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From Fancy to Reason: Scaling Deaf and Hearing Children's Understanding of Theory of Mind and Pretence

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Abstract

We examined deaf and hearing children's progression of steps in theory-of-mind (ToM) development including their understanding of social pretending. Ninety-three children (33 deaf; 60 hearing) aged 3 to 13 years were tested on a set of six closely-matched ToM tasks. Results showed that deaf children were delayed substantially behind hearing children in understanding pretending, false belief and other ToM concepts, in line with their delayed uptake of social pretend play. By using a scaling methodology, we confirmed previous evidence of a consistent five-step developmental progression for both groups. Moreover, by including social pretence understanding, both deaf and hearing children's ToM sequences were shown to extend reliably to six sequential developmental steps. Finally and focally, even though both groups' sequences were six steps long, the placement of pretence relative to other ToM milestones varied with hearing status. Deaf children understood social pretending at an earlier step in the ToM sequence than hearing children, albeit at a later chronological age. Theoretically, the findings are relevant to questions about how universal developmental progressions come together along with culturally-distinctive inputs and biological factors (such as hearing loss) to set the pace for ToM development.

> "Imagination is more important than knowledge"
>
> Albert Einstein, On Science

Typically developing children rapidly acquire a theory of mind (ToM)--understandings that allow them to perceive and interpret the thoughts and feelings of self and others. As one example, consider children's understanding of false belief as assessed on standard tests. Between 3 and 6 years, false belief performance switches from consistently incorrect to consistently correct (Wellman, Cross, & Watson, 2001) whereas substantial delays, typically stretching into the teens, are observed among children with autism (e.g., Baron-Cohen, 2000). Most theory-of-mind investigations have focused on some single mental-state concept, especially false belief, in normally developing children (Wellman, et al. 2001). However, achieving a theory of mind includes concepts potentially acquired in developmental sequences (see Harris et al., 2005; Wellman & Liu, 2004) and is a developmental task for both typically developing and atypically developing children (see Peterson, 2003; Peterson & Siegal, 1999). Evidence about reliable sequences and about patterns of performance across different groups of children can be especially informative, both theoretically and practically.

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For example, Wellman and Liu (2004) recently established a sequentially reliable set of steps in typically-developing preschoolers' conceptual understanding of mental states. That research yielded a 5-step ToM scale that was found to chart the development of ToM from an early appreciation of diverse desire, then diverse belief, through knowledge-ignorance, false belief, and an understanding of emotional concealment. Guttman and Rasch scaling methodologies showed that each new step followed the previous step in an orderly and progressive sequence: The vast majority of children who passed any subsequent task in the sequence had also passed each of the previous steps, so that observed patterns of performance conformed closely to the theoretical ordering to be expected if mastery of the first concept developmentally preceded the second, the second preceded the third, and so on.

How are we to understand such sequences? Conceivably, such a sequence could result (a) from innately programmed, modular maturations, (b) from domain general cognitive gains (say, increases in executive functioning (Scholl & Leslie, 2001) or language competence (deVilliers, 2005), or (c) from processes of conceptual learning whereby earlier understandings (e.g., of desires) lead to later understandings (e.g., of diverse or false beliefs) as shaped by social-interactive experiences. More careful consideration of sequences, and of typical and atypical development, can help disentangle and potentially weave together such alternatives.

Consider children's understanding of diverse desires, diverse beliefs, and false belief, three of the five tasks in Wellman and Liu's battery. In a diverse desire task the child has one desire, the other person has an opposite desire, and the child must predict the other's action. In a diverse belief task no one knows where a target object really is but the child believes it is in X whereas the other person believes it is in Y, and the chid must predict where the other will search for it. Children understand diverse desires before diverse beliefs, even though the tasks have similar executive demands: To answer correctly about someone else's (differing) desires requires inhibition of one's own competing desire, just as to answer correctly about someone else's (differing) beliefs requires inhibition of one's own competing belief (Wellman & Liu, 2004). Children also perform well on diverse belief before performing well on false belief tasks, although both are about beliefs. Extended developmental sequences such as this, when confirmed, can thus shed light on how prior conceptions enable later ones and how conceptual understandings both influence and are influenced by domain-general cognitive processes (like executive functions) and social interaction.

Now consider comparisons between typical and atypical development. As noted earlier, children with autism are substantially delayed relative to typical developers in theory of mind understanding, potentially pointing to neurological, maturational accounts of ToM development. But deaf children of hearing parents are similarly delayed (Peterson, 2004; Peterson & Siegal, 2000). These deaf children have not suffered the sort of neurological impairment that children with autism have, as is clear because natively-signing deaf children of deaf parents acquire false belief understanding on the hearing child's early timetable (e.g., Courtin & Melot, 1998; Peterson & Siegal, 1999). Only when growing up in hearing families are deaf children likely to have problems with false belief, and this is true irrespective of whether they have cochlear implants, use oral communication, or are "late signers" who begin learning sign language upon school entry (Power & Carty, 1990).

Given the informativeness of both developmental sequences and of careful comparisons across groups with and without ToM delay, it is surprising that almost no prior research combines these two foci. We aim to do so in the current study by examining sequences of ToM development across both deaf and hearing children. Deaf children are important in their own right, but additionally provide an example of children growing up in quite different socio-linguistic, socio-interactive environments in comparison to their typically developing, hearing peers. This is important because if sequences are universal across children growing up in such different circumstances, that would support theoretical accounts based on innate modular maturation or domain-general cognitive gains. In contrast, accounts based on conceptual learning from socially variable experiences and inputs should predict that sequences will vary (in at least some relevant ways). Arguably, social and conversational experiences, such as late signers' lack of family access to conversations about thoughts with others, contributes to differences (beyond delay) in ToM development in the context of hearing impairment, in contrast to both typically developing preschoolers and native signers as well (Peterson & Slaughter, 2006).

To date only one prior study has used sequential scaling methods with deaf children. Peterson, Wellman and Liu (2005) compared sequences of ToM development across hearing and deaf children and found the same robustly sequential 5-step developmental scale applied to typically developing Australian preschoolers as it did to children in the U.S.A. In line with the results from the studies of deaf children's false belief performance, late-signing deaf children displayed overall ToM delays; at the time of attaining each successive step in Wellman and Liu's (2004) sequence, the late-signers were significantly older than their hearing peers. At the same time, the deaf children's emerging understanding of ToM progressed sequentially through the same five developmental steps as hearing children's (albeit on a slower timetable).

At the very least we aim to confirm this intriguing result with further deaf (and hearing) children. In addition, a novel aim of the present study is to probe this finding of identical sequences more deeply by adding a focus on children's understanding of social pretence. Why this focus? Briefly, comparisons and sequences between understanding pretence and belief are theoretically intriguing (much like the comparisons between desires and belief). Moreover, deaf and hearing children's experiences of pretend play are likely to be quite different, providing an important test case for examining similar and/or different sequences of understanding.

In a bit more detail, understanding pretence reflects an understanding of others' mental states, at least for adults and older children (Harris, 2005; Harris & Kavanaugh, 1993; Lillard, 1993, 1994; Richert & Lillard, 2002). Indeed, mental states of both pretence (or imagination) and belief are similar in being loosely "representational". The contents of pretend thoughts and acts represent a situation as something else (if X imagines that an empty cup is full, her thoughts represent it as full). So too for beliefs (if X believes that an empty cup is full, her thoughts represent it as full). In this regard, understanding of pretence requires ToM understandings similar to those for understanding belief (Leslie, 1987). Yet conceptually, pretence (or imagination) and belief also clearly differ. Beliefs are "supposed" to be accurate. In other words, they are accepted not just as representations but as representations of factual reality. While beliefs can be false, in general they are meant to be true. In contrast, in pretence truth is less an issue. Indeed, the whole point of pretence is to create an imaginary representational situation that departs from the truth of present reality. In line with this analysis, understanding pretence (and imagination) has been shown to be easier than understanding false belief in several studies with hearing children (Custer, 1996; Gopnik & Slaughter, 1991; Hickling & Wellman, 1997--But see Lillard (1993) and Richert and Lillard (2002) for arguments and data that at least some forms of pretence understanding are harder and later-developing than understanding of false beliefs).

Pretence additionally stands out as important because childhood engagement in pretend play relates to and may influence typically developing children's ToM understandings. Thus, preschoolers' false belief scores are often found to correlate with their frequency of engaging in pretend play (Taylor & Carlson, 1997; Youngblade & Dunn 1995), at least when it is socially shared. In fact, several studies revealed no connection between solitary pretend play and false belief scores, in contrast to significant links observed for social pretending and pretence-related talk (e.g., Astington & Jenkins, 1995; Schwebel, Rosen & Singer, 1999). Arguably, this is because the frequency of children's conversations and interactions with peers and family members about imaginary roles and ideas within pretence are particularly influential (e.g., Astington & Jenkins, 1995; Taylor & Carlson, 1997; Youngblade & Dunn, 1995). Siblings' and peers' spontaneous conversations about cognition may consist largely (e.g., 77%: Brown, et al., 1996) of words like "pretend" or "dream", while frequent use of contrastive speech (e.g., "It's not real, only pretend"; "I pretend it's lipstick, you pretend it's cheese") has likewise been shown to predict laboratory false belief success better than simple mentions of mental states (Brown et al., 1996).

Much less is known about these relations and influences for deaf children. But, if social experiences crucially influence pretence understanding and ToM development, there are reasons to expect that the experience of pretence, and thus the impact of pretence on ToM, might be quite different for deaf children. In advance of precise data, we can imagine two different scenarios. On the one hand, it is clear that deaf children (of hearing parents) are generally delayed in their pretence actions and interactions, just as they are generally delayed in their understanding of mental states such as beliefs and false beliefs. Intriguingly, Brown et al. (1997) found that whereas hearing preschoolers discussed pretence frequently in free play with peers (averaging 20 such utterances per hour), an age-matched deaf group did so rarely (2 or 3 utterances per hour or not at all). These data, as well as other considerations, suggest that (especially if early shared pretend interactions are key) deaf children may be particularly delayed in understanding (as well as participating in) pretence. Preschoolers who are severely or profoundly deaf may miss out on pretence discourse and other experiences with social pretending owing to lack of a common language (speech or sign) that they can fluently share with hearing family members or their deaf peers. When Higginbotham and Baker (1981) observed a group of orally-communicating deaf 4- and 5-year-olds, they found that solitary pretend play was infrequent and social pretence was almost non-existent. Whereas hearing preschoolers spent 25% of their free time in social pretend play (or 42% of it in pretence of all kinds), corresponding percentages for the deaf children were only 3% and 25%, respectively. The deaf were also less likely than the hearing to use cognitively complex forms of pretence (object substitution or abstract symbolism).

On the other hand, granting overall delays in ToM understanding, pretence understanding and experiences may be less delayed or less impaired in deaf children than understandings of belief. For example, for deaf children, sharing pretence stipulations with others may proceed in largely nonverbal ways via gesture, pantomime, or toy manipulation. Indeed, simple pretence stipulations might arguably occur as well via gestures as words (e.g., by holding a banana to one's ear or pressing imaginary keys to simulate a mobile phone). This could make nonverbal gestures (a strength of deaf children) a facilitative medium for the social sharing of mental states with parents and playmates, within pretence. Via nonverbal exchanges of fictional states of mind with others during pretend play, as well as via simple pretend-related speech, deaf children might manage to "achieve the same increment in mental state understanding" (Harris, 2005, p. 80) as a language-advanced child does through general conversation. Yet these and other hypotheses remain speculative because research has not addressed the relationship between pretence and ToM understanding for deaf children alone or in comparison to hearing children.

The Current Study

We examine sequences of ToM understanding, compare deaf and hearing children and explore the place of pretence understanding in a consideration of deaf children's developing theory of mind. To do so we extend the scaling methods used by Wellman and Liu (2004) and Peterson et al. (2005). For feasibility with young children, this sort of method requires using a limited number of well-designed tasks that make minimal language demands. Thus, we began with Wellman and Liu's five tasks and added a single task designed to assess pretence understanding; a task comparable in format to false belief, and one that focuses on understanding pretence within a socially shared situation. Specifically, Hickling, Wellman and Gottfried (1997) report a task that is carefully comparable to a standard changed-contents test of false belief. We chose this task, because the false belief task in the ToM scale is a changed-contents false belief task. Establishing interpretable scale sequences requires not just differing tasks (e.g., hopping on one foot versus counting to 10) but differing tasks that are comparable in format and information processing demands within a targeted domain of understanding (in our case, understanding of others' mental states).

Method

Participants

The sample of 93 Australian children aged 3 to 13 years included 33 deaf children (17 boys; 16 girls) ranging in age from 5 years 10 months to 13 years 6 months (mean = 9–8). They were pupils in Total Communication (TC) schools where teachers used a simultaneous combination of Signed English and speech. All had attended their school for at least one academic year and were rated by their teachers as having adequate signing skills for everyday communication, a prediction that was confirmed by their success on our comprehension control questions. Seventy-six percent were profoundly deaf (hearing losses of 91 dB or more) and 24% were severely deaf (losses of 71 to 90 dB). None had signing deaf family members.

There were also 60 hearing preschoolers (33 boys; 27 girls) ranging in age from 2 years 8 months to 5 years 9 months (mean = 4–5). None had any serious disabilities or a language other than English.

Tasks, Procedures and Scoring

Children were tested individually by the main experimenter (E) who was assisted by a professional sign-language interpreter with the deaf group. Interpreters translated E's spoken narratives and questions into Signed English, using a method of interaction that was a familiar part of classroom routine. Both adults monitored that the child's attention was appropriately directed (at materials, interpreter, etc.) before continuing each part of the procedure.

The six tasks we used included the five tasks from Wellman and Liu's (2004) scale that were presented exactly as in Peterson et al. (2005: see Appendix, p. 517 for verbatim details). In brief, these tasks were: (1) Diverse Desires (DD: knowing that different people may want different things), (2) Diverse Beliefs (DB: knowing that different people may have different, equally plausible, beliefs about the same situation), (3) Knowledge Access (KA: knowing that not seeing something leads to ignorance of it), (4) False Belief (FB: predicting a naïve observer's false belief about misleading contents), and (5) Hidden Emotion (HE: awareness that expressed emotion may not match true, subjective emotion).

The sixth task, Social Pretend (SP), assessed understanding of the subjectively different mental states of different persons within a social pretence episode (i.e., those with or without exposure to a socially-shared pretence stipulation). As closely modelled on Hickling et al.'s (1997), this task used a procedure parallel to standard false belief and thus was highly similar in format and materials to all the other five tasks from the Wellman and Liu scale (which includes a changed-contents false belief task). For SP, E first enlisted the child in jointly pretending to paint a red toy car blue. This pretence interaction was then saliently terminated and all evidence of painting material concealed, while E stated: "Now we have finished pretending". The key test question was: "X [a classmate] is coming next. He/she hasn't seen us pretending. I'm going to show him [her] this car. When I ask him [her] what color this car is, what will he [she] say?" The memory control question was: "When we played pretending before, what color did we pretend to paint this car?" Thus, in line with Wellman and Liu's (2004) careful matching of all stimulus and response features of their original tasks, the SP test used familiar materials, included a comprehension control question and posed similar linguistic and executive demands to each of the other tasks on the scale (e.g., provision of two response choices, each entailing the inhibition of a salient alternative).

Previous research (Wellman & Liu, 2004; Wellman et al., 2006) has demonstrated minimal effects of the order in which these scale tasks are presented to hearing children either upon individual task success or upon overall accuracy or scalability. We therefore used an order (DD, DB, SP, KA, FB, HE) that began with an easy task (DD) and worked up to tasks that should be more difficult (FB, HE) to maximize motivation and engagement. Given deaf children's widely observed lack of confidence in testing situations and vulnerability to becoming distracted or giving up prematurely (Marschark, 1993), we considered it especially important to minimize the risk of unnecessary failure experiences early in the testing sequence that would have resulted from random presentation orders. Thus 23 of the deaf children received the tasks in this prescribed order, but 10 deaf children received a somewhat different task ordering; they received DD, DB, KA, FB, and HE in a first session (and their data for those five tasks were presented in Peterson et al. 2005) and then the SP task approximately two weeks later. No difference between the two deaf subgroups emerged on any variable we examined, including passing versus failing the pretence task, χ^2 (1) = 1.39, N = 33, *ns*, or scale- consistency, χ^2 (1) <1, *ns*. This suggests our findings are not the result of some peculiar single order of presentation of the tasks. The data were collapsed across presentation orders for remaining statistical analyses.

Scoring—All six tasks included a focal test question and either preliminary and/or control questions. As in previous research, we ensured that children responded to each of the preliminary questions sensibly and attentively. In addition, for a child to pass a task, all control and test questions had to be correct (as in Wellman & Liu, 2004; Peterson et al. 2005). This ensured that children were adept with all the relevant linguistic skills and story information upon which a meaningful, rather than random, response to a test question could be based. Passing responses scored 1. Otherwise children received 0 *for that item.* Total scores ranged from 0 to 6.

Results

Table 1 shows the numbers and percentages of children in each group who passed each task by correctly answering each test and control question. Our initial analyses established loose comparability between our samples and prior research. Then we turned to the focal analyses that explored sequences of task success and failure.

Few of the deaf children in this sample passed the standard false belief test, echoing much previous research (see: Peterson, 2004; Peterson & Siegal, 2000, for reviews). Like previous research (Peterson, 2004), we also found that the 12 deaf children in our sample who used cochlear implants were no more likely than the 21 who did not to pass false belief, χ^2 (1) = 1.07, N = 33, $p > .25$. The children with implants similarly scored no higher than the others in total ToM scores (M = 2.58 and 3.48, respectively), t (31) = 1.45, p >.15. This makes sense since auditory acuity was not a requirement for task success; moreover, all the deaf children in the present sample were pupils in a TC school and were sufficiently skilled users of sign language to comprehend our bimodal presentation of the tasks. The hearing children's patterns of performance were also consistent with age trends revealed in earlier research (see Wellman et al. 2001, for a review). For example, only 1 (4%) of the 25 hearing preschoolers in the age range 2.7 to 4.4 years passed false belief, compared with a significantly higher proportion (16/35 or 46%) of children over 4.5 years who passed, χ^2 (1) = 13.07, N = 60, $p < .01$, and age was significantly correlated with their total ToM scores, r (58) = .58, $p < .01$. In parallel, age was also correlated with the deaf children's ToM total, r (31) = .63, $p < .01$, and false belief, r (31) = .52, $p < .01$.

As we had hoped when selecting our sample, the hearing and deaf groups were roughly comparable both in false belief understanding, χ^2 (1) < 1, N = 93, p = ns, and on total ToM scores (means were 3.62 and 3.12 out of 5, respectively), t (91) = 1.63, p = .11. However, the mean age of the 17 hearing preschoolers who passed false belief was 4.89 years, whereas that of the 9 deaf children who passed was 12.06 years, t (24) = 20.14, $p < .001$.

Scalogram Analyses

Given these comparisons, the key question for our research concerns developmental trends and extended sequences in the growth of mentalistic understanding. Statistically, Guttman scalogram analyses (Green, 1956) assess the fit of a sample's performance to the theoretical prediction of a perfectly ordered developmental scale such that anyone who passes a harder item on the scale will have passed *all* the easier items, and no passer of a later item will have failed *any* of the earlier ones. We used scalogram analyses, first, to assess whether our data confirmed the 5-step scale discovered earlier for deaf and hearing children and, second, to evaluate whether an understanding of pretence occupied a reliable position in the developmental progression towards ToM for deaf and hearing children.

5-Step Scale Sequence—Of the 60 hearing preschoolers, 52 (87%) displayed patterns of performance across the 5 original tasks (DD to HE) that were perfectly scale-consistent. Green's (1956) Index of Reproducibility (*Rep*) was .97 for these data (scores above .90 are significant: Green, 1956), and Green's Index of Consistency (*I*)--a more conservative measure that takes into account the patterns to be expected by chance alone--was .50 (scores .50 and above are significant). The sequence that resulted (see Table 1) is identical to that for typically developing preschoolers in Wellman and Liu (2004) and Peterson et al. (2005).

More importantly, consider the deaf children. As shown in Table 1, of the 23 novel deaf children (whose data have never previously been reported) a total of 22 (97%) displayed patterns that were perfectly scale-consistent on the same established 5-step scale. Green's *Rep* = .99 and *I* = .87 for these deaf children (both highly significant). This is very similar to the coefficients *Rep* = .98 and *I* = .77 that were found for late-signing deaf children by Peterson et al. (2005). Because a focal question remains establishing a replicable sequence of ToM steps for deaf children, Table 1 also presents the data from all 59 late-signing deaf children tested here *and* in Peterson et al. . The data are highly consistent and scalable. Using that combined data, statistics for the sample of 59 deaf children were *Rep* = .98 and *I* = .79 (both significant). These data together with those for 60 hearing children *and* together with those from Peterson et al. (2005) clearly demonstrate that the same sequence characterizes deaf and hearing children's performance on these five tasks, even though the deaf are substantially slower in their progress along this sequence.

Scaling Pretence Understanding—(1) Where do concepts of social pretence fit into the established 5-step ToM scale? and (2) If a 6-step sequence emerges with pretence included, is it the same for deaf and hearing children? Based on patterns of task success and failure in Table 1, we tested several different 6-step sequences.

Of the 60 hearing preschoolers, 48 (80%) displayed response patterns that were perfectly consistent with the sequence: DD, DB, KA, SP, FB, HE, $Rep = .97$ and $I = .67$ (both significant). Thus, the pretend task ordered itself in a reliable manner within a 6-step developmental scale of ToM mastery for the hearing children. Of the 33 deaf children who received the social pretence task, 27 (75%) displayed a pattern across the six tasks that was perfectly consistent with a different sequence DD, DB, SP, KA, FB, HE. Green's coefficients (Rep =.97, and more importantly, $I = .71$) were both significant. Thus, deaf also children evidenced a consistent developmental progression, including social pretence among other ToM concepts. Furthermore, in the specific sequence that emerged, deaf children understood social pretence sequentially earlier than the hearing children (not only easier than false belief but also easier than knowledge/ignorance).

To confirm the differences in sequence across groups, we compared understanding of pretence versus knowledge-ignorance directly, focusing on the two tasks where the two sequences appear reversed. The data here concern children who pass one or other of these tasks, but not both. For these 28 individuals, 83% of deaf children (10 of 12) passed SP but failed KA, whereas 88% of hearing children (14 of 16) passed KA but failed SP. A comparison of frequencies of children who passed SP but not KA versus those with the reverse pattern between deaf versus hearing groups was statistically significant, $\chi^2(1) = 10.46$, $p < .01$. Thus for hearing children, social pretence came after knowledge access, whereas for deaf children it came one step earlier (although of course at a later mean age than for the hearing).

Mimicking the data from Hickling et al. (1997), both hearing and deaf children consistently passed our social pretence task (SP) before understanding false belief (FB), although the formats of the two tasks were very similar. Of the total of 23 hearing preschoolers who passed only one task, 21 (91%) passed SP but not FB. By McNemar's test this difference was significant, $\chi^2(1) = 14.09$, $p < .001$. Moreover, of a total of 13 deaf children who passed only one of SP or FB, significantly more (11 = 85%) passed SP but not FB, McNemar's $\chi^2(1) = 4.92$, $p < .05$. Across both groups combined, a total of 32 of 36 (89%) passed SP only, McNemar's $\chi^2(1) = 20.25$, $p < .001$.

When children failed an item, they typically passed its associated preliminary or control question(s). Of course, less advanced children in a group might fail both target items and control questions for the hardest items; thus the most relevant data concern the first item a child fails in his/her sequence. Using the established Guttman sequences, we examined the easiest item failed for each child. For these failed items 80% (74 of 93) passed the associated preliminary or control question, showing mastery of the task, format and events. Indeed, a disproportionate number of the relatively few control question errors (42%) occurred on the hardest task, HE. Further, consider the pretence task, novel for this research. Only 10 children (11%: 4 hearing, 6 deaf) failed the control by stating the toy's true color as the color they had pretended to paint it. Furthermore, all but 2 of these children (80%) answered the associated test question incorrectly too. Thus they would have failed even if control questions were ignored. Given the control question's embedded complement syntax ("What color [did we pretend to paint] the car?"), the deaf and hearing children's high level of control question accuracy further indicates their possession of the syntactic knowledge (deVilliers, 2005), attention skills, and so on needed for these and other tasks, including the false belief test question.

Discussion

Our research yields findings about both similarities and differences in the sequence of ToM understandings for deaf and hearing children. First, deaf children, just like typically developing children, evidence a consistent sequence of ToM understandings. This is an important finding in its own right because a great many factors (e.g., differential exposure to social interactions and language) could have meant that deaf children would exhibit *no* consistent sequence of ToM understandings. Not only is their sequence consistent across individuals, it is similar in many key ways to the sequence evident in typically-developing, hearing children.

Like prior studies, these deaf children from hearing families display delayed understanding of false belief (see Peterson, 2004; Peterson & Siegal, 2000, for reviews). Going beyond these prior studies, we confirm that deaf children proceed through the same 5-step sequence discovered for hearing preschoolers by Wellman and Liu (2004), and first demonstrated for deaf children by Peterson et al. (2005). Including the present sample, 197 typically developing hearing English-speaking 3- to 6-year-olds have been tested in these studies. Results demonstrate that these preschoolers progress through a reliably consistent developmental sequence of ToM understandings, beginning with an appreciation of the diversity of desires and beliefs, progressing through understanding of ignorance and false belief, and culminating in a grasp of intentional emotional concealment. Our new sample of 23 late-signing deaf children, together with similar children in Peterson et al. (2005), constitute a total sample of 59 deaf children from hearing families. They progress through the same developmental sequence of five steps, albeit at a slower rate than their hearing peers. That they exhibit the same sequence as hearing children is important for our understandings of ToM and for our understanding of social development, amidst delay, for deaf children.

At the same time, we demonstrate a salient and intriguing difference, revealed by our extending a focus on ToM sequences to include the understanding of social pretence. Given the carefully chosen tasks we used, awareness of pretending as a subjective, socially shared-unshared mental state developed as a reliable, distinctive step in the ToM sequence. Furthermore this development preceded false belief for both hearing and deaf children. The sequential position of this type of pretence understanding before false belief, while novel for deaf children, is consistent with several previous studies of hearing preschoolers (e.g., Custer, 1996; Gopnik & Slaughter, 1991; Hickling et al., 1997). However, comparing deaf with hearing children, there are two important differences: understanding of pretence occurs at a later *age* for the deaf than the hearing, but earlier *within the sequence* of emerging understandings for deaf than hearing children. Such a difference is understandable, based on the assumptions (a) that social-interactive experiences (and conversation) about pretence differ for deaf and hearing child and (b) that social-interactive experiences significantly influence the achievement of ToM understanding.

It is easy to understand the later age of emergence for pretence understanding in deaf children. Pretence merely takes its place alongside other ToM understandings that are all delayed in deaf children. We can only speculate as to what accounts for its earlier position in deaf children’s sequence. Harris (2005) suggested that pretend play and speech might interact in mutually compensatory ways to facilitate children’s ToM development. On one hand, children who have advanced language skills and rich exposure to family talk about serious mental states may not need pretend play. Their ToM development is likely to advance rapidly anyway via the rich parental conversational input about real-life feelings, desires and belief that is a longitudinal predictor (e.g., Ruffman, Slade, & Crowe, 2002; Taumoepeau & Ruffman, 2006) of their precocious insights into others' minds. However for language-delayed children, and deaf children without any signing family conversational partners, social pretending could serve a crucial compensating function as a stepping stone into a grasp of serious contrary-to-fact mental states like ignorance or false belief. Relatedly, as outlined earlier, sharing pretence stipulations with others may often proceed in largely nonverbal ways via gesture, pantomime, or toy manipulation. Indeed, simple pretence stipulations may occur as easily via gestures as with words. This could facilitate deaf children's social involvement in pretending and make it a more congenial medium than language for the social sharing of mental states with family and playmates. If so, nonverbal exchanges of fictional states of mind with others during pretend play might be an especially early and important venue for learning about mental states for deaf children. "Early" deserves care here, because deaf children are older on average when they evidence this understanding of pretence, but it is earlier in relation to other ToM understandings for them.

It is important to note several limitations of our research. For pragmatic reasons we used only a single pretend task. Of course, pretence understandings themselves are various and presumably occur in a progression of increasing development (see Harris & Kavanaugh, 1993). Indeed, other research with typical preschoolers has identified aspects of pretence understandings that develop considerably *later* than false belief (e.g., Lillard, 1993; Richert & Lillard, 2002). Given we limited ourselves to a single pretence assessment, because many studies now suggest that socially-shared pretence might aid subsequent ToM acquisitions, and to achieve comparable formats across our tasks, we chose a pretence task with a social focus and one that paralleled standard changed-contents false belief tasks.

In addition, it is important to emphasize that the empirical fact of statistically reliable sequentiality does not necessarily imply a cause-effect relationship between earlier and later steps in the ToM sequence. Our data do not confirm that earlier social-pretence understandings are necessary or influential in shaping later theory of mind understanding (such as false belief or hidden emotion) for deaf or for hearing children. Longitudinal evidence and, especially, systematic training studies are needed to establish such causal conclusions. However, careful data as to consistent sequences (among carefully chosen, comparable tasks within a targeted domain of understanding) helpfully inform and constrain such training studies. If understanding A reliably *succeeds* understanding B it is implausible that it shapes and causes B; if it reliably *precedes* understanding B it becomes a plausible candidate for training research.

In this regard our finding that understanding of socially-shared pretence may appear reliably "early" for deaf children within a more comprehensive sequence of ToM understandings has not only theoretical but also practical import. Specifically, our data suggest the possibility of using socially shared pretence experiences and structured pretence-elicitation tasks to boost deaf children's (admittedly) delayed ToM understanding and skills. However, in advance of data such as ours, such a training study was non-obvious and possibly counter-indicated. After all, considerable data demonstrate important delays in deaf children's participation in pretence relative to rapid, robust development in hearing children (e.g., Brown et al. 1997; Spencer, Deyo, & Grindstaff, 1990). Nonetheless, our data now show a level of pretence understanding that develops in advance of other important ToM understandings, and so might serve to aid those later attainments. In this vein, the present 6-step ToM scale (with five of its steps now validated across several studies) could prove to be a particularly promising empirical tool for designing training research, aimed at theoretical and/or practical concerns. The scale provides a blueprint of sequenced understandings that could be used to build on one another, and provides a reliable, extended measuring device for assessing systematic gains. The spread of the scale could prove especially advantageous for assessing short-term improvements in delayed groups (like late-signing deaf children or those with autism) who may require over 10 years to achieve the traditional ToM criterion (false belief) that hearing children master in half that time.

From a broad theoretical perspective, our findings combine with the results of a recent study by Wellman, Fang, Liu, Zhu and Liu (2006). In a cross-cultural comparison they report a reversal of sequence for two steps within the 5-step ToM scale between children in China versus English-speaking preschoolers in the U.S.A. and Australia. (Diverse beliefs emerged earlier than knowledge-access in the English speakers' sequence whereas knowledge-access emerged earlier than diverse beliefs for the Chinese children). We report a reversal of sequence between deaf and hearing children; and not just any reversal, but one highlighted in advance from prior considerations as to the role of pretence in ToM understandings. Our data, along with theirs, emphasize a central role for children's early social and conversational experiences for the acquisition of theory of mind understandings. In accord with the importance of such experiences, children growing up in different cultures (like China versus the U.S.A.) or in different social-conversational environments within the same culture (like deaf children in hearing versus signing families or late signers versus their hearing siblings) are distinguished not just by delays or advances but by theoretically targeted divergent developmental sequences. Our data thus provide important support for descriptions of social cognition that attempt to blend cultural and social-interactive learning influences with universal conceptual acquisitions for key cognitive developments of childhood (Schweder et al., 2006) and in particular false belief and ToM understanding.

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Table 1

Numbers (and percentages) of children passing ToM tasks in the present sample (*plus previously*)*

Task: Group:	**Diverse Desires (DD)**	**Diverse Beliefs (DB)**	**Social Pretend (SP)**	**Knowledge Access (KA)**	**False Belief (FB)**	**Hidden Emotion (HE)**
Present Deaf (n = 33)	30 (91%)	29 (88%)	18 (54%)	12 (36%)	9 (27%)	6 (18%)
Total Deaf (n = 59)*	*54 (92%)*	*53 (90%)*	*N/A*	*25 (42%)*	*17 (29%)*	*12 (20%)*
Present Hearing (n = 60)	58 (97%)	52 (87%)	36 (60%)	48 (80%)	17 (28%)	7 (12%)

* Includes n = 26 late-signers tested by Peterson et al. (2005) who were not included in the present study