*(1), 1-20.

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, G., Cox, A. & Drew, A. (2000) Testing joint attention, imitation and play as infancy precursors to language and theory of mind. *Cognitive Development, 15,* 481–498.

Courtin, C. (2000). The impact of sign language on the cognitive development of deaf children: The case of theories of mind. *Journal of Deaf Studies and Deaf Education, 5*, 266-276.

Courtin, C., & Melot, A.M., (2005). Metacognitive development of deaf children: Lesson from the appearance-reality false belief tasks. *Developmental Science, 8*(1), 16-25.

Cutting, A. L., & Dunn, J. (1999). Theory of mind, emotion understanding, language, and family background: Individual differences and interrelations. *Child Development, 70*, 853-865.

de Rosnay, M., & Hughes, C. (2006). Conversation and theory of mind: Do children talk their way to socio-cognitive understanding? *British Journal of Developmental Psychology, 24,* 7-37.

de Villiers, P. A. (2005). The role of language in theory-of-mind development: What deaf children tell us. In J. W. Astington & J. A. Baird (Eds.), *Why language matters for theory of mind* (pp. 266-297). New York, NY: Oxford University Press, Inc.

de Villiers, J. G., & de Villiers, P. A. (2000). Linguistic determinism and the understanding of false beliefs. In P. Mitchell and K. J. Riggs (Eds.), *Children's reasoning and the mind* (pp. 191-228). Hove, UK: Psychology Press.

de Villiers, J. G., & Pyers, J. E. (2002). Complements to cognition: A longitudinal study of the relationship between complex syntax and false-belief-understanding. *Cognitive Development, 17*, 1037-1060.

de Villiers, P. A., & de Villiers, J. G. (2012). Deception dissociates from false belief reasoning in deaf children: Implications for the implicit versus explicit theory of mind distinction. *British Journal of Developmental Psychology, 30*, 188-209. doi: 10.1111/j.2044-835X.2011.02072.x.

Dockett, S. (1998). Constructing understandings through play in the early years. *International Journal of Early Years Education, 6*, 105-116.

Fernandez, C. (2013). Mindful storytellers: Emerging pragmatics and theory of mind development. *First Language, 33*(20), 20-46. doi: 10.1177/0142723711422633

Figueras-Costa, B., & Harris. P. (2001). Theory of mind development in deaf children: A nonverbal test of false-belief understanding. *Journal of Deaf Studies and Deaf Education, 6*(2), 92-102.

Fischer, K.W., Knight, C.C., & Van Parys, M. (1992). Analyzing diversity in developmental pathways: Methods and concepts. In W. Edelstein & R. Case (Eds.), *Contributions to human development: Constructivist approaches to development.* Basel, Switzerland: S. Karger.

Garfield, J. L., Peterson, C. C., & Perry, T. (2001). Social cognition, language acquisition and the development of the theory of mind. *Mind and Language, 16*, 494-541.

Gersten, R., Fuchs, L. S., Compton, D. L., Coyne, M., Greenwood, C., & Innocenti, M. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, *71*(2), 149–164.

Gola, A. A. (2012). Mental verb input for promoting children's theory of mind: A training study. *Cognitive Development, 27*(1), 64-76.

Gonzalez, A., Quintana, I., Barajas, C., & Linero, M. J. (2007). The role of age and oral lexical competence in false belief understanding by children and adolescents with hearing loss. *The Volta Review, 107*(2), 123-139.

Gopnick, A. (1993). How we know our minds: The illusions of first-person knowledge of intentionality. *Behavioral and Brain Sciences, 16*, 1-14.

Green, B.G. (1956). A method of scalogram analysis using summary statistics. *Psychometrika, 21*, 79-88.

Guttman, L. (1944). A basis for scaling qualitative data. *American Sociological Review, 9*, 139-150.

Hale, C. M., & Tager-Flusberg, H. (2003). The influence of language on theory of mind: A training study. *Developmental Science, 6*, 346-359.

Harris, M. (1992). *Language experience and early language development*. Hove, U.K.: Erlbaum Associates.

Horner, R. H., Carr, E. G., Halle, J., Mcgee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children*, *71*, 165–179.

Howely, M., & Howe, C. (2004). Social interaction and cognitive growth: An examination through role-taking skills of deaf and hearing children. *British Journal of Developmental Psychology, 22*, 219-243.

Lederberg, A. R., & Everhart, V. S. (2000). Conversations between deaf children and their hearing mothers: Pragmatic and dialogic characteristics. *Journal of Deaf Studies and Deaf Education, 5*, 303-322. doi: 10.1093/deafed/5.4.303

Lederberg, A. R. (2003). Expressing meaning: From communicative intent to building a lexicon. In M. Marschark & P. E. Spencer (Eds.), *Oxford Handbook of deaf studies*, *language, and education.* New York, NY: Oxford University Press.

Lederberg, A. R., Schick, B., & Spencer, P. E. (2013). Language and literacy development of deaf and hard of hearing children: success and challenges. *Developmental Psychology, 49*(1), 15-30. doi: 10/1037/a0029558

Macaulay, C. E., Ford, R. M. (2006). Language and theory-of-mind development in prelingually deafened children with cochlear implants: a preliminary investigation. *Cochlear Implants International, 7*(1), 1-14. doi:10.1002/cii.22

Meadow-Orlans, K.P., Spencer, P.S. & Koester, L.S. (Eds.).(2004). *The world of deaf infants*. New York, NY: Oxford University Press.

Melot, A., & Angeard, N. (2003). Theory of mind: Is training contagious? *Developmental Science, 6*, 178-184.

Meltzoff, A., & Brooks, R. (2008). Self-experience as a mechanism for learning about others: A training study in social cognition. *Developmental Psychology, 44*, 1257-1265. doi: 10.1037/a0012888

Meristo, M., & Hjelmquist, E. (2009). Executive functions and theory-of-mind among deaf children: Different routes to understanding other minds? *Journal of Cognition and Development, 10*(1-2), 67-91. doi: 10.1080/1524870902966552

Meristo, M., Morgan, G., Geraci, A., Iozzi, L., Hjelmquist, E., Surian, L., & Siegal, M. (2012). Belief attribution in deaf and hearing infants. *Developmental Science, 15*, 633-640. doi: 10.1111/j.1467-7687.2012.01155.x

Mitchell, R. E., & Karchmer, M. A. (2004). Chasing the mythical ten percent: Parental status of deaf and hard of hearing students in the United States. *Sign Language Studies, 4*(2), 138-163. doi: 10.1353/SLS.2004.0005

Moeller, M. P., & Schick, B. (2006). Relations between maternal input and theory of mind understanding in deaf children. *Child Development, 77*, 751-766.

Morgan, G., & Kegl, J. (2006). Nicaraguan sign language and theory of mind: The issue of critical periods and abilities. *Journal of Child Psychology and Psychiatry, 47*, 811-819.

Muller, U., Liebermann-Finestone, D. P., Carpendale, J. I. M., Hammond, S I., Bibok, M. B. (2012). Knowing minds, controlling actions: The developmental relations between theory of mind and executive function from 2 to 4 years of age. *Journal of Experimental Child Psychology, 111*, 331-348. doi: 10.1016/j.jecp.2011.08.014

Nowakowski, M. E. (2009). Establishment of joint attention in dyads involving hearing mothers of deaf and hearing children, and its relation to adaptive social behavior. *American Annuls of the Deaf, 154*(1), 15-29.

Odom, S. L., Brantlinger, E., Gersten, R., Horner, R. H., Thompson, B., Harris, K. R. (2005). Research in special education: Scientific methods and evidence-based practices. *Exceptional Children, 71*(2), 137-148.

Peters, K., Remmel, E., & Richards, D. (2009). Language, mental state vocabulary, and false belief understanding in children with cochlear implants. *Language, Speech, and Hearing Services in Schools, 40*, 245-255. doi: 0161-1461/09/4003-0245.

Peterson, C. C. (2004). Theory-of-mind development in oral deaf children with cochlear implants or conventional hearing aids. *Journal of Child Psychology & Psychiatry, 45*, 1096-1106.

Peterson, C., & Siegal, M. (1998). Changing focus on the representational mind: Deaf, autistic, and normal children's concepts of false photos, false drawings, and false beliefs. *British Journal of Developmental Psychology, 16*, 301-320.

Peterson, C. C., & Siegal, M. (1999). Representing inner worlds: Theory of mind in autistic, deaf, and normal hearing children. *Psychological Science, 10*(2), 126-129.

Peterson, C., & Slaughter, V. P. (2006). Telling the story of mind: Deaf and hearing children's narratives and mental state understanding. *British Journal of Developmental Psychology, 24*, 151-179.

Peterson, C. C., Wellman, H. M., & Liu, D. (2005). Steps in theory-of-mind development for children with Deafness or Autism. *Child Development, 76*, 502-517.

Peterson, C. C., & Wellman, H. M. (2009). From fancy to reason: Scaling deaf and hard of hearing children's understanding of theory of mind and pretence. *British Journal of Developmental Psychology, 27,* 297-310.

Peterson, C. C., Wellman, H. M., & Slaughter, V. (2012). The mind behind the message: Advancing theory-of-mind scales for typically developing children, and those with deafness, autism, or Asperger syndrome. *Child Development, 83*, 469-485.

Pyers, J. E., & Senghas, A. (2009). Language promotes false-belief understanding: Evidence from leaners of a new sign language. *Psychological Sciences, 20*, 805-812. doi: 10.111/j.14679280.2009.02377.x.

Quittner, A. L., Leibach, P., & Marciel, K. (2004). The impact of cochlear implants on young deaf children: new methods to assess cognitive and behavioral development. *Archives of Otolaryngology: Head and Neck Surgery, 130*, 547-554.

Rakoczy, H., Tomasello, T., & Striano, T. (2010). The role of experience and discourse in children's developing understanding of pretend play actions. *British Journal of Developmental Psychology, 24*, 302-335. doi: 10.1348/026151005X36001

Remmell, E., Bettger, J. G., & Weinburg, A. M. (2001). Theory of mind development in deaf children. In M. D. Clark, M. Marschark & M. Karchmer (Eds.), *Context, cognition, and deafness* (pp. 113-134). Washington DC: Gallaudet University Press.

Ruffman, T., Slade, L., & Crowe, E. (2002). The relation between children's and mother's mental state language and theory-of-mind understanding. *Child Development, 73*, 734-751.

Ruffman, T., Slade, L., Rowlandson, K., Rumsey, C., & Garnham, A. (2003). How language relates to belief, desire, and emotion understanding. *Cognitive Development, 18*, 139-158.

Russell, P. A., Hosie, J. A., Gray, C. D., Scott, C., Hunter, N., Banks, J. S., & Macaulay, M. C. (1998). The development of theory of mind in deaf children. *Journal of Child Psychology and Psychiatry, 39*, 903-910.

Schick, B., de Villiers, P., de Villiers, J., & Hoffmeister, R. (2007). Language and theory of mind: A study of deaf children. *Child Development, 78*, 376-396.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and Quasi-Experimental Designs for Generalized Causal Inference.* Boston, MA: Houghton Mifflin Company

Shanton, K., & Goldman, A. (2010). Simulation Theory. *Wiley Interdisciplinary Reviews: Cognitive Science, 1*, 527-538. doi:10.1002/wcs.33

Spencer, P. E., & Marschark, M. (Eds.). (2010). *Evidence-Based Practice in Educating Deaf and Hard-of-Hearing Students (Professional Perspectives on Deafness: Evidence and Applications*. New York, NY: Oxford University Press.

Taumoepeau, M., & Reese, E. (2013). Maternal reminiscing, elaborative talk, and children's theory of mind: An intervention study. *First Language, 33*, 388-410. doi: 10.1177/0142723713493347

Tomasuolo, E., Valeri, G., Di Renzo, A., Pasqualetti, P., & Volterra, V. (2013). Deaf children attending different school environments: Sign language abilities and theory of mind. *Journal of Deaf Studies and Deaf Education, 18*(1), 12-29. doi:10.1093/deafed/ens035

Van Staden, A. (2009). Comparing native signing, late-signing and orally trained deaf children's "theory of mind' abilities. *South African Journal of Psychology, 40*(1), 99-106.

Want, S. C., & Gattis, M. (2005). Are "late signing" deaf children "mindblind"? Understanding goal-directedness in imitation. *Cognitive Development, 20*, 159–172.

Wellman, (1990). *The Child's Theory of Mind.* Cambridge, MA: MIT Press

Wellman, H. M., Cross, D., & Watson, J. (2001) Meta-analysis of theory-of-mind development: the truth about false belief. *Child Development, 72*, 655-684.

Wellman, H. M., & Liu, D. (2004). Scaling of theory of mind tasks. *Child Development, 75*, 523-541.

Wellman, H. M., & Peterson, C. C. (2013). Deafness, thought bubbles, and theory-of-mind development. *Developmental Psychology,* Advance online publication. doi:10.1037/a0032419

Wiig, E., Secord, W., & Semel, E. (1992). *Clinical Evaluation of Language Fundamentals (CELF)—Preschool*. New York, NY: Psychological Corporation.

Woolfe, T., Want, S. C., & Siegal, M. (2002). Signposts to development: Theory of mind in deaf children. *Child Development, 73*, 768-778.

Ziv, M., Meir, I., Malky, L. (2013). Enhancing theory-of-mind discourse among Deaf parents of children with hearing loss. *Journal of Education and Training Studies, 1*(2), 249-262. doi: 10.11114/jets.v1i2.169

Ziv, M., Most, T., & Cohen, S. (2013). Understanding of emotions and false beliefs among hearing children versus Deaf children. *Journal of Deaf Studies and Deaf Education*, *18*(2), 161-174. doi: 10.1093/deafed/ens073

2 THE EFFECTS OF THEORY OF MIND INSTRUCTION ON THE FALSE BELIEF UNDERSTANDING OF DEAF AND HARD OF HEARING STUDENTS IN PREKINDERGARTEN AND KINDERGARTEN

A growing body of developmental research suggests that children with hearing loss are delayed in Theory of Mind (ToM) acquisition when compared to their typically developing, hearing peers. While the majority of these studies have examined deaf and hard of hearing (DHH) children's developmental trajectories and their related measurement issues, a small number have addressed the need for interventions for this population. The present study extends the research on ToM interventions for DHH students to PreKindergarten and Kindergarten learners. A single-case multiple-baseline, multiple-probe, across-skills design with replications across classrooms (Kratochwill et al., 2010) was used to examine the effects of a ToM intervention on participants' false belief understanding as well as posttest performances on near generalization (i.e., Sally-Anne task; Baron-Cohen, Leslie, & Frith, 1985) and far generalization (i.e., movement on a five-task ToM developmental scale; Wellman & Liu, 2004) measures. A thought bubble intervention (i.e., a visual representation of what people are thinking) developed by Wellman and Peterson (2013) was modified in key areas: (a) participants were substantially younger than the population in the original study and thus required a preteaching phase addressing vocabulary and materials, (b) manipulable materials were created from the description provided in the Wellman and Peterson study along with parallel materials for use in assessment probes, (c) a certified teacher of DHH children provided explicit instruction to participants in a small group setting, (d) study length was increased from 6 to 15-18 weeks, and (e) methodological design change (i.e., group design to single-case design). The aforementioned modifications address the need for evidence-based ToM interventions that are both proactive and easily implemented by teachers in a classroom setting. Results inform the field in regard to the efficacy and feasibility of a ToM intervention for young DHH children.

This study is part of a larger project funded by the Institute of Education Sciences (IES) (R324E06035; R324A110101; R324C1200001) to develop early literacy interventions for students who are DHH in PreKindergarten through 2nd grade. A previously unreported aspect of the funded projects, known as *Foundations for Literacy* and the Center on Literacy and Deafness (CLAD), is the incorporation of Theory of Mind (ToM) as a component of the literacy intervention. Other researchers (Peterson & Wellman, 2009; Peterson, Wellman, & Lui, 2005; Peterson, Wellman, & Slaughter, 2012; Schick, de Villiers, de Villiers, & Hoffmeister, 2007; Wellman & Peterson, 2013) have studied ToM development with young students who are DHH with varied levels of speech perception and who use signed communication (e.g., ASL, CASE, SimCom, Pidgin) as well as with those who use spoken language only. However, no direct ToM training studies with DHH children of this age were found in the extant literature. The two research questions within the present study are:

1. What effect does ToM training incorporating thought bubbles have on the false belief understanding of the following DHH populations: (a) PreKindergarteners who use sign language, (b) PreKindergarteners who use spoken language, (c) Kindergarteners who use sign language, and (d) Kindergarteners who use spoken language; and

2. What effect does ToM training have on children's movement along the five-task ToM developmental scale (Wellman & Liu, 2004) and the Sally-Anne task (Baron-Cohen et al., 1985) for the following DHH populations: (a) PreKindergarteners who use sign language, (b) PreKindergarteners who use spoken language, (c) Kindergarteners who use sign language, and (d) Kindergarteners who use spoken language?

Review of the Literature

While it is widely accepted that language and ToM are interconnected, the precise role or roles language plays in the development of ToM is contested. Researchers suggest that language facilitates the development of ToM in a number of ways: (a) language mediates the cognitive processes of executive functioning and working memory that contribute to ToM (Ashington & Jenkins, 1999), (b) language is the primary way children gain environmental information (e.g., explicit mental explanations of behavior, vocabulary for unseen abstract concepts) necessary for ToM development (Ashington, 2001; Muller, Liebermann-Finestone, Carpendale, Hammond, Bibok, 2012), (c) language provides access to and engagement in informal conversations which are an important source of information about intentions, beliefs, and knowledge (de Rosnay & Hughes, 2006; Ruffman, Slade, & Crowe, 2002), (d) language enables children's constructions of mental representations of complex and abstract concepts (Ruffman, Slade, Rowlandson, Rumsey, & Garnham, 2003), and (e) the linguistic environment of the child influences the understanding of false beliefs (Cutting & Dunn, 1999). Additionally, researchers suggest that grammatical structure, specifically sentential complements (e.g., *Riley thinks that her Mom is mad.*), affects the development of ToM in that the structure provides children a linguistic representation of the world as seen through the perspective of another (de Villiers, 2005).

Young DHH children are studied in an attempt to ascertain the role of language in ToM development as this population comprises two subgroups (i.e., DoD and DoH) that acquire language and interact with the linguistic environment altogether differently. These developmental dissimilarities result in two distinct ToM trajectories where DoD children develop typically (Courtin, 2000; Peterson & Siegal, 1998, 1999; Peterson & Slaughter, 2006; Russell et al., 1998; Wolfe, Want & Siegal, 2002) and DoH children regardless of language modality (i.e., spoken or signed) develop atypically (Peterson & Wellman, 2009; Peterson et al., 2005; Peterson, Wellman, & Slaughter, 2012). DoH children develop ToM along the same sequential progression but at a delayed pace (i.e., master ToM task at later chronological ages) (Courtin, 2000; Peterson, 2004; Peterson & Siegal, 1998, 1999; Peterson & Slaughter, 2006; Remmell, Betteger, & Weinberg, 1998; Russell et al., 1998; Woolfe, Want & Siegal, 2002).

Studies have frequently shown that language ability and access to fluent models are significant predictors of DHH children's ToM development (Gonzalez, Quintana, Barajas, & Linero, 2007; Macaulay & Ford, 2006; Meristo & Hjelmquist, 2009; Morgan & Kegl, 2006; Pyers & Senghas, 2009; Tomasuolo, Valeri, Di Renzo, Pasqualetti, & Volterra, 2013; Van Staden, 2010). Studies attempting to explain the relation between language and DHH children's ToM development can be grouped into three primary themes: linguistic structures, specifically sentential complements (e.g., *Stacey thinks that her mother is mad*., *The boy thinks that his friend is lying*.) (de Villiers, 2005; Schick, de Villiers, de Villiers, & Hoffmiester, 2007; de Villiers & de Villiers, 2012), exposure to specific mental state vocabulary (e.g., *think*, *know*, *don't know*) (Peters, Remmel, & Richards, 2009; Ruffman et al., 2003), and socio-communicative exchanges including shifts in perspective (e.g., Howley & Howe, 2004; Meristo et al., 2012, Courtin & Melot, 2005; Ziv, Mier & Malky, 2013; Wellman & Peterson, 2013).

The skills targeted in the following intervention studies align with the thematic patterns present in the previously discussed investigational studies. These include linguistic structures, exposure to specific vocabulary or ToM content, and interactions with the linguistic environment. Only ToM interventions (i.e., training studies) conducted with children who are typically developing or who are DHH are presented in this literature review as these populations progress through similar developmental sequences with the exception of pacing. Interventions conducted with children with other disabilities (e.g., Autism) are excluded as these populations present dissimilar developmental trajectories.

The first group of studies examined the training effects of a linguistic structure (i.e., sentential complement) on false belief understanding including *thinks that* (Hale & Targer-Flusberg, 2003), *pretends that* (Rakoczy, Tomasello, & Striano, 2010), and *thinks that* as related to levels of executive functioning (Benson, Sabbagh, Carlson, & Zelazo, 2012). All three studies found the acquisition of the specific linguistic structure of sentential complements to be a contributor to the development of ToM in hearing preschoolers.

The next group of intervention studies examined the effects of specific mental state vocabulary and explicit instruction in ToM content including mental state vocabulary on children's ToM development. Researchers found that exposure to mental state language, specifically when the language is embedded within an intact socio-conversational exchange, increases hearing children's FB understanding (Gola, 2012), systematic training on changed-location false belief tasks increased school-aged DHH children's ToM understanding (Wellman & Peterson, 2013), and exposure to training (including explicit feedback) in one dimension of ToM transfers to untrained dimensions for hearing preschoolers (Melot & Angeard, 2003).

The final group of studies examined the effects of systematic changes within the linguistic environment as a method for increasing children's ToM understanding. A study implemented with hearing infants found that training on how occluders influence visual perception changed the infants' interpretation of the visual behaviors of others (Meltzoff & Brooks, 2008) which may support the development of a necessary ToM skill, joint attention. An early intervention program that targeted parent-child discourse (i.e., elaborative reminiscing) was found to be an effective strategy for increasing hearing preschooler's ToM understanding (Taumoepeau &

Reese, 2013). Two studies used the social interactions of preschoolers as a way to increase ToM development. The first found that guided play interactions involving shared social interactions and verbal communication increased young hearing children's ToM understanding (Dockett, 1998). The second found that guided pretense play had a positive effect on some aspects of ToM (i.e., emotion recognition) while other aspects (i.e., false belief) needed additional training (i.e., increased duration and communicative development) (Allen & Kinsey, 2013). Due to the singular linguistic focus of most ToM studies, it remains unclear how the various aspects of language (e.g., semantic, syntactic, and pragmatic) contribute independently and/or interdependently to the development of ToM (Fernandez, 2013) in young children regardless of their hearing levels. In an attempt to circumvent the linguistic delays present in the DHH population, the present intervention used visual representations (i.e., thought bubbles) of the underlying linguistic structures (i.e., the complement structure - *She thinks that it is a shoe*.) shown to predict False Belief understanding in DHH children (Schick, de Villiers, de Villiers, & Hoffmiester, 2007).

Method

Participants and Setting

This study took place in two schools in the Southeastern region of the United States. The first was a private school with PreK and Kindergarten programs for students who are DHH and use spoken language only. The second was a public school with PreK through 5th grade programs for students who are DHH and use some form of signed communication (ASL, CASE, SimCom) as reported by the classroom teachers. The participating PreK classrooms were in self-contained settings and the Kindergarten classrooms were in resource rooms (i.e., students received academic instruction in both the general education and the special education settings). The researcher (a certified teacher of students who are DHH) implemented the ToM training sessions in all participating classrooms and used the communication modality specified by the classroom teacher in all training (i.e., intervention) and assessment sessions. Inclusionary criteria for participants included eligibility and enrollment in PreK or Kindergarten DHH classrooms, a chronological age of 4.0 – 7.0 years, and a current audiogram establishing the student's level of hearing loss and aid use (i.e., hearing aids and/or cochlear implants). There was no minimum loss requirement. Classroom teachers and/or participants' parents completed a student demographic form for each child participant (see Appendix A). In addition, participants were required to fail the False Belief task on the ToM pretest. Participants could pass and/or fail any combination of the preceding tasks on the ToM assessments as long as the False Belief task received a failing score. All students receiving instruction in the participating classrooms were included in the study with exception of one student who was unresponsive during the entirety of the pretest battery. Said student received additional language instruction during the ToM intervention sessions. Intervention data from one child who participated in all training sessions were not included in the present study as the assessor was unable to collect pre- and posttest scores due to unintelligible speech.

Table 3. *Participant Demographics*

Child ID	Age	Gender	Classroom Grade	Classroom Communication Modality	Speech Perception Score (ESP)	Combined Language Standard Scores (WJ–Picture Vocab)	Expressive Language Standard Scores (EOWPVT)
101	50 mos	F	PreK	Spoken Language	4	105	92
102	49 mos	F	PreK	Spoken Language	4	97	110
103	58 mos	F	PreK	Spoken Language	4	79	61
201	76 mos	M	K	Spoken Language	4	66	68
202	63 mos	F	K	Spoken Language	4	73	69
203	76 mos	M	K	Spoken Language	4	67	55
204	69 mos	M	K	Spoken Language	4	68	65
301	53 mos	F	PreK	Total Communication	4	78	69
302	54 mos	F	PreK	Total Communication	1	98	73
303	59 mos	F	PreK	Total Communication	2	100	64
401	81 mos	F	K	Total Communication	4	76	57
402	63 mos	F	K	Total Communication	1	88	62
403	63 mos	M	K	Total Communication	1	104	65

Research Design

The researcher utilized a single-case multiple-baseline multiple-probe across skills design during which assessment probes were gathered to determine if a functional relation existed. The design was replicated across four classrooms. The study met the established criteria for the experimental design (Kratochwill et al., 2010), as the researcher: (a) actively manipulated the independent variable (i.e., ToM thought bubble training), (b) measured the dependent variable systematically over time (i.e., assessment probes for each stage in the intervention) and included interassessor agreement for at least 20% of data points in each phase meeting minimum thresholds (i.e., reliability measures), (c) collected 3 to 5 data points per phase with three demonstrations of effect or with three phase repetitions (i.e., 5 to 6 stages per intervention with 3 to 4 participants per class with replications in 4 classrooms) A multiple-probe design was used due to the impracticality of a continuous baseline (Horner & Baer, 1977; Horner, et al., 2005; Murphy & Bryan, 1980). According to Horner and Baer (1977), probes in this type of design must adhere to the following guidelines: (a) an initial baseline probe session for each stage in the training sequence, (b) an additional probe session conducted for each stage in the training sequence immediately after criterion is met on any training stage, and (c) a series consecutive baseline sessions must be conducted immediately prior to the introduction of each stage in intervention sequence (Horner & Baer, 1977, p. 190). The use of the multiple-probe technique with a successive sequence requires that a probe procedure be designed to assess performance in each step of the sequence. Data in baseline, intervention, and maintenance phases were collected on the individual participant level and each participant was assigned a unique data path on the resulting graph.

As in the Wellman and Peterson (2013) study, ToM training in the present study concentrated on changed-location False Belief situations and used two-dimensional cardboard objects including paper dolls, thought bubbles, miscellaneous known objects and containers, and rooms with opening and closing ‘door’ flaps. Two-dimensional training materials were specifically designed to differ from the three-dimensional dolls, props, and stimuli used for the ToM pretests and posttests administered within the context of the *Foundations for Literacy* and *CLAD* projects. The ToM thought bubble training (Wellman & Peterson, 2013) was modified for the present study in following ways:

1. A pre-teaching phase of one week in length was added to the original intervention. Due to the considerably younger mean age of the participants in this study, task vocabulary

and manipulative use were explicitly taught to ensure students understood the language and stimuli used during the training and assessment phases.

2. Manipulable materials were created from the description provided in the Wellman and Peterson (2013) study along with parallel materials for use in assessment probes.

3. The study length was extended from six weeks to 15 to 18 weeks. Again, due to the age of the participants, children often took more than one week to reach the pre-established mastery criterion especially in the latter stages of the intervention.

4. A certified teacher of DHH children provided direct instruction to participants in a small group setting. In the Wellman and Peterson (2013) study, researchers delivered instruction in a one-to-one basis for children using spoken language and a two-to-one (i.e., researcher, interpreter, child) basis for children using a signed language. In this study the sign proficient researcher delivered instruction to groups ranging from 3 (3 classrooms) to 4 children (1 classroom).

5. Due to the heterogeneity of the DHH population (e.g., varied levels of hearing loss, various types of hearing equipment and length of use, differing communication modalities, etc.), the researcher choose to implement a single-case design methodology as opposed to the original group design to better assess the intervention's effect on individual participants.

These modifications address the need for evidence-based ToM interventions that are both proactive (i.e., early intervention before a delay is pronounced) and easily implemented by teachers in a classroom setting (i.e., small group setting versus one-on-one).

Reliability

One graduate research assistant with signing ability was trained on the procedures for evaluating and scoring assessment probes including baseline, intervention, and maintenance sessions. To ensure scoring procedures were implemented correctly, the research assistant watched two practice videos of assessment probes and scored student responses on sample protocols. Point-by-Point Agreement was calculated for all of the practice sessions. It was not necessary to retrain the research assistant. Interassessor agreement was calculated for 25% (i.e., 65 of 257) of all recorded assessment sessions (i.e., baseline, intervention, and maintenance).

Fidelity

Fidelity of intervention implementation was completed for 29% (i.e., 25 of the 85) of the recorded intervention sessions using a fidelity checklist. A score of 0 (i.e., not observed) or 1 (i.e., observed) was assigned to each element in the fidelity checklist. The checklist included the following elements: (a) researcher used materials correctly, (b) researcher demonstrated concept, (c) researcher followed intervention script, (d) researcher gave corrective feedback when necessary, and (e) researcher gave each child the correct number of trials per session. Fidelity was measured by dividing the number of elements observed during a training session by the total number of required elements as outlined in the fidelity checklist.

Social Validity

The researcher collected social validity from the student participants to evaluate the perceived benefit to the students. The student survey presented four statements accompanied by recognizable icons (i.e., happy face, neutral face, sad face), which were used as a rating scale with a score of 1 equaling a negative response and a score of 3 equaling a positive response. (See Appendix B) In addition to student surveys, the researcher asked classroom teachers to share their thoughts about the intervention regarding ease of implementation, appropriateness to setting, and perceived benefit to the teacher and student participants. Intervention materials, scripts and intervention videos were shared with the classroom teachers at the completion of the study. The teacher survey presented four statements accompanied by a rating scale with a score of 1 equaling a negative response and a score of 5 equaling a positive response. Three free-response questions were also included. (See Appendix C)

Materials

Measures. Wellman and Peterson's (2009) five-task ToM scale was administered to determine the participants' eligibility status and initial stage on the scale. Within the context of the *Foundations* and *CLAD* studies, five consecutive ToM tasks were assessed: (a) Diverse Desires (DD), (b) Diverse Beliefs (DB), (c) Social Pretend (SP), (d) Knowledge Access (KA), and (e) misleading-container False Belief (FB). Tasks included prequestions, test questions, and comprehension control questions, all of which must be answered correctly to pass the task. Each participant received a total scaled score ranging from 0–5. This score reflects the total number of tasks passed. Additionally, this measure was used as a far generalization task as the intervention targets changed-location False Belief, whereas the developmental scale assesses misleading-container False Belief. In a changed-location false belief situation, a short sketch is enacted in which a paper doll character, a girl, takes a marble and hides it in a basket. The girl then "leaves" the room. While she is away, a different girl takes the marble out of the initial basket (i.e., location one) and puts it in her own box (i.e., location two). The first girl is then reintroduced and the child (being assessed) is asked the key question: "Where will the girl look for her marble?" The child must indicate that the girl will look for her marble in the basket (i.e., location one). A child without ToM and thus unable to take an alternative perspective will indicate the girl will look in the changed location (i.e., location two – box.) In a misleading-container False Belief situation a child is presented with a familiar box, typically a box of candy and asked what they believe to be inside. After the child indicates that she believes that candy is in the box, she is shown that the box in fact contained a spoon. The spoon is then placed back inside the box and the child is asked what she thinks another person, who has not been shown the true contents of the box, will think is inside. The child passes the task if she responds that another person will think that there is candy in the box, but fails the task if she responds that another person will think that the box contains a spoon. A second ToM measure, the Sally-Anne Task (Baron-Cohen et al., 1985), was used as a near generalization measure as this task assesses changed-location False Belief task. Because language development and ToM development are closely aligned, additional standardized measures were used to determine the participants' receptive and expressive language levels in relation to typical developmental indicators (i.e., age-appropriate language). Language scores on the Woodcock-Johnson, Picture Vocabulary subtest (WJ-III; Woodcock, McGrew & Mather, 2007) and the Expressive One Word Picture Vocabulary Test (EOWPVT-3; Brownwell, 2000) were used to posit explanations for participants' intervention and generalization performance discrepancies. Furthermore, the Early Speech Perception test (ESP; Moog & Geers, 1990), a speech perception/functional hearing abilities test, and individual child demographics (i.e., hearing loss and hearing technology use) were used to examine child characteristics.

Videotaping. Kodak Playtouch cameras were used to videotape all training as well as pre/post ToM testing. Videos of assessments and intervention are necessary because it is not always easy to rate extemporaneously a child who uses sign language. In this instance, children were using American Sign Language (ASL) or a combination of spoken and signed language, and the researcher and research assistant needed to watch the child's productions on multiple occasions.

Intervention Materials. As mentioned above, the two-dimensional thought bubble training materials were specifically designed to differ from the three-dimensional dolls, props, and stimuli used for the ToM pretests and posttests. (See Appendix D)

Stage 1. The first manipulative was a picture of a young girl with an empty thought bubble image slightly above her head. A small Velcro dot was affixed to the middle of the thought bubble so that the object the girl was thinking about could be changed. A second picture of the same young girl showed her looking at an object on a rug while a different object was lying behind her. A small Velcro dot was affixed to the middle of the rug and to the floor behind the girl. Duplicate copies of various objects (e.g., cat, dog, backpack, pair of shoes, ball, toy car, books) had Velcro dots affixed to the back so that they could be placed in different locations on the additional materials (e.g., on the rug, behind the girl, in the thought bubble).

Stage 2. The Stage One picture of the girl with an empty thought bubble was used again in stage two. A modified version of the scene in which the girl was looking at an object on a rug was also used. The modified Stage Two picture had the same rug from the stage one picture however there was no longer a girl or a second object in the scene. A paper flap that looked like a door was affixed to the scene so that the girl could enter and exit the room with the rug (i.e., when they girl left the room she could still think about the object on the floor even though she could not see it.) Velcro dots were affixed to the middle of the rug and thought bubble. Duplicate copies of various objects (e.g., cat, dog, backpack, pair of shoes, ball, toy car, books) were carried over from Stage One.

Stage 3. The picture of the girl with an empty thought bubble was used again in Stage Three. A modified version of the scene in which the girl was looking at an object on a rug was also used. The Stage Three picture had an image of a table in room (instead of a rug). A paper flap that looked like a door was affixed to the scene so that the girl could enter and exit the room with the table (i.e., when the girl left the room she could still think about the object on the table even though she could not see it.) Velcro dots were affixed to the top of the table. Duplicate copies of various objects (e.g., cat, dog, backpack, pair of shoes, ball, toy car, books) were carried over from Stage One

Stage 4. The picture of the girl with an empty thought bubble was used again in Stage Four. A modified version of the table scene was used. The Stage Four picture had an image of a table with three different containers sitting on top. The containers were visually distinctive (e.g., a red box; a purple cylindrical trash can; and a brown, rectangular basket). Each container image was affixed to the background scene like a flap which allowed the researcher to slide one of the paper objects behind the container as if the object was being placed inside. A paper flap that looked like a door was affixed to the scene so that the girl could enter and exit the room with the table. Duplicate copies of various objects (e.g., cat, dog, backpack, pair of shoes, ball, toy car, books) were carried over from Stage One.

Stage 5. All of the materials in Stage Four were used again in Stage Five with no modifications. The only difference in the Stage Five materials was the introduction of a new paper doll character, a young boy. The boy does not have an accompanying thought bubble.

Stage 6. All of the materials in Stage Five were used again in Stage Six with no modifications. The only difference in the stage six materials was the introduction of a new paper doll character, a second young girl. The new girl was visually distinctive from the first girl and she had an accompanying thought bubble.

Independent and Dependent Variables

The independent variable was a 15-18 week ToM training incorporating thought bubble representations of concepts related to False Belief understanding specifically the relationship between the main verb of the sentence (e.g., *She thinks…*) and the complement structure that completes the sentence (e.g., *She thinks that it is a shoe*.). The first dependent variable was the number of correct responses on assessment probes identifying whether or not the child acquired the concepts presented in each stage of the thought bubble intervention (single-case data). Additional dependent variables were children's post-test scores on two ToM measures: (a) a near generalization changed-location False Belief task (i.e., Sally-Anne task) and (b) a far generalization measure (i.e., movement on the five-task ToM developmental scale including a misleading containers task).

Procedures

All proper Institutional Review Board (IRB) documentation, including consents and assents, were submitted and authorization procured before initiation of any aspects of the intervention. Prior to intervention all participants received all pretest measures administered by the *Foundations for Literacy* and CLAD assessment staff. At the conclusion of the intervention study, all participants received posttesting measures, again, administered by the *Foundations* and CLAD assessment staff. Participants were involved in the study for a total of 30-35 sessions (i.e., 15-18 weeks) depending on school schedules, student absences, and length of time needed to reach mastery for each stage. In the initial baseline phase, each participant was individually assessed on the entire sequence of the ToM thought bubble training (i.e., Stages 1 – 6) at least three times to establish a stable baseline. Once baseline probes were completed, all participants received a week of preteaching in which explicit instruction in vocabulary necessary to task understanding (e.g., *look*, *think*, *thought bubble*, *in the room*, *leave the room*) and familiarization with task manipulatives occurred. Once preteaching ended, intervention began in all classrooms.

Baseline Phase

Baseline for all participants was established through individual assessment and represented as unique data paths on the multiple-baseline multiple-probe graph. The researcher administered all baseline assessment probes. The baseline probe for each stage within the intervention comprised a unique sequence of assessment questions with the exception of Stage 6. The first three questions in the six-question sequence in Stage 6 were identical to the three-question sequence in Stage 5. Once a child missed any question within the sequence, the probe for that stage ended and the probe for the next stage began. The same question sequences used in the baseline probes were used in the intervention probes. Due to the repetition of questions from Stage 5 to Stage 6, a decrease in the number of initial baseline sessions from three to one for Stage 6 was implemented to lessen participants' test fatigue and frustration as participants were quite young and often unable to answer any questions in the latter stages correctly. Each participant received the following baseline assessments: (a) three initial consecutive baseline probe sessions for each stage in the training sequence with the exception of Stage 6 which included only one session, (b) an additional probe session conducted for each stage in the training sequence immediately after criterion was met on any training stage, and (c) an additional baseline probe conducted immediately prior to the introduction of each new stage in intervention sequence. This is a slight variation in the traditional multiple-probe design established by Horner and Baer (1978) (i.e., baseline assessments a – three sessions instead of one and c – one session instead of a series of sessions). The use of the multiple-probe technique with a successive sequence requires that a probe procedure be designed to assess performance in each step of the sequence. In a traditional multiple-probe design, intermittent probes are scheduled at various points (i.e., when conditions change – new skill) in the intervention with a series of consecutive probes occurring immediately prior to each new stage (i.e., new skill) in the intervention. This series of consecutive probes is increased by one as the procedure is applied to each additional baseline in the intervention sequence (e.g., one probe in the first baseline, two consecutive probes in the second baseline, three consecutive probes in the third baseline, etc.). Typically this design is used to examine interventions targeting behavioral objectives such as brushing one's teeth. If one were to consider the stages in learning to brush one's teeth, one would realize that mastery of an initial stage would be unlikely to influence mastery of a following stage (i.e., learning to squeeze toothpaste onto a toothbrush would not teach a child the next step in the sequence - turning on the water). Therefore, a single probe in the initial baseline session and consecutive probes in multiple sessions immediately prior to the introduction of the next step in the sequence would not compromise the design's ability to establish a functional relation. However, the intervention in this study is based on a cognitive developmental sequence, therefore learning in an initial stage may bleed over into following stages affecting the design's ability to capture a stable baseline immediately prior to the introduction of a new stage (e.g., mastering understanding of two character perspectives may influence a child's understanding of three character perspectives). Therefore, it was necessary to conduct an initial series of baseline probes to obtain a stable baseline.

Intervention Phase

Each classroom received direct instruction in the modality specified by the classroom teacher. The researcher implemented all training sessions in all classrooms. The intervention phase included six training stages with a preteaching week for vocabulary and manipulative use. All classrooms entered Stage One of the intervention within the same week. Participants received training in a small group classroom setting 2 to 4 days per week depending on the school schedule and student absences. Participants received training followed by intervention assessment probes each day of training as this followed the procedures in the original study (Wellman & Peterson, 2013). The intervention assessment probes (i.e., question sequences) were identical to the baseline assessment probes. Participants received at least three training sessions per stage before moving to the next stage. During each intervention stage, participants were given 2 to 3 group demonstrations of the task before they were asked to provide any individual responses. If children gave incorrect responses during the group instruction, corrective feedback was given. The majority rule was used to determine progressions through the intervention stages (i.e., when the majority of the students within a classroom met the mastery criterion the class moved to the next intervention stage; two out of three/three out of four children). Criterion for mastery was defined as correct responses on all questions within a sequence (i.e., at least two and no more than six questions per stage) in each probe for two out of three attempts on three out of four consecutive intervention sessions. In the event the class moved to the next stage due to the majority rule, remediation days were scheduled for students not meeting mastery when school schedules and child attendance allowed. Remediation training provided additional information regarding latency of the intervention for diverse participants (e.g., language ability, functional hearing/speech perception, child demographics). A detailed description of each stage in the intervention phase is provided in the following table.

Table 4. *Theory of Mind Intervention Scripts*

Stages of Intervention	Demonstration Description
Stage 1 **Introducing the concept of thinking and thought bubbles**	Researcher displays a picture of a girl with a thought bubble and asks, *"What is this girl doing? [Yes] she is thinking."* Researcher points to thought bubble and asks, *"What is this? [Yes] it is called a thought bubble."* Researcher introduces a new picture of the same girl looking at one object with another object behind her and says, *"Here's the girl again."* Researcher asks, *"What's the girl looking at? [Yes] the girl is looking at a ball. What is in her thought bubble? [Yes] her thought bubble has a ball in it."* Researcher places a ball picture in the girl's thought bubble and says, *"If the girl is looking at the ball, she is thinking about the ball. When people look at things, they think about them."* *Demonstration is repeated at least two times with different objects in the thought bubble.
Stage 2 **Thinking about out-of-sight objects that remain as they are**	Researcher displays a picture of the same girl looking at an object and asks the children to identify what the girl is looking at and what is in her thought bubble. Researcher tells the children, *"The girl is going to leave the room and her thought bubble is going with her."* The researcher moves the girl out of the room so that the ball is obscured by a 'door' flap. Researcher says, *"The girl can't see the ball, but she can think about the ball. Look her thought bubble still has a ball. People can think about things they can't see."* *Demonstration is repeated at least two times with different objects in the thought bubble
Stage 3 **Thinking about out-of-sight objects that are changed**	Researcher moves the girl out of the room (as in Stage 2). The children are asked, *"Can the girl see what is on the table?"* (children's feedback) *"Yes, her think bubble has a car in it. So what does she think is on the table?"* (children's feedback) *"Is she right?"* (children's feedback) *"Can she see the car?"* (children's feedback) Researcher changes the object (i.e., car to a backpack) on the table and says, *"If I change the car to a backpack, the girl cannot see. Look, her thought bubble still has a car in it. What does she think is on the table?"* (children's feedback) Researcher brings the girl back into the room where she can see the table. *"Now the girl comes back. She sees the backpack on the table. Uh-oh, the girl knows her thought is wrong. Now she sees the backpack on the table. Now her thought changes to a backpack."* Researcher replaces the car in the thought bubble with a backpack.

	*Demonstration is repeated at least two times with different objects in the thought bubble
Stage 4 **Predicting the location of hidden objects that remain unmoved**	Researcher introduces a picture of a table with three containers (with lid flaps) able to contain smaller 2-D objects. Researcher says, *"People can use thought bubbles when they want to find things. Look, the girl is putting her ball in the box. She gets a thought bubble with the ball in the box."* Researcher moves the girl out of the room and the containers on the table are obstructed by a 'door' flap. The researcher says, *"The girl can't see where the ball is, but she can think about where the ball is. When she comes back into the room, she knows where to look for her ball."* *Demonstration is repeated at least two times with different objects in different containers on the table and in the girl's thought bubble.
Stage 5 **Predicting the location of hidden objects that are displaced**	The situation in Stage 4 is extended to include a new paper doll character, the boy, who moves the object from one container to another while the girl is out of the room. The girl's thought bubble follows her and shows the object (ball) in the container [backpack] the girl initially saw it. Demonstration is repeated with three different pairs of containers and objects. After the girl is shown leaving with her thought bubble, the children are asked three questions: (1) *"Can she see where X is?"*, (2) *"Where does she think X is?"*, and (3) *"Where is X?"* Now the invisible displacement takes place. Researcher says, *"Now the boy is moving the girl's object (ball) to a different container (box). The girl can't see the boy because the door closed."* Researcher moves the object to the new container and asks the children three questions: (1) *"Where is X now?"*, (2) *"Did the girl see what happened?"*, and (3) *"Where does the girl think X is?"* After children give feedback, researcher says, *"Look, the ball is really in the box. Where will the girl look for the ball when she comes back? She will look for it where she THINKS ball is."* Researcher points to the thought bubble and says, *"Where will the girl look?"* Children give feedback and researcher responds, *"[Yes] but she is wrong, because the boy moved the ball to the box."* *Demonstration is repeated at least two times.
Stage 6 **Predicting the thoughts of different people with differing access to information about the location of displaced hidden objects**	The situation in Stage 5 is extended to include an additional female paper doll that is visually distinctive from the original girl doll. Both girls see that the object (ball) is placed in one container (backpack) and the corresponding picture is placed in their thought bubbles. The researcher moves the original girl out of the room while the

new girl watches the boy move the object (ball) from the initial container (box) to a different container (can). Children are then asked to identify each girl's current thought about the location of the object (ball) using thought bubbles.

As the researcher enacts the situation, she says, "*Now the boy moves the ball to the basket. Girl 2 saw the boy move the ball. Girl 1 cannot see the boy move the ball because she is in the other room.*"

Researcher asks the following questions:
(1) *"Where is the ball now?"*
(2) *"Where does Girl 1 think the ball is?"*
If incorrect response, ask, *"Where does Girl 1's thought bubble show the ball?"*
(3) *"Where does Girl 2 think the ball is?"*
If incorrect response, ask, *"Where does Girl 2's thought bubble show the ball?"*
(4) *"Where will Girl 1 look for the ball?"*
If incorrect response, ask, *"Where is the ball in Girl 1's thought bubble?"*
(5) *"Where will Girl 2 look for the ball?"*
If incorrect response, ask, *"Where is the ball in Girl 2's thought bubble?"*

(6) Group explanation question –

*Demonstration is repeated at least two times with different containers and objects and the characters alternating their roles as the watcher or non-watcher.

*Adapted from Wellman, H. M., & Peterson, C. C. (2013). Deafness, thought bubbles, and theory-of-mind development. *Developmental Psychology, 49*(12), 2357-2367.

Assessment Phase

Individual assessment probes were completed immediately after group training each day. Each assessment stage in the intervention had a unique sequence of comprehension questions with the exception of Stage 6 (i.e., Stage 1 = 3 questions, Stage 2 = 2 questions, Stage 3 = 4 questions, Stage 4 = 3 questions, Stage 5 = 3 questions, and Stage 6 = 6 questions, the first three questions in the Stage 6 sequence were identical to the Stage 5 questions). Participants must answer correctly all comprehension questions within the sequence to pass the probe and must pass each probe twice in no more than three attempts to score 100% for the session. If participants answered the first two probes correctly, a third attempt was not given. A third probe attempt was only given when a participant did not answer the first two probe attempts correctly. Therefore assessment probes were scored accordingly: 2 correct attempts out of 2 total attempts scored a 100%, 2 correct attempts out of 3 total attempts scored a 100%, 1 correct attempt out of 3 attempts scored a 50%, and 0 correct attempts out of 3 total attempts scored a 0%. Participants needed to score a 100% in three out of four consecutive sessions to master an intervention stage. Once a participant reached mastery, data collection for that stage ceased. When the majority of the class met mastery, the class moved to the next intervention stage. In keeping with the procedures in the original intervention (Wellman & Peterson, 2013), participants were given corrective feedback after incorrect responses during assessment probes. An additional reason for corrective feedback during assessment probes arose in the present study as participants received group instruction as opposed to individual instruction in the original study. Incidental learning is thought to be a major contributor to the development of ToM (Cutting & Dunn, 1999; de Rosnay & Hughes, 2006; Ruffman et al., 2002). Therefore, the “overhearing” or “overseeing” of incorrect responses by other participants in the group needed to be addressed with corrective feedback to ensure participants were not incidentally learning incorrect information.

A maintenance point on all preceding stages (except for the stage most recently mastered) was collected on the first session of the next stage prior to training in the new stage. Participants were given only one attempt to answer all questions in the sequence correctly. Therefore a participant could score a 100% or a 0% on the maintenance probes. The question sequences used in the maintenance probes were identical to the assessment probe sequences. A detailed description of each probe in the assessment phase is available in the following table.

Table 5. *Theory of Mind Assessment Probe Scripts – Baseline and Intervention*

Stages of Intervention	Assessment Probe Questions
Stage 1 Introducing the concept of thinking and thought bubbles	Two to three trials per training day with various objects. Assessment Questions: "What is the girl/boy looking at?" "What is in her/his thought bubble?" "What is she/he thinking about?" Children advance to Stage 2 upon correctly answering all 3 questions for 2 out of 3 trials. All trials use different correct objects.
Stage 2 Thinking about out-of-sight objects that remain as they are	Two to three trials per training day with various objects. Assessment Questions: "Can the girl/boy see the object (e.g., car)?" "What is she/he thinking about?" Children advance to Stage 3 upon correctly answering both questions for 2 out of 3 trials. All trials use different correct objects.
Stage 3 Thinking about out-of-sight objects that are changed	One trial per training day with various objects. Assessment Questions: "What is on the table now?" "Can the girl/boy see the object (e.g., car)?" "What does she/he think is on the table?" "Is she/he right or wrong?" Children advance to Stage 4 upon correctly answering all 4 questions for 2 out of 3 trials. All trials use different correct objects.
Stage 4 Predicting the location of hidden objects that remain unmoved	One trial per training day with various objects. Assessment Questions: "Where does she/he think the object (e.g., car) is?" "Where is it really?" "Now the girl/boy comes back, where will she/he look for the object (e.g., car)?" Children advance to Stage 5 upon correctly answering all 3 questions for 2 out of 3 trials. All trials use different correct objects.
Stage 5 Predicting the location of invisible displaced objects	Two to three trials per training day with various objects. Assessment Questions: "Where does she/he think the object (e.g., car) is?" "Where is it really?" "Now the girl/boy comes back, where will she/he look for the object (e.g., car)?" Children advance to Stage 6 upon correctly answering all 3 questions for 2 out of 3 trials. All trials use different correct objects.
Stage 6 Predicting thoughts of different people with differing access to information	Two to three trials per training day with various objects. Control Question "Where is the ball now/really?

about the location of invisible displaced hidden objects	Assessment Questions for Girl/Boy #1: “Where does she/he think the object (e.g., car) is?” “Is she/he right or wrong?” “Now the girl/boy comes back, where will she/he look for the object (e.g., car)?” Assessment Questions for Girl/Boy #2: “Where does she/he think the object (e.g., car) is?” “Is she/he right or wrong?” “How did she/he know the object (e.g., car) was in the container (i.e., changed location)?” Children master Stage 6 upon correctly answering all 6 questions for 2 out of 3 trials. All trials use different correct objects. Group Explanation - Extension “Why is the first girl/boy right (know where to look for the object)? “Why is the second girl/boy wrong (does not know where to look for the object)?

*Adapted from Wellman, H. M., & Peterson, C. C. (2013). Deafness, thought bubbles, and theory-of-mind development. *Developmental Psychology, 49*(12), 2357-2367.

Results

Data Analysis

Data for each participant are displayed on a multiple-baseline multiple-probe across skills (i.e., stages) graph where each participant is represented by a unique data path identified by a unique data marker (i.e., closed circle, open square, open diamond, open triangle). Each graph is identified by a classroom number (i.e., 1-4) and participants within the class are identified by the classroom number and an individual identifier within the class. All classrooms had three participants and therefore three data paths with the exception of one classroom which had four students and four data paths. Replications occurred across classrooms and so there is one graph per classroom (i.e., four total graphs).

The researcher used visual analysis to examine the data for individual participants (rather than the group) because assessment occurred at the participant level due to the heterogeneous characteristics of the participants (e.g., language levels, age, level of hearing loss, and communication modality). The data were evaluated for the following features: stability, level, trend, immediacy of effect, as suggested by Kratochwill et al. (2010) and percentage of all nonoverlapping data (PAND). PAND is "the percentage of data remaining after removing the fewest number of data points that would eliminate all overlap and was designed to provide nonoverlap with an established effect size" (Parker, Vannest, & Davis, 2011, p. 310). Comparisons across replications (i.e., at the group/class level) are made in addition to the individual participant level analysis and examined in the discussion section. Additional results from two generalizations measures: (a) near generalization, Sally-Anne task (Baron-Cohen et al., 1989), and (b) far generalization, five-task ToM developmental sequence (Wellman & Liu, 2004), are presented in Table 6.

Classroom 1

Participant 101. Baseline was stable for all stages except Stage 2 in which one data point fell outside the stability range of 18.8-56.3. However, the final baseline data point returned to zero prior to intervention. A strong immediacy of effect was found across all stages with a more powerful effect for Stages 1-4 than for Stages 5-6. There was no variability in the intervention data across Stages 1-4 and very little variability for data in Stages 5-6. There was an immediate change in level across all stages. Percentage of all nonoverlapping data (PAND) was 100% in all stages except Stage 2 (57%). The participant remained at mastery for all maintenance probes in all stages.

Participant 102. Baseline was stable for Stages 3, 5, and 6. In Stage 1, one data point fell outside of the stability range of 8.4-25 while the final two data points returned to zero. In Stage 2, two points fell outside the stability range of 12.5-37.5 while the final two data points returned to zero. In Stage 4, one point fell outside the stability range 8.4-25.1 while the final four points returned to zero. A strong immediacy of effect was found across all stages. There was no variability in the intervention data across Stages 1-4 and very little variability for data in Stages 5-6. There was an immediate change in level across all stages. Percentage of all nonoverlapping data (PAND) was 100% in all stages except Stage 4 (67%). The participant remained at mastery for all maintenance probes except the initial data point in Stage 4. However, the final data point returned to mastery.

Participant 103. Baseline was stable for all stages except Stage 2 in which two points fell outside the stability range of 25.0-75.0 and Stage 4 in which two points fell outside the stability range of 16.7-50.0. However, the final three data points in Stage 4 returned to zero. A strong immediacy of effect was found across all stages with a more powerful effect for Stages 1-4 than for Stages 5-6. There was little to no variability in the intervention data across Stages 1-4 and some variability in the data in Stages 5-6. There was an immediate change in level in Stages 1-4. A slightly weaker level change was present in Stages 5-6. PAND was 100% in Stages 1 and 3. Other PAND percentages are as follows: Stage 2 (57%), Stage 4 (67%), Stage 5 (92%) and Stage 6 (91%). The participant remained at mastery for all maintenance probes except the initial data point in Stages 3-4. However, the final data point returned to mastery in both stages.

Figure 1. *Multiple-Baseline, Multiple-Probe, Single-Case Graph*

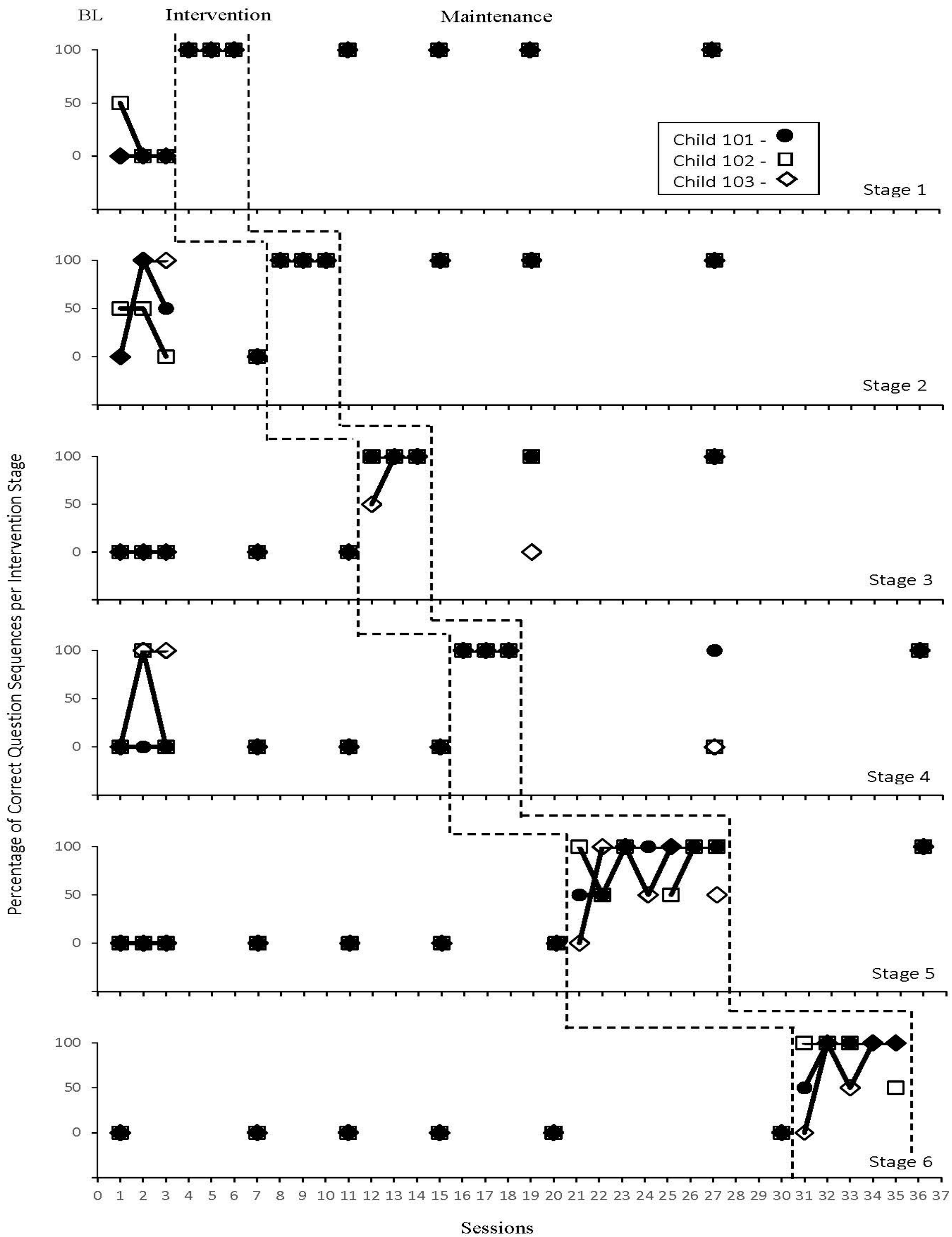


Figure 1. Multiple-baseline graph for Theory of Mind intervention targeting False Belief understanding in three preschool-aged children with hearing loss who use spoken English (Classroom 1)

Classroom 2

Participant 201. Baseline was stabile for all stages except Stage 1 in which one data point fell outside the stability range of 16.65-50.0 and Stage 4 in which two data points fell outside the stability range of 12.5-37.5. In Stage 4, the four data points prior to intervention returned to zero. A strong immediacy of effect was found in Stages 2-4 with a slightly slower effect in Stages 5-6. There was little to no variability in the intervention data in Stages 1-4. Variability was present in Stages 5-6. However, the final data point in both stages returned to mastery. PAND was 100% in Stages 2 and 3. Other PAND percentages were as follows: Stage 1 (50%), Stage 4 (67%), Stage 5 (82%) and Stage 6 (92%). The participant remained at mastery for all maintenance probes in Stages 1-5. Maintenance data were not available for Stage 6.

Participant 202. Baseline was stable for Stages 3, 5, and 6. In Stage 1, the two final data points reached mastery. In Stage 2, one point reached mastery. In Stage 4, two points reached mastery. However, the two points prior to intervention returned to zero. A strong immediacy of effect was found in Stages 2-4 with slightly slower effects found in Stages 5 and 6. Variability was present in Stages 5 and 6. The final two points in Stage 5 reached mastery, while no data points in Stage 6 reached mastery. PAND was 100% in Stage 3. Other PAND percentages were as follows: Stage 1 (60%), Stage 2 (57%), Stage 4 (67%), Stage 5 (82%) and Stage 6 (70%). The participant remained at mastery for all maintenance probes in all stages except Stage 5. Maintenance data were not available for Stage 6.

Participant 203. Baseline was stable for Stages 2, 3, 5, and 6. In Stage 1, one point reached mastery and thus fell outside the stability range of 16.65-50.0. However, the final point prior to intervention returned to zero. In Stage 4, one point fell outside the stability range of 4.2-12.45. A strong immediacy of effect was found in all stages. There was no variability in the intervention data across Stages 1-4 and very little variability in the intervention data in Stages 5-6. PAND was 100% in all stages except Stage 1 (50%) and Stage 6 (77%). The participant remained at mastery for all maintenance points in all stages. Maintenance data were not available for Stage 6.

Participant 204. Baseline was stable for Stages 3, 5, and 6. Data points in Stages 1 and 2 reached mastery. In Stage 4, two data points fell outside the stability range of 20.8-62.5. A strong immediacy of effect was found in Stages 4 and 5. There was no variability in the intervention data across Stages 1, 2, and 4 and very little variability for data in Stages 3, 5, and 6. PAND percentages were as follows: Stage 1 (60%), Stage 2 (57%), Stage 3 (88%), Stage 4 (67%), Stage 5 (91%), and Stage 6 (91%). The participant remained at mastery for all maintenance probes in all stages. Maintenance data were not available for Stage 6.

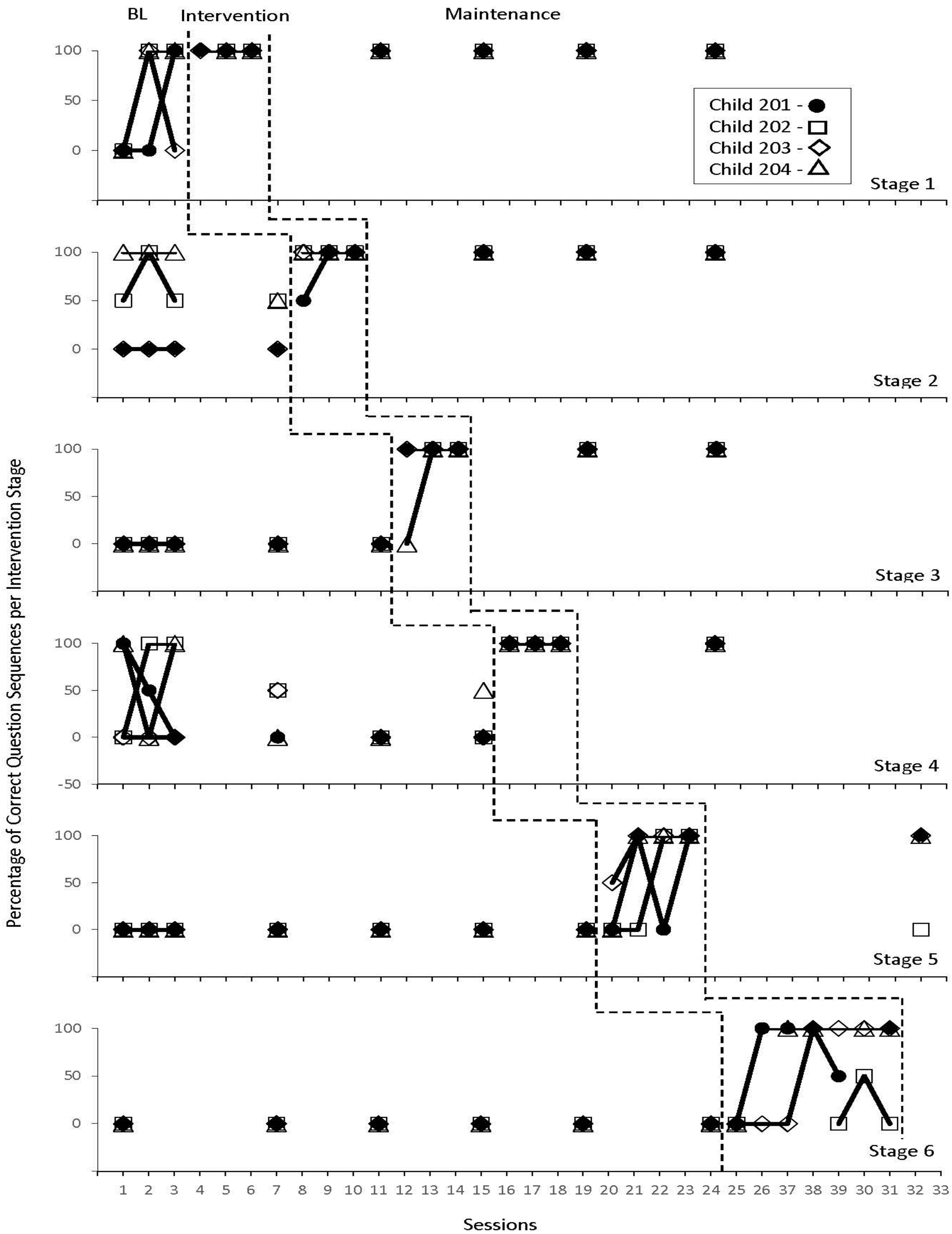


Figure 2. Multiple-baseline graph for Theory of Mind intervention targeting False Belief understanding in four kindergarteners with hearing loss who use spoken English (Classroom 2)

Classroom 3

Participant 301. Baseline was stable for all stages. A strong immediacy of effect was found in Stages 1, 2, and 4 with a slightly slower effect in Stage 3. No effect was found in Stage 5. Thus, Stage 6 was not attempted. There was little variability in Stages 1-4 with data points in all stages reaching mastery. PAND percentages were as follows: Stage 1 (100%), Stage 2 (91%), Stage 3 (89%), Stage 4 (100%), and Stage 5 (0%). The participant remained at mastery for all maintenance probes in Stages 1, 2, and 4.

Participant 302. Baseline data were stable for all stages. A strong immediacy of effect was found in Stages 1, 2, and 4 with a slightly slower effect in Stages 3 and 5. There was little variability in the intervention data in Stages 1-4 with data points in all stages reaching mastery. Variability was present in Stage 5 with one data point reaching mastery. However mastery criterion was not met for Stage 5. Thus, Stage 6 was not attempted. PAND percentages were 100% for all stages except Stage 5 (77%). The participant remained at mastery for all maintenance probes in Stages 1 and 2.

Participant 303. Baseline data were stable for all stages. A strong immediacy of effect was found in Stages 1-4. No effect was found in Stage 5. Thus, Stage 6 was not attempted. There was little variability in Stages 1-4 with data points in all stages reaching mastery. PAND percentages were 100% for all stages with the exception of Stage 5 (0%). The participant remained at mastery level for maintenance probes in Stages 1 and 2.

Figure 3. *Multiple-Baseline, Multiple-Probe, Single-Case Graph*

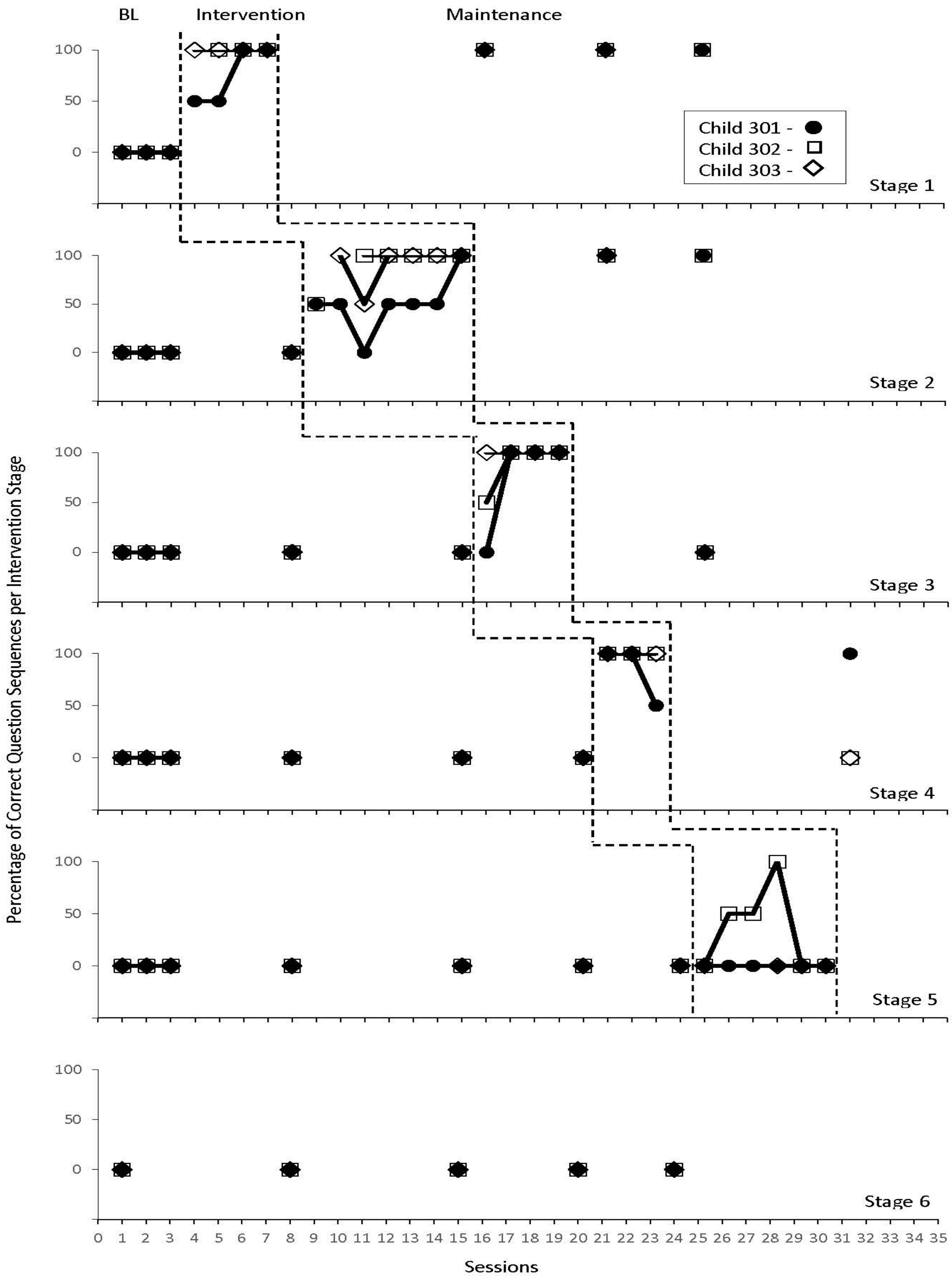


Figure 3. Multiple-baseline graph for Theory of Mind intervention targeting False Belief understanding in three preschool-aged children with hearing loss who use American Sign Language and spoken English (Classroom 3)

Classroom 4

Participant 401. Baseline data were stable for Stages 2, 3, 5, and 6. In Stage 1, one data point fell outside the stability range of 8.3-25.0. In Stage 4, two data points fell outside the stability range of 10.7-32.1. However, the final four points prior to intervention returned to zero. A strong immediacy of effect was found in Stages 1-4. No effect was found in Stage 5. Thus, Stage 6 was not attempted. There was little variability in Stages 1-4 with data points in all stages reaching mastery. PAND percentages were 100% except for Stage 4 (70%) and Stage 5 (0%). The participant remained at mastery level for all maintenance probes in Stages 1-4. Maintenance data were not available for Stages 5-6.

Participant 402. Baseline data were stable for Stages 2, 3, 4, and 6. In Stage 1, one data point fell outside the stability range of 8.3-25.0. However, the two points prior to intervention returned to zero. In Stage 5, the final data point fell outside the stability range of 3.6-10.7. A strong immediacy of effect was found for Stages 1-4 with no effect in Stage 5. There was little variability in Stages 1-5 with data points in all stages reaching mastery with the exception of Stage 5. Mastery criterion was not met for Stage 5. Thus, Stage 6 was not attempted. PAND percentages were 100% except for Stage 2 (63%) and Stage 5 (82%). The participant remained at mastery level for all maintenance probes in Stages 1, 2, and 4. Maintenance data were not available for Stages 5-6.

Participant 403. Baseline was stable for all stages except Stage 1 where one data point fell outside the stability range of 8.33-25.0. However the final point prior to intervention returned to zero. A strong immediacy of effect was found in Stages 1-4. No effect was found in Stage 5. Thus, Stage 6 was not attempted. No variability was present in Stage 1, and little variability was present in Stages 2 and 4. Variability was present in Stage 3 where the initial data points met mastery and the final points dropped to zero. PAND percentages were as follows: Stages 1 and 4 (100%), Stage 2 (88%), Stage 3 (80%), and Stage 5 (0%). The participant remained at mastery for all maintenance probes in Stages 1 and 2. Maintenance data were not available for Stages 5-6.

Figure 4. *Multiple-Baseline, Multiple-Probe, Single-Case Graph*

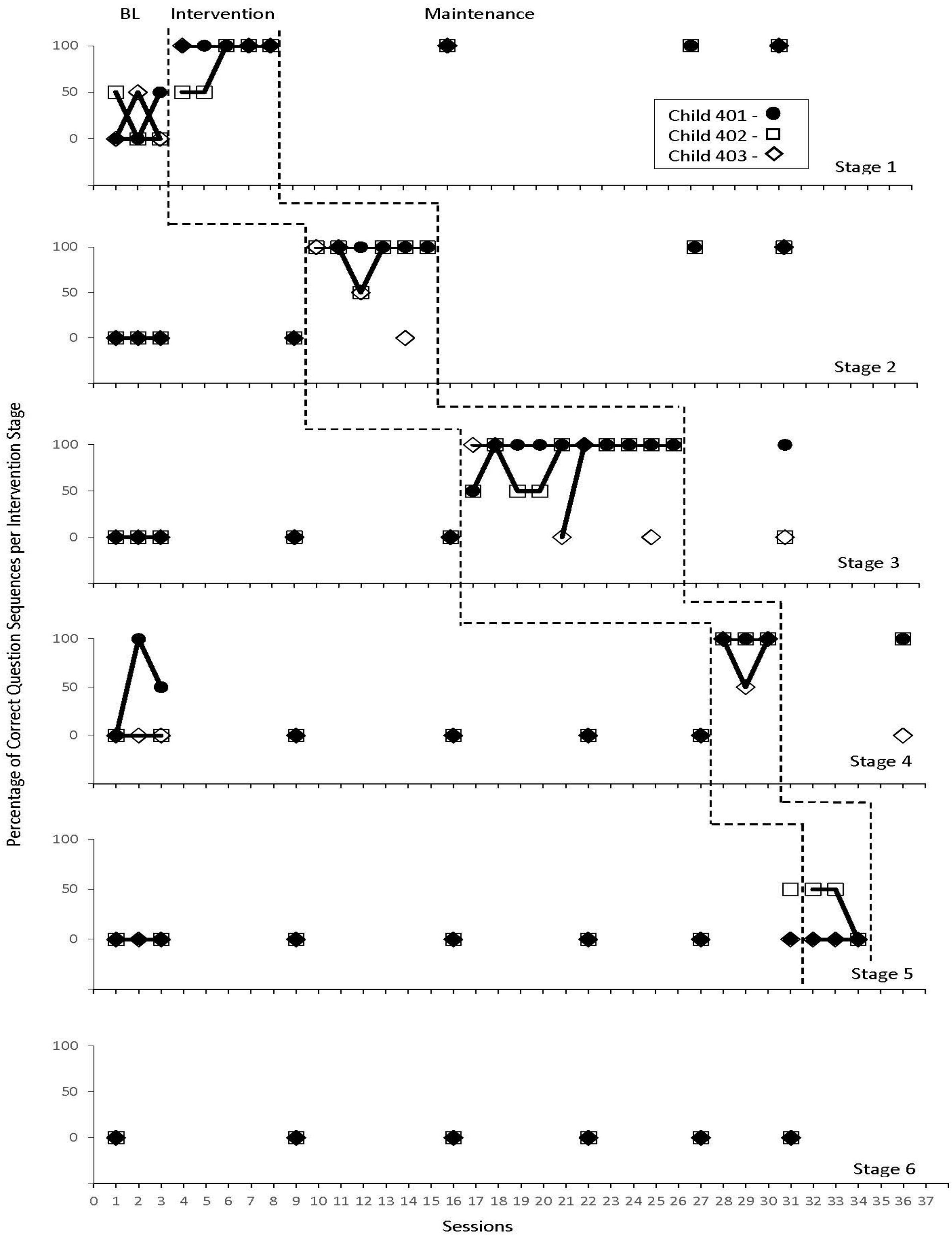


Figure 4. Multiple-baseline graph for Theory of Mind intervention targeting False Belief understanding in three kindergarteners with hearing loss who use American Sign Language and spoken English (Classroom 4)

Generalization Measures

All participants (n= 13) received two generalization measures (i.e., near generalization, Sally-Anne task and far generalization, ToM developmental scale) at pretest. All participants received identical generalization measures at posttest with the exception of one participant who was absent on all attempted posttest sessions. No children passed the near generalization measure (i.e., Sally-Anne task) at pretest. Eight of twelve participants passed the near generalization measure at posttest. There was a range of stage change from loss to gain in the far generalization measure (i.e., ToM developmental sequence). The average change for the posttest measure was 0.33 stages. See table 6 for individual participant scores.

Table 6. *Pre- and Posttest Results for Theory of Mind Generalization Measures*

Child ID	Near Generalization Pretest (Sally-Anne)	Near Generalization Posttest (Sally-Anne)	Far Generalization Pretest (ToM Developmental Sequence)	Far Generalization Posttest (ToM Developmental Sequence)	Total Change in ToM Sequence Score
101	Fail	Pass	2 DD, DB	3 DD, DB, KA	+1
102	Fail	Pass	0 Failed all tasks	2 DD, DB	+2
103	Fail	Fail	2 DD, DB	2 DD, DB	0
201	Fail	Fail	2 DD, DB	3 DD, DB, KA	+1
202	Fail	Pass	2 DD, DB	2 DD, DB	0
203	Fail	Pass	3 DD, DB, SP	2 DD, DB	-1
204	Fail	Pass	3 DD, DB, SP	3 DD, DB, KA	0
301	Fail	Fail	1 DD	2 DD, DB	+1
302	Fail	Pass	2 DD, DB	2 DD, DB	0
303	Fail	Fail	3 DD, DB, KA	2 DD, DB	-1
401	Fail	Pass	2 DD, DB	3 DD, DB, SP	+1
402	Fail	Pass	0 Failed all tasks	1 DD	+1
403	Fail	Absent	3 DD, DB, SP	Absent	--
Total Number Passing	0/13	8/12		Average Stage Gain	.333

Fidelity

Fidelity of intervention implementation was measured by dividing the number of elements observed during a training (i.e., intervention) session by the total number of required elements as outlined in the fidelity checklist including: (a) uses stage-specific materials, (b) demonstrates concept, (c) follows stage-specific script, (d) gives corrective feedback, and (e) gives each child correct number of individual attempts. Fidelity was 96.8% for 25 out of 85 recorded intervention sessions.

Reliability

Interassessor agreement was calculated using point-by-point agreement for 27% of the sessions distributed across baseline, intervention, and maintenance. Overall agreement was 90.42% (80-100). Baseline agreement was 82% (80-100). Intervention agreement was 89.25% (85-100). Maintenance agreement was 100%.

Social Validity

The student survey presented four statements accompanied by recognizable icons which were used as a rating scale with a score of 3 equaling a positive response (i.e., happy face) and a score of 1 equaling a negative response (i.e., frowning face). Student participants gave positive ratings to all statements on the survey which included questions about individual learning and enjoyment. Teacher surveys were completed by all 4 teacher participants. The surveys included free response questions and scaled response questions where a score of 1 equaled a negative response and a score of 5 equaled a positive response. The average rating of item 1 (i.e., ease of implementation) was 3.25; item 2 (i.e., alignment with social and behavioral goals) received a rating of 4.25; item 3 (i.e., benefit to students) received a rating of 4.5; and item 4 (i.e., willingness to implement) received a rating of 4. Teacher feedback in the free response section included statements regarding observed benefits to children's vocabulary/language and concept development as well as responses inquiring about further strategies for differentiation and integration of the intervention in multiple subject areas throughout the school day. The following are direct quotes from the teacher survey.

> "All of my students have begun using *don't know* instead of shrugging their shoulders or just sitting there looking at me when I ask them something they don't know the answer to. This is success for us! On occasion I have some students that, indeed, are beginning

to use the word *know* but it is more inconsistent and certainly it is not used by all of them. I will also say that the word *think* comes up more than before the intervention both expressively and receptively."

"The students began using the word, *think*, more often. They would say, '*I think…*' or '*She thinks…*'. It also allowed them to begin to think about how their behavior, both positive and negative, impacts and influences others in a positive and negative way. During creative writing, one student drew a picture of her daddy lying in a bed. She drew a bubble coming from his head and said, '*Daddy thinking tree*'. Another child made up a game by putting a car in his pocket and asking the teacher and his friends, '*What in pocket*? *What think in pocket*?' and had everyone take a guess about what they thought was in his pocket."

Discussion

The goal of the present study was to investigate the effects of an intervention incorporating thought bubbles on PreK and Kindergarten DHH children's ToM understanding. The intervention targeted a single aspect of ToM known as changed-location false belief. Effects of the intervention were measured using (a) repeated baseline and intervention assessment probes (i.e., single-case design study), (b) a pre- and posttest near generalization measure (i.e., Sally-Anne task; Baron-Cohen et al., 1985), and (c) a pre- and posttest far generalization measure (i.e., ToM developmental sequence; Wellman & Lui, 2004). Research Question 1 sought to identify what effect ToM training incorporating thought bubbles had on the false belief understanding of pre-kindergarten and kindergarten children who are DHH, some of whom used spoken language and some of whom used sign language. Results from the single-case design portion of the study indicate a functional relation between the thought bubble intervention and the participants' acquisition of the targeted skills in each stage, although progress was not uniform. Research question 2 sought to determine whether ToM training promoted the same children's movement along the five-task ToM developmental scale (Wellman & Liu, 2004) and the Sally-Anne task (Baron-Cohen et al., 1985). Results from the pre/post assessments indicate that the children did made progress up the scale, however, children who used spoken language tended to proceed further through the stages than those who used sign language even though their ages and language levels were relatively similar.

The present data are in agreement with research by Wellman and Peterson (2013), who reported improvements in DHH children's False Belief understanding in response to thought bubble training. Further, explicit instruction in one aspect of ToM positively influenced DHH children's overall ToM understanding. However, the participants' improvement on generalization measures was not uniform.

Thought Bubble Intervention

Each participant in the PreK and Kindergarten classes using spoken language mastered all stages in the intervention within 29 to 30 sessions with the exception of a single child who did not master the final stage (i.e., Stage 6). Said child was absent for 3 out of 7 total intervention sessions in Stage 6 and was unable to master the concept in the final 3 sessions. Participants in these classes responded quickly to training in Stages 1 – 4, mastering each stage in the least possible number of sessions (i.e., 3). Stages 5 and 6 required a minimum of 4 and a maximum of 7 sessions before children mastered the targeted concept. This is likely due to an increase in script complexity as Stages 1 – 4 presented only one character perspective and concentrated on foundational knowledge (e.g., What is thinking?) while Stages 5 and 6 presented multiple character perspectives (i.e., two characters in Stage 5 and three characters in Stage 6) and more closely resembled the typical ToM assessment tasks. Children's ability to attend to longer scripts as well as their ability to hold and manipulate multiple pieces of information (i.e., working memory) (Ashington & Jenkins, 1999), and their executive functioning levels (Benson et al., 2012) may have played a role in the increased latency period for the final two stages. The children in the Total Communication classrooms (i.e., classrooms using some combination of spoken and signed languages) differed in their responses to the thought bubble intervention in two primary respects: (a) the number of training sessions required to meet mastery in each stage was substantially longer and (b) no child was able to reach mastery criterion for stage 5 in the allotted intervention time of 29 to 32 sessions. While the reasons discussed earlier also apply to this group (e.g., increased script complexity, attention issues), there are additional reasons that may explain this group's lack of progress. Theory of Mind understanding hinges on interaction with others in a situational context in which mental state vocabulary naturally arises. Vocabulary alone is not sufficient for a proficient understanding (Garfield et al., 2001). Language is a social issue, not merely an accumulation of a prescribed number of words; it is socially adapted and socially driven. DHH children who are unable to access their linguistic environment (i.e., DHH children who use some form of signed communication) do not routinely benefit from the natural communicative exchanges that influence the development of Theory of Mind (Gonzalez, Quintana, Barajas, & Linero, 2007; Macaulay & Ford, 2006; Meristo & Hjelmquist, 2009; Morgan & Kegl, 2006; Pyers & Senghas, 2009; Tomasuolo, Valeri, Di Renzo, Pasqualetti, & Volterra, 2013; Van Staden, 2010). Consequently, their ToM development is hampered by that lack.

Another pathway through which ToM is acquired is incidental learning, both overhearing and overseeing. This requires an understanding of communicative exchanges. More specifically, how does one track a conversational exchange between two people when one is not involved in the conversation? This is a learned skill and a common experiential deficit of the DHH child (Moeller & Schick, 2006). DoD mother-child dyads and DoH mother-child dyads interact in qualitatively different ways when securing joint attention with their children (Lederberg & Everhart, 2000; Nowakowski, 2009). The absence of consistent joint attention in the DOH dyads' exchanges negatively impacts the development of both the language and the pragmatic experiences necessary to the development of ToM (Charman et al., 2000; Moeller & Schick, 2006). The children in this study were only beginning to learn effective communicative language skills. Further, none of the children using sign resided in homes with fluent users of American Sign Language (ASL). (It is important to note that one child in the study lived with a parent who was hard of hearing. However, the parent was not a fluent user of ASL.) It seems the understanding of communicative exchanges is a necessary prerequisite skill for this intervention for DHH children using a signed language. Before this group of children can benefit from the 'incidental learning' incorporated in this intervention, they must first master an extremely complex linguistic skill. Specifically, this group must physically track (i.e., with eye gaze and head turns) the conversational movement of two interlocutors as well as their joint attention to a set of manipulable objects. It may be that researchers need to incorporate strategies used by Deaf parents of Deaf children to effectively engage young DHH students in beneficial viewing of others' conversations.

Generalization Measures

The majority of children (i.e., 5 out of 7 children) in the classes using spoken language successfully passed the near generalization measure which directly tested the single aspect of ToM addressed in the intervention, changed-location false belief. The two children who did not pass the near generalization measure resided in households where English was not the primary language (i.e., the home language was Spanish). As a result, they may have experienced fewer home-based exposures to the targeted mental state vocabulary in English than their monolingual peers. If a shortage in exposure to and experience with targeted ToM vocabulary in contexts outside of the classroom did exist for these children, it may explain their lack of generalization to the Sally-Anne task (Baron-Cohen et al., 1985). Uniform improvements were not seen in the far generalization measure (i.e., ToM developmental scale, Wellman & Liu, 2004) with 3 of the 7 children gaining one to two stages, 3 of 7 making no gains or replacing a mastered pretest stage with a different posttest stage, and 1 child losing a stage. For the PreK and Kindergarten children in the Total Communication classrooms (i.e., those classrooms using spoken and signed languages in some capacity), results for the posttest generalization measures were similar in that the majority of the children passed the near generalization measure (i.e., 3 out of 5) and the improvement in the far generalization measure was not uniform (i.e., 3 out 5 children gained 1 stage, 1 child made no gains, and one child lost one stage). One child was absent for all attempted posttest sessions. It is important to note that all pre- and posttest generalization measures were given by a different researcher (i.e., a doctoral student in Educational Psychology who is a child of a Deaf adult, CODA). Because no two signers present ASL in exactly the same way, it could be that the signs used in during training differed from the signs used in the generalization measures, thus negatively affecting the signing children's performance on the generalization measures. These results are a departure from Wellman and Peterson's (2013) results as the majority of their participants made gains in the far generalization measures. For the children in the present study, the commonly gained stage, Knowledge Access, was the stage within the developmental sequence that most closely resembled the intervention training. The lack of uniform improvement in the ToM developmental sequence may be explained by two factors. First, the younger mean age of the present study's participants may suggest that younger DHH children need more intervention time to generalize a novel skill. Second, the standard stage progression for typically developing, hearing children is approximately one stage per year after the acquisition of Diverse Desires and Diverse Beliefs (Wellman & Liu, 2004). Children in this study gained an average of 0.33 stages across four months which aligns with the ToM developmental pacing for typically developing children. It is important to note that there was an extension in the Stage 3 training sessions for Classroom 4. Children in this class, specifically Child 403, received additional training sessions due extended breaks between sessions due to school closings for inclement weather and unexcused absences. Extended training sessions were given as the children in Classroom 4 were likely experience concept regression during the breaks as they resided in homes in which there was little to no functional communication with siblings and caregivers. In total, this intervention continued for an average of 4 months which suggests this may be a sufficient amount of time to learn the targeted aspect of ToM, but not sufficient time to see significant movement on the developmental scale for many of the children.

Limitations

Two limitations of concern in the present study involve the logistics of implementation. The first is a matter of assessment. Although the characters, objects, containers, and locations of objects changed in each probe and some probe materials contained ‘distractor’ objects, there is some concern that the repetitive nature of the question sequences in each stage allowed children to learn the patterns of correct responses instead of the actual concept. This might be evidenced in the small number of children who were able to progress through all or most of the intervention stages while still failing to pass the near generalization task. In an effort to ensure students were not memorizing the response pattern in the final stage (i.e., Stage 6), the researcher added a group explanation component (i.e., *Why is Tina wrong? Why does she think the flower is in the* *red box? Why is Tom right? Why does he think the flower is in the purple can?*). Once children identified the thoughts of each character (i.e., perceived location) and the actual location of the item, the researcher asked the children to explain why one character was able to correctly identify the location of the item while another character was not. Children who were able to explain why characters had opposing thoughts (i.e., access to knowledge) were more successful on the generalization measures (i.e., near and far). The second is a matter of instructional delivery. Though the researcher is a certified teacher of DHH children and is a proficient user of ASL, she is not a native user of ASL. This intervention may have been more successful with the children using signed communication if the instruction was presented by a Deaf, native user of the language.

Future Research

Possible avenues of future research include implementation with a native user of ASL. This type of implementation may support our understanding of the relationship between ToM development and ASL similar to our understanding of ToM development and English grammatical structures (i.e., sentential complements). Specifically, what strategies or parallel linguistic constructs are necessary for signing Deaf children's ToM development? How and when should young DHH children be exposed to such information? Another concern for future researchers is the social viability of the present intervention as ToM is a concept typically learned in a naturalistic context. In future studies, it would be beneficial to examine the effects of classroom teacher implementation in multiple settings throughout the school day. Additionally, implementation in the home may provide a natural setting in which family members (i.e., caregivers and siblings) are the typical purveyors of ToM.

Conclusion

In summary, results from this study support the assertion that DHH children in PreK and Kindergarten regardless of communication modality can improve their false belief understanding following a thought bubble intervention and can generalize their understanding to a parallel task (i.e., near generalization measure). Further, training in one aspect of ToM can influence other untaught aspects of ToM as evidenced by movement on the ToM developmental scale (i.e., far generalization measure). Replications of this study incorporating the use of native users of ASL and/or classroom teachers rather than a research teacher may be useful to further the field's understanding of effective ToM interventions for young DHH children who sign. Parallel interventions for the home may also provide a more naturalistic context in which young DHH children can learn the linguistic and communicative skills necessary for proficient ToM understanding.

References

Allen, J. R., & Kinsey, K. (2013). Teaching theory of mind. *Early Education and Development, 24*, 865-876. doi: 1080/1049289.2013.745182

Astington, J. W., & Jenkins, J. M. (1999). A longitudinal study of the relation between language and theory-of-mind development. *Developmental Psychology, 35*, 1311-1320.

Astington, J. W. (2001). The future of theory-of-mind research: Understanding motivational states, the role of language, and real-world consequences. Commentary on 'Meta-analysis of theory-of-mind development: The truth about false belief.' *Child Development, 72*, 685-687.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"?. *Cognition, 21*(1), 37-46.

Benson, J. E., Sabbagh, M. A., Carlson, S. M., & Zelazo, P. D. (2012). Individual differences in executive functioning predict preschoolers' improvement from theory-of-mind training. *Developmental Psychology, 49*, 1615-1627. doi: 10.1037/a0031056

Brownwell, R. (2000). *Expressive One Word Picture Vocabulary Test III*. Novato, CA: Academic Therapy Publishers.

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, G., Cox, A., & Drew, A. (2000). Testing joint attention, imitation and play as infancy precursors to language and theory of mind. *Cognitive Development, 15,* 481–498.

Courtin, C. (2000). The impact of sign language on the cognitive development of deaf children: The case of theories of mind. *Journal of Deaf Studies and Deaf Education, 5*, 266-276.

Courtin, C., & Melot, A-M., (2005). Metacognitive development of deaf children: Lesson from the appearance-reality false belief tasks. *Developmental Science, 8*(1), 16-25.

Dockett, S. (1998). Constructing understandings through play in the early years. *International Journal of Early Years Education, 6*(1), 105-116.

Cutting, A. L., & Dunn, J. (1999). Theory of mind, emotion understanding, language, and family background: Individual differences and interrelations. *Child Development, 70*, 853-865.

de Rosnay, M., & Hughes, C. (2006). Conversation and theory of mind: Do children talk their way to socio-cognitive understanding? *British Journal of Developmental Psychology, 24,* 7-37.

de Villiers, P. A. (2005). The role of language in theory-of-mind development: What deaf children tell us. In J. W. Astington & J. A. Baird (Eds.), *Why language matters for theory of mind* (pp. 266-297). New York, NY US: Oxford University Press, Inc.

de Villiers, P. A., & de Villiers, J. G. (2012). Deception dissociates from false belief reasoning in deaf children: Implications for the implicit versus explicit theory of mind distinction. *British Journal of Developmental Psychology, 30*(1), 188-209. doi: 10.1111/j.2044-835X.2011.02072.x.

Fernandez, C. (2013). Mindful storytellers: Emerging pragmatics and theory of mind development. *First Language, 33*(20), 20-46. doi: 10.1177/0142723711422633

Garfield, J. L., Peterson, C. C., & Perry, T. (2001). Social cognition, language acquisition and the development of the theory of mind. *Mind and Language, 16*, 494-541.

Gola, A. A. (2012). Mental verb input for promoting children's theory of mind: A training study. *Cognitive Development, 27*(1), 64-76.

Gonzalez, A., Quintana, I., Barajas, C., & Linero, M. J. (2007). The role of age and oral lexical competence in false belief understanding by children and adolescents with hearing loss. *The Volta Review, 107*(2), 123-139.

Hale, C. M., & Tager-Flusberg, H. (2003). The influence of language on theory of mind: A training study. *Developmental Science, 6*, 346-359.

Horner, R. H., & Baer, D. M. (1978). Multiple-probe technique: A variation of the multiple baseline. *Journal of Applied Behavioral Analysis, 11*, 189-196.

Howely, M., & Howe, C. (2004). Social interaction and cognitive growth: An examination through role-taking skills of deaf and hearing children. *British Journal of Developmental Psychology, 22*, 219-243.

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M. & Shadish, W. R. (2010). Single-case designs technical documentation. *Psychology Quarterly, 17,* 341-389.

Lederberg, A. R., & Everhart, V. S. (2000). Conversations between deaf children and their hearing mothers: Pragmatic and dialogic characteristics. *Journal of Deaf Studies and Deaf Education, 5*, 303-322. doi: 10.1093/deafed/5.4.303

Macaulay, C. E., Ford, R. M. (2006). Language and theory-of-mind development in prelingually deafened children with cochlear implants: A preliminary investigation. *Cochlear Implants International, 7*(1), 1-14. doi:10.1002/cii.22

Woodcock, R. W., McGrew, K. S., & Mather, N. (2007). *Woodcock Johnson III Tests of Achievement, Form C/Brief Battery*. Rolling Meadows, IL: Riverside Publishing.

Melot, A., & Angeard, N. (2003). Theory of mind: Is training contagious? *Developmental Science, 6*, 178-184.

Meltzoff, A., & Brooks, R. (2008). Self-experience as a mechanism for learning about others: A training study in social cognition. *Developmental Psychology, 44*, 1257-1265. doi: 10.1037/a0012888

Meristo, M., & Hjelmquist, E. (2009). Executive functions and theory-of-mind among deaf children: Different routes to understanding other minds? *Journal of Cognition and Development, 10*(1-2), 67-91. doi: 10.1080/1524870902966552

Moeller, M. P., & Schick, B. (2006). Relations between maternal input and theory of mind understanding in deaf children. *Child Development, 77*, 751-766.

Moog, J. S., & Geers, A. E. (1990). *Early Speech Perception Test for Profoundly Hearing Impaired Children*. St. Louis, MO: Central Institute for the Deaf.

Morgan, G., & Kegl, J. (2006). Nicaraguan sign language and theory of mind: The issue of critical periods and abilities. *Journal of Child Psychology and Psychiatry, 47*, 811-819.

Muller, U., Liebermann-Finestone, D. P., Carpendale, J. I. M., Hammond, S I., Bibok, M. B. (2012). Knowing minds, controlling actions: The developmental relations between theory of mind and executive function from 2 to 4 years of age. *Journal of Experimental Child Psychology, 111*, 331-348. doi: 10.1016/j.jecp.2011.08.014

Murphy, R. J., & Bryan, A. J. (1980). Multiple-baseline and multiple-probe designs: Practical alternatives for special education assessment and evaluation. *Journal of Special Education, 14*, 325-335.

Nowakowski, M. E. (2009). Establishment of joint attention in dyads involving hearing mothers of deaf and hearing children, and its relation to adaptive social behavior. *American Annuls of the Deaf, 154*(1), 15-29.

Parker, R. I., Vannest, K. J., & Davis, J. L. (2011). Effect size in single-case research design: A review of nine nonoverlap techniques. *Behavior Modification, 35*, 303-322. doi: 10.1177/0145445511399147

Peters, K., Remmel, E., & Richards, D. (2009). Language, mental state vocabulary, and false belief understanding in children with cochlear implants. *Language, Speech, and Hearing Services in Schools, 40*, 245-255. doi: 0161-1461/09/4003-0245.

Peterson, C. C. (2004). Theory-of-mind development in oral deaf children with cochlear implants or conventional hearing aids. *Journal of Child Psychology & Psychiatry, 45*, 1096-1106.

Peterson, C., & Siegal, M. (1998). Changing focus on the representational mind: Deaf, autistic, and normal children’s concepts of false photos, false drawings, and false beliefs. *British Journal of Developmental Psychology, 16*, 301-320.

Peterson, C. C., & Siegal, M. (1999). Representing inner worlds: Theory of mind in autistic, deaf, and normal hearing children. *Psychological Science, 10*(2), 126-129.

Peterson, C., & Slaughter, V. P. (2006). Telling the story of mind: Deaf and hearing children’s narratives and mental state understanding. *British Journal of Developmental Psychology, 24*, 151-179.

Peterson, C. C., Wellman, H. M., & Liu, D. (2005). Steps in theory-of-mind development for children with Deafness or Autism. *Child Development, 76*, 502-517.

Peterson, C. C., & Wellman, H. M. (2009). From fancy to reason: Scaling deaf and hard of hearing children’s understanding of theory of mind and pretence. *British Journal of Developmental Psychology, 27,* 297-310.

Peterson, C., Wellman, H. M., & Slaughter, V. (2012). The mind behind the message: Advancing theory-of-mind scales for typically developing children, and those with deafness, autism, or Asperger syndrome. *Child Development, 83*, 469-485.

Pyers, J. E., & Senghas, A. (2009). Language promotes false-belief understanding: Evidence from leaners of a new sign language. *Psychological Sciences, 20*, 805-812. doi: 10.111/j.14679280.2009.02377.x.

Rakoczy, H., Tomasello, T., & Striano, T. (2010). The role of experience and discourse in children's developing understanding of pretend play actions. *British Journal of Developmental Psychology, 24*, 302-335. doi: 10.1348/026151005X36001

Remmell, E., Bettger, J. G., & Weinburg, A. M. (2001). Theory of mind development in deaf children. In M. D. Clark, M. Marschark & M. Karchmer (Eds.), *Context, cognition, and deafness* (pp. 113-134). Washington DC: Gallaudet University Press.

Ruffman, T., Slade, L., & Crowe, E. (2002). The relation between children's and mother's mental state language and theory-of-mind understanding. *Child Development, 73*, 734-751.

Ruffman, T., Slade, L., Rowlamdson, K., Rumsey, C., & Garnham, A. (2003). How language relates to belief, desire, and emotion understanding. *Cognitive Development, 18*, 139-158.

Russell, P. A., Hosie, J. A., Gray, C. D., Scott, C., Hunter, N., Banks, J. S., & Macaulay, M. C. (1998). The development of theory of mind in deaf children. *Journal of Child Psychology and Psychiatry, 39*, 903-910.

Schick, B., de Villiers, P., de Villiers, J., & Hoffmeister, R. (2007). Language and theory of mind: A study of deaf children. *Child Development, 78*, 376-396.

Taumoepeau, M., & Reese, E. (2013). Maternal reminiscing, elaborative talk, and children's theory of mind: An intervention study. *First Language, 33*, 388-410. doi: 10.1177/0142723713493347

Tomasuolo, E., Valeri, G., Di Renzo, A., Pasqualetti, P., & Volterra, V. (2013). Deaf children attending different school environments: Sign language abilities and theory of mind. *Journal of Deaf Studies and Deaf Education, 18*(1), 12-29. doi:10.1093/deafed/ens035

Van Staden, A. (2009). Comparing native signing, late-signing and orally trained deaf children's "theory of mind' abilities. *South African Journal of Psychology, 40*(1), 99-106.

Wellman, H. M., & Liu, D. (2004). Scaling of theory of mind tasks. *Child Development, 75*(2), 523-541.

Wellman, H. M., & Peterson, C. C. (2013). Deafness, thought bubbles, and theory-of-mind development. *Developmental Psychology, 49*, 2357-2367. doi:10.1037/a0032419

Woolfe, T., Want, S. C., & Siegal, M. (2002). Signposts to development: Theory of mind in deaf children. *Child Development, 73*, 768-778.

Ziv, M., Meir, I., & Malky, L. (2013). Enhancing theory-of-mind discourse among Deaf parents of children with hearing loss. *Journal of Education and Training Studies, 1*, 249- 262.

doi: 10.11114/jets.v1i2.169

APPENDICES

Appendix A
Child Demographic Form

Background Information Form

Today's Date: ________
Child's Name: ________________________________ Child's Date of Birth ________________
Person completing form:
Name: _______________________________ Relation to child: ____________________________
Please write ages as years and months (ex: 4 yrs. 5 mos) as close as you can remember.
At what age was the above child identified as deaf or hard-of-hearing? ______________________
What was the cause of the child's hearing loss? ____
At what age was the child first enrolled in intervention services? __________________________
At what age did the child enter his/her current school? ______________________________
At what age did the child first use hearing aid(s)? __________
Does the child wear hearing aid(s) now? ___ yes ___no
If yes, how many: circle: one or two
How much does s/he use it at school? *circle:* Never Occasionally Almost Always
How much does s/he use it at home? *circle:* Never Occasionally Almost Always
Does the child have a cochlear implant(s)? ___ yes ___no *If yes: circle:* one or two
At what age(s) did the child get the implant(s)? __________
How much does s/he use it at school? *circle:* Never Occasionally Almost Always
How much does s/he use it at home? *circle:* Never Occasionally Almost Always
Is the child's mother deaf? ___ yes ___no Is the child's father deaf? ___ yes ___no
Mother's highest education________________ Father's highest education_________________

Mother's ethnicity *(circle below)*	Father's ethnicity *(circle below)*
American Indian or Alaskan Native	American Indian or Alaskan Native
Asian or Pacific Islander	Asian or Pacific Islander
Black	Black
White	White
Hispanic	Hispanic
Mixed	Mixed
Other	Other

Does your child receive free or reduced lunch? ___ yes ___ no
What language is used at home? *(circle all that apply)*
Spoken English, Spoken Spanish, American Sign Language, Signed English, a combination of spoken and signed language, other _________________
If your child uses sign language, at what age did s/he start using it (*years and months*)? _______
Please check any area(s) that the child has an additional disability.

	Diagnosed	Suspected
Attention	☐	☐
Cognitive/intellectual	☐	☐
Motor/physical	☐	☐
Emotional/behavioral	☐	☐
Other: ____________	☐	☐

Please describe any information you have on the specific kind and severity of the disability (if known) and any testing done to diagnose the disability on the back of this paper.

*Adapted from *Foundations for Literacy*. by A.R. Lederberg, E.M. Miller, S.R., Easterbrooks, & C.M. Connor, 2011, Unpublished curriculum. Atlanta, GA: Georgia State University.

Appendix B
Student Participant: Social Validity Measure

Name:________________________________ Date:_____________________________

Directions: Please pay attention carefully. Circle the face that matches what you think.

1. I liked using *Thought Bubbles.*

2. *Thought Bubbles* was fun.

3. I understand my thoughts can be different from other people's thoughts.

4. I learned a lot using *Thought Bubbles*.

Appendix C
Teacher Participant: Social Validity Measure

Completed by: ______________________ Date: ________________________

Directions: Please circle the number that describes how you feel about the Theory of Mind (ToM) intervention.

1) This intervention would be easy to implement in my classroom.
Strongly Disagree ---1---2---3---4---5--- Strong Agree

2) This intervention aligns with my students' social and behavioral goals.
Strongly Disagree ---1---2---3---4---5--- Strong Agree

3) This intervention was beneficial to my students.
Strongly Disagree ---1---2---3---4---5--- Strongly Agree

4) I would implement this intervention with my students.
Strongly Disagree ---1---2---3---4---5--- Strongly Agree

Please answer as briefly or in as detailed a manner as you wish. Feel free to write on the back.

1. Did you notice any changes in your students during or after the implementation of the ToM intervention that you believe were a result of the intervention? (For example: students began to use vocabulary from the intervention – think, don't know, know, sneaky/tricky)

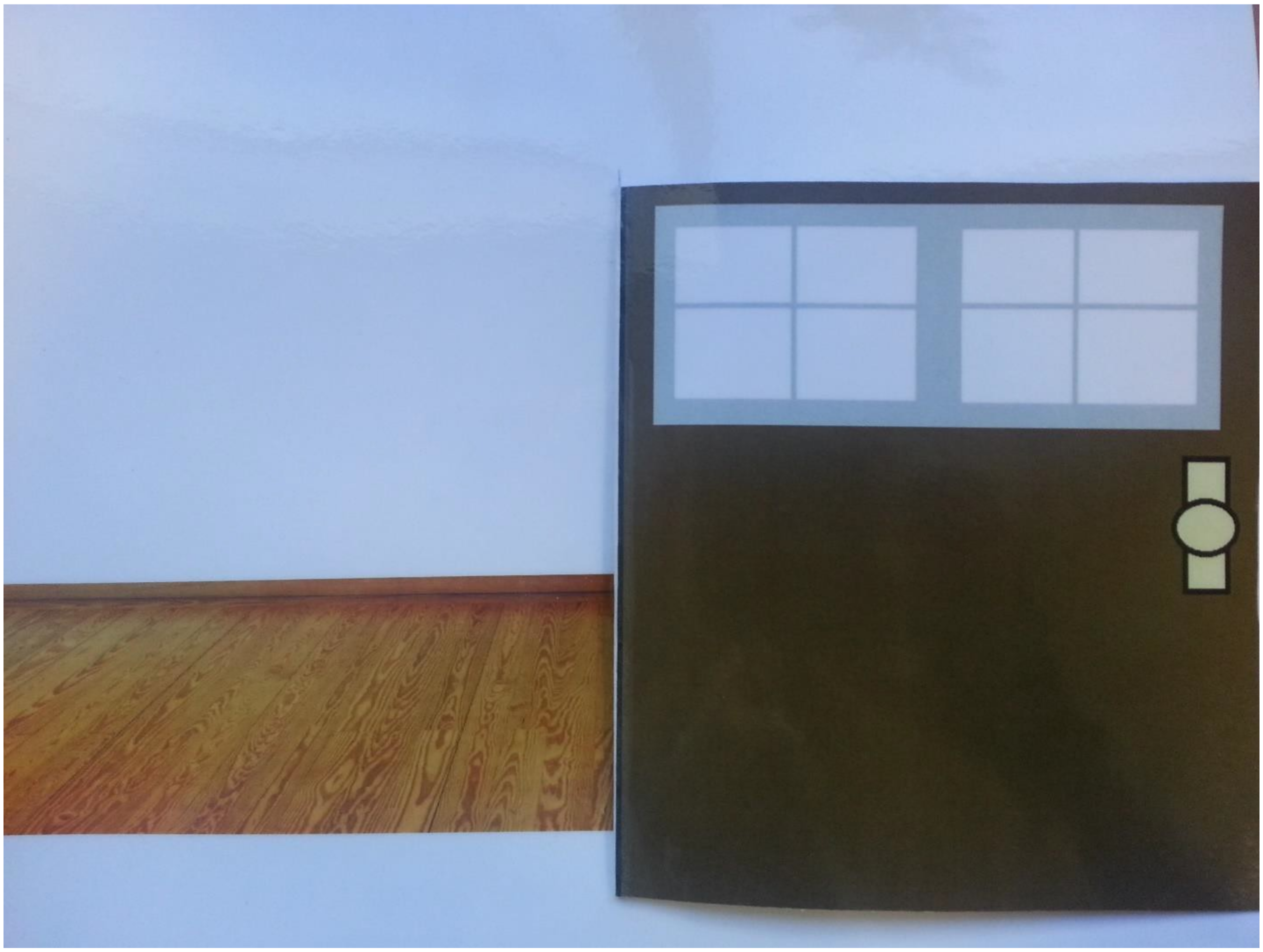
2. What do you believe are the challenges and benefits to implementing a ToM intervention with your students?

3. If you were going to change this intervention in any way, how would you change it to implement it in your classroom? Why?

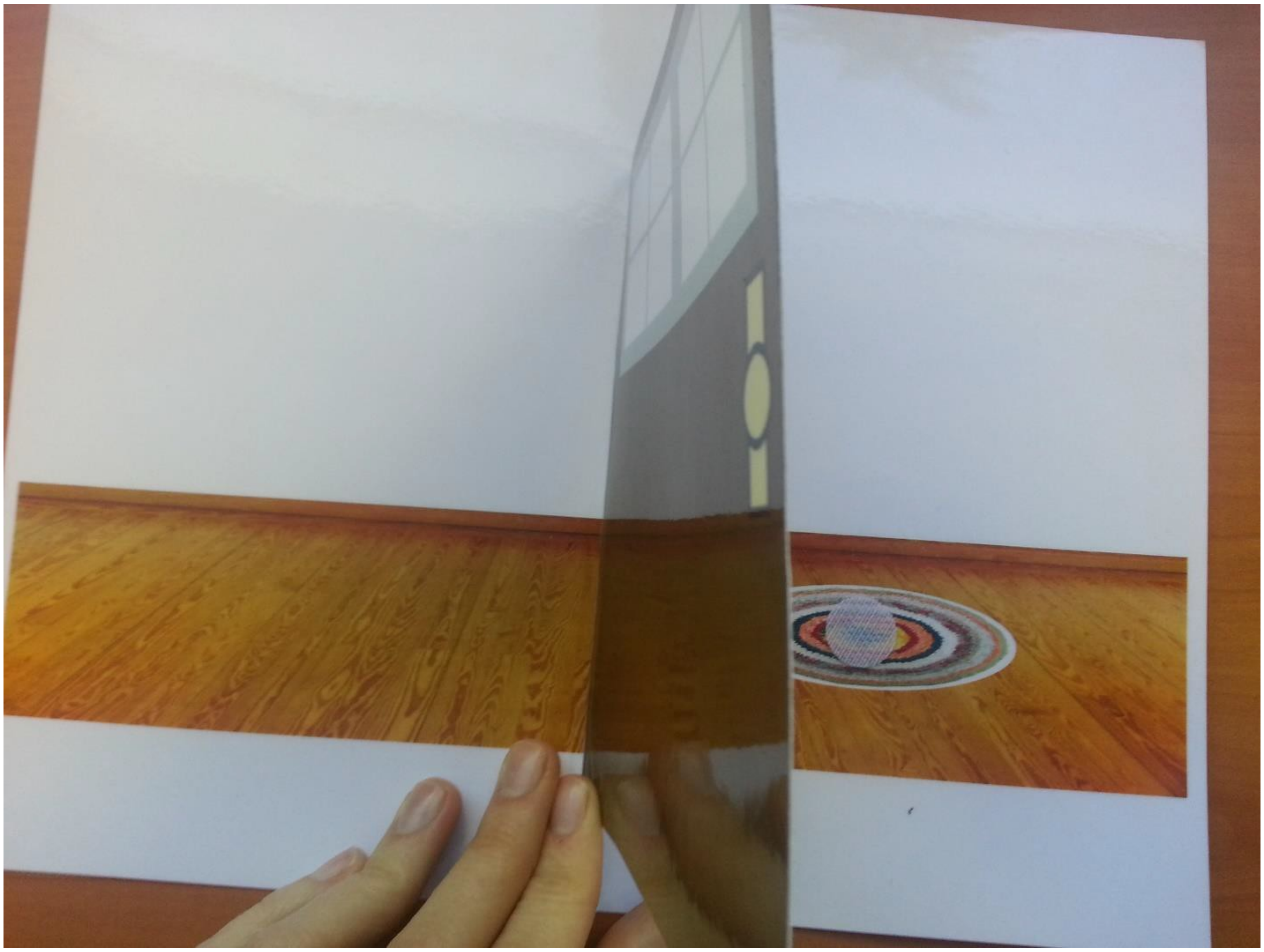
Appendix D
ToM Intervention Materials

Girl 1 Looking (used in Stage 1)

Girl 1 Thinking (used throughout intervention)



Door Flap Image (used throughout intervention)



Rug Scene with Door Flap (used in Stage 2)

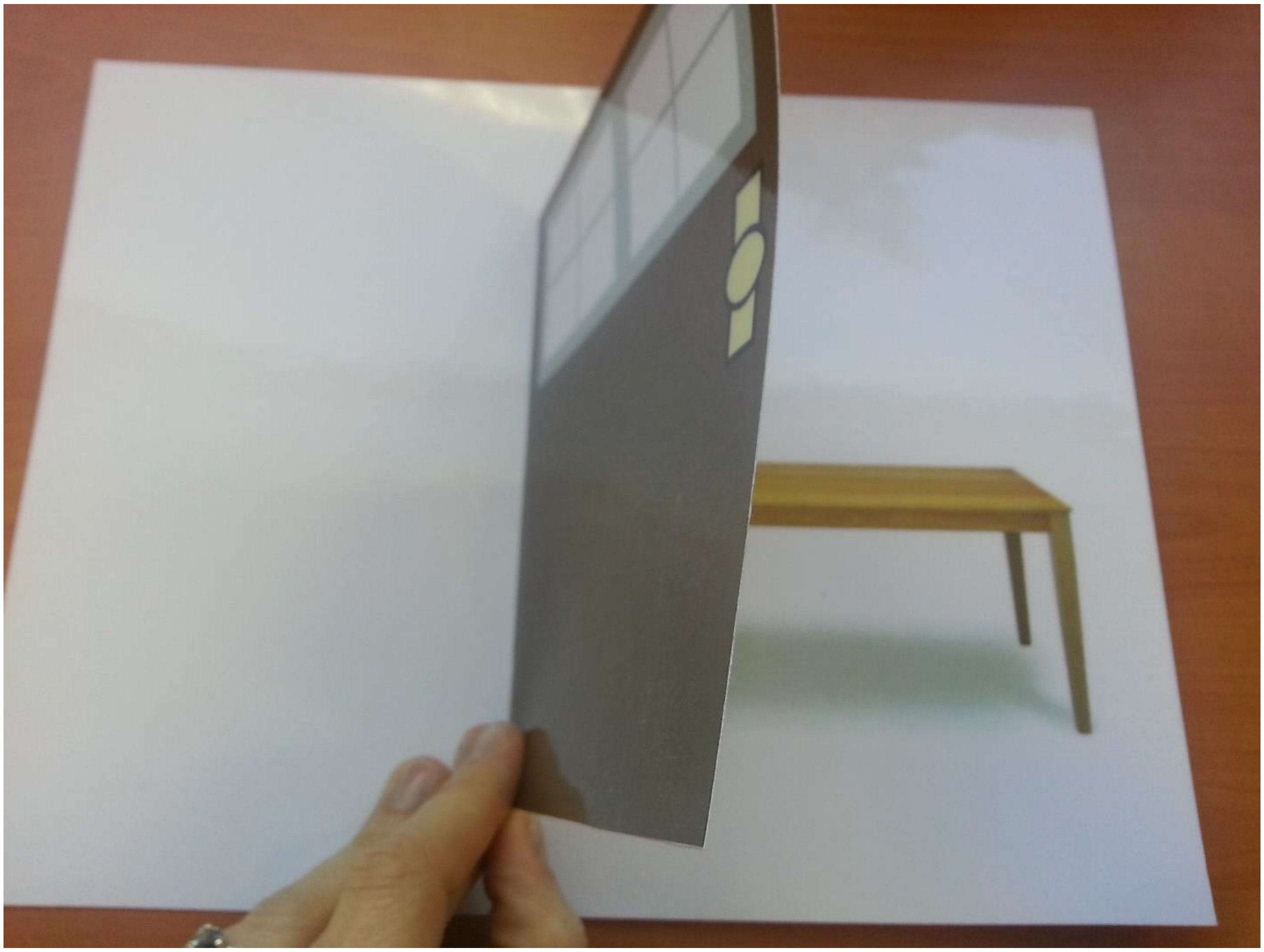


Table Scene with Door Flap (used in Stage 3)

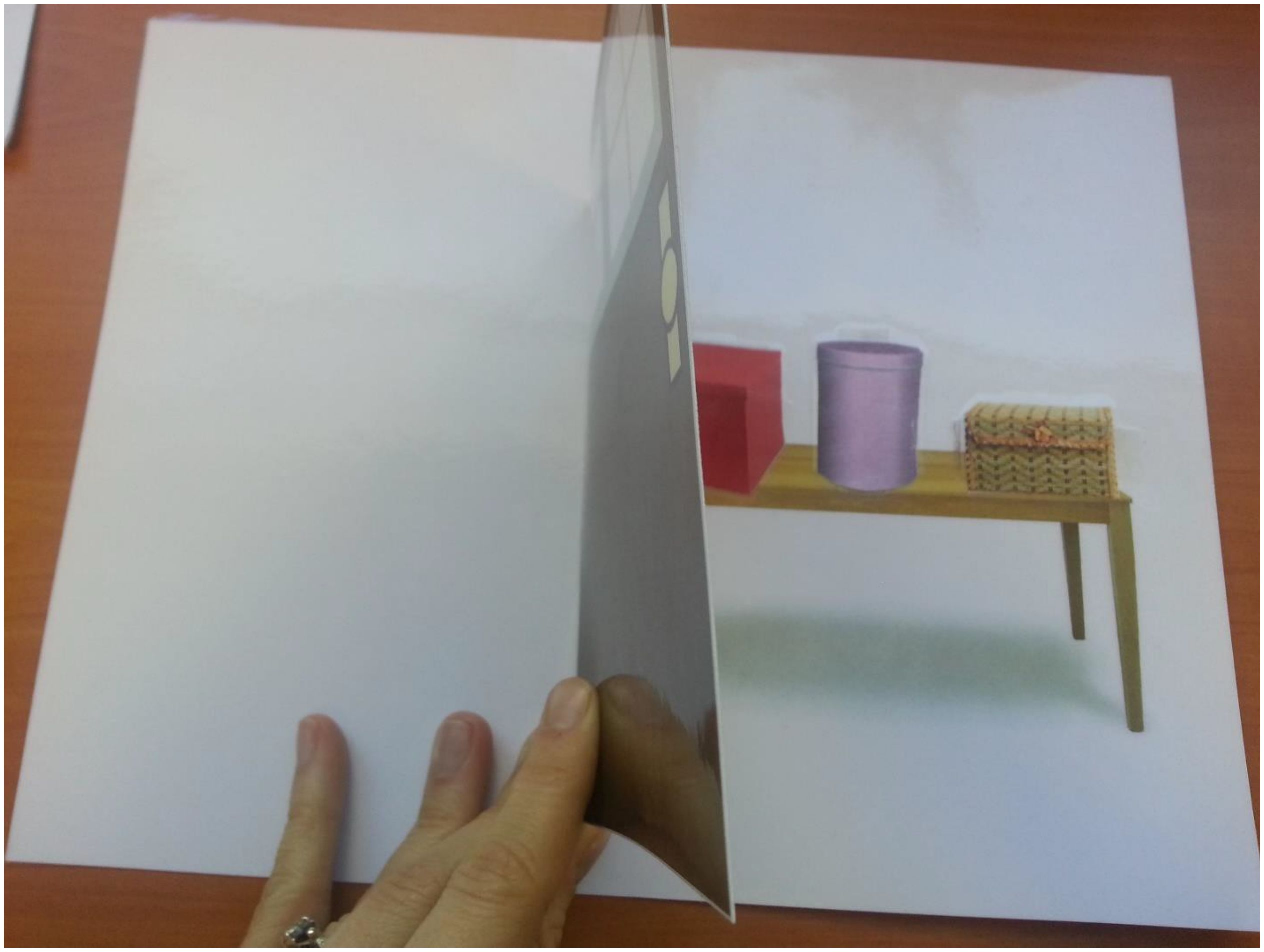


Table with Containers Scene with Door Flap (used in Stages 4, 5 and 6)

Boy 1 (used in Stages 5 and 6)
Various Objects and Containers (used throughout intervention)

Girl 2 Thinking (used in Stages 5 and 6)