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The Role of Hearing Mothers' Signing Ability in Deaf Children's Theory of Mind Development

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Abstract ~ The present review aims to provide a comprehensive discussion of the relationship between maternal sign language ability and Deaf children's theory of mind (ToM) development, specifically in Deaf children of hearing parents. Emphasis will be placed on one identified component of ToM, which is called false-belief understanding. Research has recognized the influence of the hearing parent's American Sign Language (ASL) abilities on the Deaf child's own developing ASL and ToM abilities. However, prior research has not provided thorough measurement of hearing parents' ASL abilities, as there has been no measurement of the correctness of the parents' grammatical facial expression while signing. In addition to discussing the progress of ToM research and its subsequent connection to Deaf children's ToM development, the present review will make suggestions to those interested in this area of research.

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Introduction to Theory of Mind (ToM)

During the course of normal development in the preschool years, a child is said to have achieved a theory of mind (ToM) when he or she is able to attribute independent mental states to him- or herself and others. With a ToM, a child can now predict and explain others' behaviors (Premack & Woodruff, 1978). A child's understanding of mental states implies that he or she grasps human mental activity, such as believing, forgetting, remembering, and knowing. With a ToM, the child now understands that others, including him- or herself, can experience a variety of emotions and thought processes, and that these are related to human action and events in the physical world (Russell et al., 1998). ToM is very important, as it provides children with a necessary tool for social interaction with others (Brown, Donelan-McCall, & Dunn, 1996). ToM abilities are demonstrated in normally developing children by age 5 (Milligan, Astington, & Dack, 2007).

The term "Theory of Mind" (ToM) was first introduced by Premack and Woodruff (1978), who proposed that chimpanzees possessed a ToM. Premack and Woodruff's theory was met with strong opposition, with the argument that ToM could only be truly demonstrated with the use of verbal tests (Slaughter & Mealey, 1998). In Dennett's (1978) critique of Premack and Woodruff, the most popular test for ToM, called the inferential false-belief paradigm, was developed. In the inferential false-belief paradigm, a child is required to make inferences about the behavior of others whose beliefs about reality are false, due to some sort of manipulation. In order to demonstrate an understanding of a false-belief, the child must possess knowledge of others' mental states (e.g., "know", "remember"). There are three versions of the false-belief paradigm that are the most commonly used in experimental research. The first, the 'change in location' task, was developed by Baron-Cohen, Leslie, and Frith

(1985) as the Sally-Anne task. A transformation of reality is created in order to contradict the original belief of the story character (e.g., hiding a ball in another location while the story character is out of the room), and the child must be able to respond that the story character's knowledge is not changed by the unseen trick, and the character still believes that the ball is hidden in the original location. The second task, the 'appearance-reality' task, presents the child with an object that, on first look, has one obvious interpretation (e.g., it is a rock). The child is then made aware of the contradictory information (e.g., the rock, when touched, is really a sponge), and must demonstrate that an individual who was not present during this revelation would not, if asked, express knowledge of the object's real quality and purpose. In the third task, the 'unexpected contents' task, the child is led to believe that expected contents are in their typical container, when in fact they are not. For example, the child is given a box of crayons, and is shown that the box contains rulers, not the expected crayons. In order to demonstrate ToM, the child must be able to tell the experimenter that an individual who was not present for this revelation would not know what is really inside the container, and if asked, would respond that crayons are inside the crayon box.

Theories of ToM Development

Research has consistently shown that children with autism have a particularly difficult time with ToM (Baron-Cohen et al., 1985). Autism is a childhood disorder that is characterized by stereotypic behavior and a broad range of intellectual, communicative, and social deficiencies (Gleason, 2001). Children with autism frequently exhibit atypical language development; they may have difficulties using language related to the emotional states of other people (Tager-Flusberg, 1999). Research on ToM with autistic children has produced various theories on the nature of ToM development. One theory proposes that ToM depends on a

specific brain mechanism that is present before birth, and must mature before ToM can develop (Fletcher et al., 1995). A second theory posits that false-belief understanding develops out of other capacities that mature earlier. For example, pretend play (Leslie, 1987) and shared attention (Baron-Cohen et al., 1996) may be skills that precede ToM abilities. A third theory postulates that the development of ToM is influenced by exposure to conversation about mental states (Jenkins & Astington, 1996; Perner, Ruffman, & Leekman, 1994). According to this theory, the communication difficulties that are often characteristic of autistic children may prevent them from being able to successfully converse with others, therefore affecting their ToM abilities. In support of the third theory, research has found a relationship between verbal ability and ToM in normally developing children (Jenkins & Astington, 1996). These discoveries have been highly influential to the field of developmental psychology (Baron-Cohen, Tager-Flusberg, & Cohen, 1993), and have implications for the study of ToM in Deaf children.

ToM in Deaf Children

If communication is important in a child's development of ToM, how might a Deaf child's ToM develop in the context of American Sign Language, or other forms of communication? Deaf children born to signing Deaf parents acquire language similarly to hearing children of hearing parents (Pettito & Marentette, 1991). However, not all Deaf children are born to Deaf parents; less than 10% of hearing parents with Deaf children are fluent signers. Many hearing parents with Deaf children cannot converse easily with their Deaf child about a variety of topics (Marschark, 1993). One area where communication is difficult includes conversations about everyday events, and many topics are restricted to the immediate visual field (Vaccari & Marschark, 1997). For many hearing parents, they are working on their own signing abilities while learning to converse with and

teach ASL to their Deaf child. This may hinder the number and scope of topics that can be effectively discussed (Moeller & Schick, 2006). As a result of limited exposure to language, Deaf children will be delayed in gaining conversational access to information about the thoughts and feelings of others, which may interrupt or delay ToM development.

Deaf children of hearings parents have been consistently found to do poorly on false-belief tasks, when compared to Deaf children of Deaf parents (Courtin & Melot, 1998; Peterson & Siegal, 1995; de Villiers & de Villers, 2000; Schick, de Villiers, de Villiers, & Hoffmeister, 2007). Peterson and Siegal (1995) found that the majority of a group of Deaf children aged 8 to 13 years with hearing parents did not pass a false-belief test that most hearing children passed around 4 or 5 years of age. In fact, the Deaf children's performance was similar to that of autistic children, and was replicated in a later comparison of Deaf and autistic children across a wider age range (Peterson & Siegal, 1999). Additional research did not find Deaf children of hearing parents to consistently display accurate understanding of false-belief until after the age of 15 years (Russell et al., 1998). Peterson and Siegal's (1995) findings are consistent with the proposition that ToM development is dependent upon appropriate social experience; this is called the 'early conversational hypothesis'. Most of the children in their study were raised in homes with no other Deaf family members and no one who was proficient in sign language. Therefore, research suggests that the children's opportunities for learning about mental states through conversation and other types of interaction were limited.

Another line of research has found that Deaf children from Deaf households develop false-belief concepts at the same age as children of normal hearing (Peterson & Siegal, 2000; Schick et al., 2007). In fact, Deaf native signers have been found to converse as frequently about mental states and past and future occurrences

with their Deaf children as hearing parents do with their hearing children (Meadow, Greenberg, Erting, & Carmichael, 1981).

Further support for the relationship between ToM and the "early language hypothesis" comes from research with precocious, hearing 3-year-olds, who have been found to display a ToM; this finding has been greatly attributed to their frequent exposure to sophisticated dialogue during the early years (Peterson & Siegal, 2000). Furthermore, hearing children who are consistently exposed to sophisticated talk with adults and older children, both at home and in the extended community, demonstrate more advanced false-belief understanding (Lewis, Freeman, Kyriakidou, Maridaki-Kassotaki, & Berridge, 1996).

As more research has connected ToM development and the "early language hypothesis," there has been recognition and utilization of verbal ability measures in studies of ToM development in hearing children. Research has progressed to include administering verbal ability measures in studies of Deaf children's ToM development. A growing recognition of the relationship between children's ToM and social dialogue has also produced research directly examining hearing mothers' mental state talk with their hearing children. This is often gauged by talking about the past or sharing in a task (Welch-Ross, 1997; Ruffman, Slade, & Crowe, 2002). However, only one study to date has directly examined hearing mothers' mental state talk with their Deaf children (Moeller & Schick, 2006). In Moeller and Schick's (2006) study, mother-child dyads, which included hearing mothers and hearing children versus hearing mothers and Deaf children, were videotaped for one hour while engaging in three activities designed to elicit mental state talk. The researchers examined both groups of mothers' discussion of mental state terms with their child. In addition, the researchers measured the mothers' manual signing ability. Moeller and Schick (2006) found that mothers of hearing children produced mental state terms signifi-

cantly more often in conversation with their children than the mothers of Deaf children. Specifically, mothers of Deaf children did not produce much variety in the types of mental terms used in conversation, and those scoring below 75% on false-belief tasks used significantly fewer instances of mental state terms. In addition, mothers' signing ability significantly correlated with their talk about mental states and their history of participation in ASL classes. Also, maternal mental state input scores contributed significantly to Deaf children's false-belief understanding.

Hearing Mothers' Sign Language Ability

Although there has been measurement of Deaf children's signing fluency, only more recent research has directly measured hearing mothers' signing ability. Although Moeller and Schick (2006) measured mothers' manual signing skill, there was no measurement of the mothers' nonverbal communication ability. Sign language involves a special awareness of nonverbal communication cues; one extremely important nonverbal cue is facial expression (Emmorey, 1993). Lundy (2002) recognized the importance of measuring Deaf children's facial expression abilities while signing, as teachers were asked to rate the children's sign competency with a series of questions that included competency with the grammatical facial expressions of ASL. However, mothers' correct display of facial expressions during signing has yet to be considered.

Facial expression is important to the syntax (arrangement of words) and morphology (structure and form of words) of ASL, where movements of the eyes, eyebrows, and mouth often determine what is being signed. For example, furrowing the eyebrows during a manual sign indicates the intent of questioning or inquiry, and is typically accompanied with "who," "what," "where," "when," and "why" questions. Unlike emotional facial expressions, which can be used by the speaker when and how he

or she chooses, ASL grammatical facial expressions have a clear beginning and end, and are specifically coordinated with parts of the manual sign (Reilly, McIntire, & Bellugi, 1990). For many manual signs, the same manual expression is used, but the different facial expressions accompanying the manual sign distinguish the meaning (McCullough & Emmorey, 1997). For example, during one manual sign, a natural facial expression indicates "for," whereas a facial expression furrowing the eyebrows indicates the question "what for?" In this example, the manual sign is the same, but what differs is the accompanying facial expression.

Recommendations for Future Research

Based on the existing literature, it is clear that one of the next steps in research on Deaf children's false-belief understanding is a closer examination of hearing mothers' sign language ability. This would include looking beyond their accuracy in producing correct manual signs to their ability to produce the correct accompanying grammatical facial expressions. Specifically, does the hearing mother's correct display of grammatical facial expressions while signing to her Deaf child significantly contribute to the child's false-belief task understanding? A proposed study will be briefly outlined to demonstrate how this research question might be answered. The proposed study has two main hypotheses:

1. Mother's accuracy of facial expressions during signing with her child will be positively correlated with child's false-belief task performance.

2. Mother's accuracy of facial expressions during signing with her child will significantly contribute to the variance of child's false-belief task performance.

The participants would be hearing mothers and their Deaf chil-

dren. Participants would be recruited from local schools for the Deaf, other school systems, organizations targeted toward the Deaf community, and word of mouth. Children between the ages of 4 and 10 years would be eligible to participate, as this age range has been utilized in previous research in this area (Moeller & Schick, 2006; Lundy, 2002). Screening criteria would be used to eliminate children with comorbid disabilities and children who were not living in a home with an English-speaking hearing parent. The children would have no additional disabilities, and must live at home with hearing parents whose primary language is English. The children may use bilateral hearing aids, cochlear implants, or be unaided, but they must rely on signed communication as their primary interaction in the family. Previous research has found no significant differences in language or ToM skills between hearing aid and cochlear implant users (Peterson, 2004; Moeller & Schick, 2006), so all children would be collapsed for analyses in the proposed study.

In the proposed study, researchers would include a measure of hearing mothers' ability to produce grammatically correct facial expressions during signing with their Deaf children. In order to utilize this measure of facial expression ability, mother-child dyads would be videotaped performing various play tasks together. Sessions would occur in a playroom in a research laboratory. Mothers would be instructed to engage in three separate play activities with their child, which will be chosen based on the tasks' utility in eliciting communication of mental state terms (for a more detailed discussion of this borrowed methodology, see Moeller & Schick, 2006). In order to rate mothers' ability to communicate facial expressions correctly during signing, two trained Deaf, fluent signers of ASL would view the videotapes separately, and would code mothers on their facial communication ability. Both raters would evaluate the correctness of the mothers' facial communication while signing in four areas, including questions (e.g., who, where), exaggerations (e.g., tired vs. really

tired), emotions (e.g., surprised, angry), mental state terms (e.g., guess, trick). Mothers would be rated on each of the four areas on a scale of 1 to 10, with 10 signifying perfectly correct facial expressions. Scores would be totaled across the four areas, with a maximum score of 40. Mothers' final score would be the mean of the two raters' scores.

In addition to scores reflecting mothers' accuracy in facial communication while signing, other variables would also be measured and included in the study, such as mother's frequency and variety of mental state terms spoken to the child during videotaped tasks, three false-belief tasks (change in location, appearance-reality, unexpected contents), child's sign language ability, mother's manual signing skill, mother's length of time in ASL classes or training, child's family background (number of siblings in the home and their respective frequency of signing with the Deaf child), family socioeconomic status, and maternal education level. Using stepwise regression to analyze the data would provide the clearest picture of mothers' facial accuracy while controlling for these additional variables.

If future research finds that mothers' overall sign fluency, accounting for both manual and facial expression ability, is related to their Deaf children's false-belief understanding, it would have some important implications. One of the most important implications would be the emphasis we must place on hearing parents' correct learning of ASL. This would include teaching parents that they should learn correct manual gestures, but that the grammatical facial expressions that accompany the gestures are equally important. In addition to the correct learning of ASL formally, parents may also consider interacting with members of the Deaf community. Watkins, Pittman, and Walden (1998) reported communication benefits for hearing parents who participated in the Utah Deaf Mentor Program, in which Deaf adults mentored hearing family members and helped them build their

ASL skills. After program participation, parents reported using six times more signs with their Deaf child, as well as feeling less frustration when signing with their child.

Encouraging hearing parents to learn how to communicate effectively with their Deaf child will help pave the way for the child's ToM development and future successful communication, social interaction, and understanding of others.

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