Cognitive Development 29 (2014) 41–49

Contents lists available at ScienceDirect

Cognitive Development

Mental state language and quality of conversational experience in deaf and hearing children

Gary Morgan[a,b,*,1], Marek Meristo[c,d,**,1], Wolfgang Mann[a,b], Erland Hjelmquist[c], Luca Surian[d], Michael Siegal[e,2]

[a] City University London, United Kingdom
[b] DCAL Research Centre, United Kingdom
[c] University of Gothenburg, Sweden
[d] University of Trento, Italy
[e] University of Sheffield, United Kingdom

ARTICLE INFO

Keywords:
Deaf
Social cognition
Conversation

ABSTRACT

Deaf children of hearing parents show a protracted delay in performance on 'theory of mind' measures that suggests they encounter difficulties in acquiring knowledge of false beliefs and other mental states. Considerable evidence indicates that children's early experience of adults' mental state talk predicts their later social-cognitive development. However, no previous study has analyzed very young deaf children's access to conversation about mental states. We compared the conversational turn-taking and input of hearing parents to deaf and hearing children aged 17–35 months in the UK and Sweden. Mothers of hearing children used far more cognitive mental state language with their infants and their conversations were characterized by more communicatively effective turn-taking than mothers of deaf children. Across two different cultures, these findings indicate that conversations differ significantly in these aspects of interaction thought to be crucial for later social-cognitive development.

* Corresponding author at: Department of Language and Communication Science, City University London, Northampton Square, London, EC1VOHB, UK. Tel.: +44 207 040 8291.
** Corresponding author at: Department of Psychology, University of Gothenburg, Box 500, 405 30 Göteborg, Sweden.
E-mail addresses: g.morgan@city.ac.uk (G. Morgan), marek.meristo@gu.se (M. Meristo).

[1] These authors contributed equally to the research.

[2] We wish to dedicate this paper to Michael Siegal, who passed away February 20th, 2012, for his support and encouragement in our research and wider lives.

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http://dx.doi.org/10.1016/j.cogdev.2013.10.002

1. Mental state language and quality of conversational experience in deaf and hearing children

Exposure to mental state language and interaction with adults are crucial factors in the early development of social cognition. Caregivers' attunement to their infants' thoughts and feelings – their so-called "mind-mindedness" (Meins et al., 2002) – predicts children's subsequent social-cognitive and social-emotional development, including performance on verbal elicited-response Theory of Mind (ToM) tasks. Similarly, Ruffman, Slade, and Crowe (2002) and Taumoepeau and Ruffman (2006) have reported that mothers' references to mental states directed at children during the second year of life are correlated with their children's later mental state language and emotion understanding. At the same time, the connectedness of the conversations between caregivers and infants is important. Ensor and Hughes (2008) coded video transcripts of observations of family interaction for quantity, connectedness, and content of mothers' and children's talk. Mothers' connected turns (i.e., utterances semantically related to the child's prior utterance) and mental-state references within connected turns with their 2-year-olds were independently associated with measures of children's social-cognitive understanding.

These findings indicate that early interaction including the mental state content of conversations and the quality of the interaction between child and adult are some of the environmental contributions to children's social cognitive development. An extreme illustration of the importance of such factors comes from studies of children born deaf but raised by hearing parents who themselves are not fluent users of sign language. In the early stages of social-cognitive development these children, even with early cochlear implants, might experience a different quality of conversation and interaction while their parents adapt to their infant's deafness. Many previous studies have reported that deaf children age 4 and older from hearing families who do not use sign language effectively display a protracted delay in Theory of Mind (ToM) reasoning on explicit tests (Courtin & Melot, 2005; Figueras-Costa & Harris, 2001; Meristo, Hjelmquist, Surian, & Siegal, 2012; Morgan & Kegl, 2006; Peterson & Siegal, 1995, 1999, 2000; Pyers & Senghas, 2009; Schick, de Villiers, de Villiers, & Hoffmeister, 2007; Woolfe, Want, & Siegal, 2002).

It is not the case that deaf children from hearing parents have an impaired ToM like that identified in children with autism. Instead, the typical trajectory of development is delayed, with children acquiring the false belief concept several years after their hearing peers, although there may be an upper limit on this delay (Marschark, Green, Hindmarsh, & Walker, 2000; Morgan & Kegl, 2006).

Methodologies exploiting spontaneous visual preferences measures and anticipatory gaze have demonstrated that children as young as 13 months behave consistently with the hypothesis that they understand false belief in other minds (Baillargeon, Scott, & He, 2010; Surian & Geraci, 2011). Consistent evidence is also provided by studies on infants' spontaneous pointing gestures and helping behaviour (Buttelmann, Carpenter, & Tomasello, 2009; Southgate, Chevallier, & Csibra, 2010). Using eye tracking methods with deaf infants from hearing parents, a recent study reported more difficulties understanding false belief in 2-year-old deaf children compared with 2-year-old hearing children (Meristo, Morgan, et al., 2012).

The ToM delay may be related to deaf children's difficulties in conversational understanding (Surian, Tedoldi, & Siegal, 2010), but it does not extend to other areas of cognitive development and does not affect deaf children from deaf families who are exposed to a signed language from birth that provides continual access to a language environment (Meristo, Hjelmquist, & Morgan, 2012; Meristo, Morgan, et al., 2012; Remmel, Bettger, & Weinberg, 2001; Siegal & Peterson, 2008). So why do deaf infants with hearing parents show early signs of delay in social-cognitive development? Performance on elicited-response theory of mind tests in both typically developing hearing and deaf children around 4–5 years of age is influenced by language development (Milligan, Astington, & Dack, 2007; Schick et al., 2007). Thus, language skills may be the crucial ingredient for explicit ToM assessments, but as recent studies of spontaneous ToM abilities have shown, social-cognitive abilities can be observed several months before children use language. Therefore, it is possible that more general features of early communication play a role in the first stages of social-cognitive development rather than the child's language skills.

Social-cognitive and social emotional understanding in typically developing hearing children has been linked to family conversational input about mental states (Brown, Donelan-McCall, & Dunn, 1996; Meins et al., 2002; Slaughter & Peterson, 2012; Slaughter, Peterson, & Mackintosh, 2007). Access to mental state language during interaction between mothers and deaf children aged 4–10 years was identified as an important predictor of ToM development (Moeller & Schick, 2006). Generally, 4–10-year-olds should pass ToM tasks, so it would be of interest to know what the children in Moeller & Schick's study had as? conversational experiences when they were much younger.

Examining conversational input and communicative interaction between hearing parents and very young children may help to identify the origins of subsequent social-cognitive delays in deaf children. In the current study we examined the content and interactional quality of maternal mental state language directed at young deaf and hearing children. We made no specific prediction as to which of these two aspects of conversational input (turn-taking or language) is more influential for ToM development. It may be that mental state language and coherent conversation do not contribute independently to social cognitive understanding. This is because one is in fact linked to the other. For example, mental state language may be found primarily in coherent conversations contribute independently to social cognitive understanding; or that one is an artefact of the other, e.g., mental state language being found primarily in coherent conversations and so it is turn-taking that really matters.

We are confident that two factors are critical to social-cognitive development: mental state language (Taumoepeau & Ruffman, 2006) and turn-taking (Ensor & Hughes, 2008). By examining early experiences of a group of children who will likely experience delays in ToM understanding, we can both support a rich body of previous research as well and identify possible origins of social-cognitive delays in this group. It is also true that the language children produce affects the complexity of conversation their parents will engage them in. Language development is highly variable among deaf children, and by examining the effects of child language on parent input we can look more closely at the impact of deafness and communication skills on child–adult interaction.

We were also interested in the effects of different language and cultural environments on children's early conversational experience. We examine this by comparing infants and toddlers from the UK and Sweden. Both countries have a strong record in early identification of deafness and subsequent remediation services. Hence, we will be able to evaluate development in children who experience both early and high quality intervention.

2. Methods

2.1. Participants

The Swedish sample consisted of 10 hearing infants (four female) and 10 deaf infants (six female), all of whom had hearing parents. Seven mothers and five fathers had University level education and the remaining had graduated from secondary school. Nine sets of parents were monolingual Swedish speakers. The mean age of the hearing group was 23 months (range 19–28 months). Mean age of the deaf infants was 23 months (range 17–26 months). They were healthy and without known additional disabilities such as cerebral palsy, autism, mental retardation, or visual impairment.

Of the Swedish deaf infants, five used cochlear implants (CI) and five used hearing amplifications (HA). The CI children had pre-implant hearing levels in the range of 65–120 dB hearing loss. Mean age of implantation was 14 months (range 12–19 months) and mean time since implantation was 7 months (range 1–12 months). The HA children had hearing levels in the moderately to severely deaf range (50–80 dB hearing loss). Mean age of amplification was 12 months (range 3–26 months) and mean time since first use of HA was 14 months (range 1–21 months). The deaf infants had hearing parents who had gained some acquaintance with Swedish Sign Language (SSL) and communicated with the infants in spoken Swedish supported with signs. Language comprehension scores in SSL were measured by an SSL adaptation of the MacArthur-Bates Communicative Development Inventories for British Sign Language (Woolfe, Herman, Roy, & Woll, 2010), and for spoken Swedish we used the Swedish version of the Reynell for comprehension (Uhlén, Bergman, Hägg, & Eriksson, 2005). One child (DoH8) was not tested on signs. There was a great deal of group variation ranging from 0 to 285

signs in comprehension ($M = 90.7$, SD = 94.3), and 0–180 signs in production ($M = 47.1$, SD = 58.8); for spoken Swedish, comprehension ranged from 0 to 19 words ($M = 7.1$, SD = 7.7).

In the deaf group, two infants had two older siblings (age range 4–7). In the hearing group, three infants each had one older sibling (age range 5–13). One infant in each group had a 2-month-old younger sibling. Five other infants were initially tested and excluded because they did not cooperate during the visit (one deaf and four hearing children). The UK sample consisted of 20 deaf children (10 female) and nine hearing children (five female) from hearing parents. Thirteen mothers and 12 fathers had University level education and the remaining had graduated from secondary school. Eighteen sets of parents were monolingual English speakers. For the deaf children, mean age at time of first testing visit was 28 months (range 22–35 months) and for hearing children mean age at first visit was 28 months (range 20–35 months). The British sample was significantly older than the Swedish one, $t(28) = 3.34$, $p = .002$ for deaf children, and $t(17) = 2.06$, $p = .055$ for hearing children. They were healthy and without known additional disabilities such as autism, mental retardation, or visual impairment.

Of the 20 deaf children, 16 had CIs and four had HAs at the time of testing. The CI children had pre-implant hearing levels in the range of 80 to >140 dB of hearing loss. Mean age of implantation was 18 months (range 12–29 months), and mean time since implantation was 11 months (range 1–19 months). The HA children had hearing levels in the moderately to severely deaf range (50–80 dB of hearing loss). Mean age of amplification was 4 months (range 1–10 months) and mean time since first use of HA was 24 months (range 12–31 months). All deaf children had hearing parents who had minimal familiarity with British Sign Language (BSL). The children's language scores were assessed using the BSL and English MacArthur Bates CDI (Woolfe et al., 2010). Language scores in BSL ranged from 20 to 481 signs ($M = 195.43$, SD = 138.50) in comprehension and from 8 to 372 signs ($M = 112.50$, SD = 101.32) in production ($N = 14$). Participants' English scores ranged from 4 to 393 words ($M = 236.42$, SD = 113.83) in comprehension and from 3 to 316 words ($M = 144.89$, SD = 97.52) in production ($N = 19$).

Three other children were excluded: Two children did not cooperate during the first testing visit and one child had cerebral palsy.

In the hearing group recruited from preschools located in the London area, two children had younger siblings (age range 2–9 months), and one of these two children also had an older sibling (8 years). In the deaf group, 11 had 1–3 older siblings (age range 4–9 years and four had one younger sibling (age range 5–12 months).

2.2. Procedure

Mothers (in both Sweden and the UK) were given 10 pictures portraying emotionally charged or mentalistic situations such as a father scolding his son or a boy clapping his hands after building a tower of blocks (Ruffman et al., 2002). In a video-recorded session, the mother was asked to look at the pictures together and talk (using any form of spoken, signed or gestural communication they wished) with the child about what they saw.

Mental state terms. Using the method devised by Ensor and Hughes (2008), mothers' language use was analyzed for mental state categories. Categories included all references to cognitive terms (e.g. "think" or "know"), emotions (e.g., "happy", "pleased", "sad", "worried" or "bored"), and desires (e.g., "want", "like", "don't like" or "hope").

Conversational quality. Also following the method devised by Ensor and Hughes (2008), mothers' language was analyzed for quality of conversational turns. Each conversational turn – defined as the utterances of one speaker bounded by another speaker's utterances – in the mother–child conversation was classified as connected, initiated, failed or unclear. Connected turns were defined as all utterances semantically related to the other interlocutor's previous turn. A turn was categorized as initiated when the speaker initiated a new topic unrelated to the previous turn and successful in eliciting a semantically related response from the other. Failed turns were coded as turns that were directed to the other interlocutor but failed to elicit a semantically related response. Utterances that were not understandable were classified as unclear. An additional category from Hughes and Ensor, conflictual turns, was excluded since these were infrequent and could be included as one of the other four categories. To establish interrater reliability, two independent coders transcribed 10% of parental

Table 1
Means and standard deviations for measures of parental mental state talk and turn-taking for the Swedish sample (with percentages in parentheses).

Measure	Deaf ($N = 10$)		Hearing ($N = 10$)	
	M	SD	*M*	SD
Child age (months)	23.08	3.43	23.41	2.93
Time (min)	8.76	5.26	7.85	3.57
Total utterances (words)	728.30	509.38	501.90	306.91
Total mental state words	14.00 (2.26)	9.01 (1.02)	16.60 (3.15)	12.61 (1.56)
Cognitive references*	5.70 (0.83)	5.31 (0.72)	11.30 (1.96)	9.65 (1.46)
Desire references	2.60 (0.33)	2.50 (0.36)	1.80 (0.44)	1.32 (0.35)
Emotion references	5.70 (1.05)	3.97 (0.73)	3.60 (0.77)	3.50 (0.79)
Total number of turns	148.80	133.23	161.70	80.42
Mean length of turns	10.08	3.46	7.62	4.14
Connected turns**	37.90 (19.47)	56.25 (14.00)	75.50 (43.00)	46.34 (20.84)
Initiated turns*	15.80 (9.07)	19.89 (4.75)	30.50 (17.60)	18.77 (8.50)
Failed turns**	95.10 (71.31)	73.90 (18.73)	55.40 (39.06)	32.80 (28.15)
Unclear	0.50 (0.14)	1.27 (0.36)	0.40 (0.34)	0.97 (0.87)

* $p < .05$.
** $p < .01$.

Table 2
Means and standard deviations for measures of parental mental state talk and turn-taking for the UK sample (with percentages in parentheses).

Measure	Deaf ($N = 20$)		Hearing ($N = 9$)	
	M	SD	*M*	SD
Child age (months)	28.15	4.12	27.56	5.57
Time (min)	7.24	3.69	7.34	3.61
Total utterances (words)	497.95	312.59	711.00	181.48
Total mental state words*	14.05 (3.30)	12.51 (2.70)	42.22 (5.55)	28.36 (2.48)
Cognitive references**	8.10 (1.44)	9.55 (1.37)	31.67 (4.08)	24.96 (2.31)
Desire references	3.65 (1.10)	4.88 (2.61)	4.78 (0.67)	3.99 (0.59)
Emotion references	2.30 (0.76)	3.56 (1.59)	5.78 (0.79)	2.86 (0.26)
Total number of turns	58.05	36.85	81.89	57.91
Mean length of turns	12.80	19.72	13.11	10.22
Connected turns*	29.75 (44.93)	23.82 (18.99)	63.56 (65.88)	56.19 (24.66)
Initiated turns	16.55 (36.23)	7.72 (20.47)	13.56 (24.82)	3.84 (18.72)
Failed turns	1.30 (1.56)	3.21 (3.27)	0.44 (1.02)	0.88 (2.18)
Unclear*	10.75 (18.81)	8.16 (12.11)	4.33 (8.28)	3.46 (6.84)

* $p < .05$.
** $p < .01$.

conversations. Cohen's kappa was 1.0 for the mental state categories involving cognitions, desires, and emotions, and .97 for the quality of conversational turns.

3. Results

Scores for maternal mental state talk and turn-taking in the Swedish and British samples are shown in Tables 1 and 2. To control for maternal verbosity, we calculated proportions of each type of reference in relation to total number of words used by the mother, and proportions of each type of turn in relation to goal number of turns. The British hearing group's mean (42.22) was much higher than that of the Swedish hearing group's mean (16.60), $t(17) = 2.59$; $p = .019$. This difference presumably reflects cultural differences as well as age differences across cultures.

Mental state language. The mean numbers of minutes devoted to conversations about the pictures by the mothers of deaf and hearing children respectively were 8.76 (SD = 5.26) and 7.85 (SD = 3.57) in Sweden and 7.24 (SD = 3.69) and 7.34 (SD = 3.61) in the UK. These times were not significantly different for either location ($p > 655$, and $p > .948$). The number of words used by the parents during the task was 728 for the deaf and 502 for the hearing group in Sweden ($p > .244$), and 498 for the deaf and 711 for the hearing group in the UK ($p > .069$).

For each sample, a 2 (group: deaf children vs. hearing children) × 3 (content: cognitive vs. desire vs. emotion references) analysis of variance (ANOVA) was conducted to examine differences in mental state language across groups. Children develop understanding of some mental states before others – first desire, then emotion, then beliefs (Peterson, Wellman, & Slaughter, 2012). For Swedish infants, there was a main effect for content, $F(2, 36) = 7.15$, $p < .002$, $\eta_p^2 = .28$, and a significant group × content interaction, $F(2, 36) = 3.75$, $p < .033$, $\eta_p^2 = .17$. Parents of hearing infants referred to cognitions more often than did those of deaf infants, $t(18) = 2.19$, $p < .042$, $\eta^2 = .21$. There were no differences between groups in references to desires ($p > .513$) or emotions ($p > .423$). Similarly, for the British sample, there was a significant main effect for content, $F(2, 54) = 8.49$, $p < .001$, $\eta_p^2 = .24$, and a group × content interaction, $F(2, 54) = 4.67$, $p < .013$, $\eta_p^2 = .15$. Mothers of hearing children again referred to cognitions more often than those of deaf infants, $t(27) = 3.86$, $p < .001$, $\eta^2 = .36$. There were no differences between groups in references to desires ($p > .632$) or emotions ($p > .949$).

3.1. Within-group analyses for the use of mental state language

For the Swedish sample, mothers of hearing infants referred to cognitions significantly more often than to desires, $t(9) = 3.32$, $p < .009$, $\eta^2 = .55$. There was also a trend towards using more cognitive references than emotions, $t(9) = 2.19$, $p = .056$, $\eta^2 = .35$, but no significant difference in use of desire and emotion references, $t(9) = 1.02$, $p > .333$, $\eta^2 = .10$. By contrast, mothers of deaf infants used references to cognitions and emotions equally, $p > .547$, but referred less often to desires than both cognitions $t(9) = 2.32$, $p < .045$, $\eta^2 = .37$, and emotions $t(9) = 2.82$, $p < .020$, $\eta^2 = .47$. There was a significant correlation between mothers' proportional references to cognitions and children's age in the hearing group, $r = .55$, $p < .05$ (one-tailed). In the deaf group, there were no significant correlations between age and any of the measures of mothers' references.

For the British hearing sample, mothers again referred to cognitions significantly more often than to desires, $t(8) = 4.14$, $p < .003$, $\eta^2 = .68$, and emotions, $t(8) = 4.53$, $p < .002$, $\eta^2 = .72$. There were no significant differences in the deaf group in the usage of different mental state verbs. The correlation between references to cognitions and children's age in the hearing group was $r = .81$, $n = 9$, $p < .005$ (one-tailed), but there were no significant correlations in the deaf group between any of the measures of mothers' references and children's age.

3.2. Turn-taking

To examine the quality of turn-taking in conversation, a 2 (group: deaf vs. hearing) × 3 (conversational turns: connected vs. initiated vs. failed) ANOVA was carried out for each sample on the proportions of each turn type (see Tables 1 and 2).

For the Swedish dyads, there was a significant main effect for conversational turns, $F(2, 36) = 18.88$, $p < .001$, $\eta_p^2 = .51$, as well as a group × conversational turns interaction $F(2, 36) = 8.92$, $p < .001$, $\eta_p^2 = .33$. Parent–hearing infant dyads had more connected turns, $t(18) = 2.96$, $p < .008$, $\eta^2 = .33$, and initiated turns, $t(18) = 2.77$, $p < .013$, $\eta^2 = .30$, than did parent–deaf infant dyads, while there were more failed turns among parent–deaf infant dyads than among parent–hearing infant dyads, $t(18) = 3.02$, $p < .007$, $\eta^2 = .34$. For parent–hearing infant dyads, turns were significantly more likely to be connected than initiated, $t(9) = 5.73$, $p < .001$, $\eta^2 = .78$; but equally likely to be connected or failed, $p > .805$. They were also equally likely to be initiated or failed, $p > .094$. For parent–deaf infant dyads, turns were more likely to be failed than connected, $t(9) = 5.01$, $p < .001$, $\eta^2 = .74$, or initiated, $t(9) = 8.39$, $p < .001$, $\eta^2 = .89$, and also significantly more likely to be connected than initiated, $t(9) = 3.52$, $p < .007$, $\eta^2 = .58$. For parent–deaf infant dyads, children's age was significantly related to the proportion of connected turns, $r = .72$, $n = 10$, $p < .05$ (two-tailed); initiated turns, $r = .72$, $n = 10$, $p < .05$ (two-tailed); and failed turns, $r = -.72$, $n = 10$, $p < .05$ (two-tailed). There were no correlations for the parent–hearing infant dyads between age and any of the conversational quality measures.

Similarly, for the British sample, the main effect for quality of turns was significant, $F(2, 54) = 44.60$, $p < .001$, $\eta_p^2 = .62$, and there was a group × quality interaction, $F(2, 54) = 4.12$, $p < .022$, $\eta_p^2 = .13$. The parent–hearing child dyads produced significantly more connected turns than did the parent–deaf child dyads, $t(27) = 2.51$, $p < .019$, $\eta_p^2 = .19$. There were no significant differences in initiated ($p > .166$)

or failed turns ($p > .657$). Among parent–hearing child dyads, turns were significantly more likely to be connected than initiated, $t(8) = 2.86$, $p < .021$, $\eta_p^2 = .51$, more likely to be connected than failed, $t(8) = 7.63$, $p < .001$, $\eta_p^2 = .88$, and more likely to be initiated than failed, $t(8) = 3.88$, $p < .005$, $\eta_p^2 = .65$. For the parent–deaf child dyads, turns were more likely to be connected than failed, $t(19) = 10.36$, $p < .001$, $\eta_p^2 = .85$, and more likely to be initiated than failed, $t(19) = 7.28$, $p < .001$, $\eta_p^2 = .74$. There were no differences in connected and initiated turns for the parent–deaf child dyads, $p > .324$. For parent–hearing child dyads, children's age was significantly positively related to the proportion of connected turns, $r = .74$, $n = 9$, $p < .05$ (two-tailed); and negatively related to the amount of initiated turns, $r = -.68$, $n = 9$, $p < .05$ (two-tailed). There were no correlations for the parent–deaf child dyads between the children's age and any of the conversational quality measures.

While the UK deaf group are older than the Swedish deaf group, we do not see any differences in the quality or content of conversation addressed to these children by their hearing mothers. We also examined both sets of UK and Swedish data for language as a variable in a correlation analysis and found no consistent patterns, which is probably because of the large amount of variation across children in both sets of data.

4. Discussion

Compared to mothers of hearing infants and children, mothers of deaf infants and young children used significantly less cognitive mental state language and their conversations were characterized by less communicatively effective turn-taking. By using exactly the same methods employed in previous research with hearing children, we were able to pinpoint the possible predictors of child social-cognitive development in the mothers' input (Ruffman et al., 2002). These findings are the first such demonstration of differences in social-cognitive related interaction with 2–3-year-old deaf children. Therefore, the impact of childhood deafness on mother–child interaction in areas thought to be crucial for future social-cognitive development are apparent early in life. The notion that deaf children of hearing parents experience reduced access to conversations about the mind (Peterson & Siegal, 1995) is supported by our data – conversations are less mentalistic and less connected between child and adult. Results from the Swedish and British samples were very similar, providing converging cross-cultural evidence for differences between mothers of deaf and hearing childern in their use of mental state language and their use of effective turn-taking. Children in the deaf group have cochlear implants, meaning they can access some sound, and some of the children have large vocabularies. Yet, their difficulties in interaction, clearly evident in conversation data for both the British and Swedish samples, suggest that conversational input received from the hearing parent, new to the experience of interacting with a deaf infant, is impoverished. We characterize this input (from hearing parent to deaf child) as typical for a hearing child of a younger age. Taumoepeau and Ruffman (2006) showed that parental talk about mental states changes as children progress through toddlerhood. Early on there is more talk about desires, and later there is more talk about cognition. We hypothesize that parents adapt their language to accommodate the child's perceived level of understanding, and this leads to simpler conversation with regard to mental state terms but cannot explain the limited nature of the conversational turn-taking. Further research is required to confirm this hypothesis. Even when the children have a CI and some hearing, it is apparent that fluid conversational interaction is more limited compared with hearing-hearing dyads of the same age.

While similar findings have been reported for parents of children with autism (Slaughter et al., 2007) and for much older deaf children who use sign language (Moeller & Schick, 2006), our study includes children who are being raised in mostly spoken language environments where parents do know some sign language in both cultures. We found a great deal of variation in the language skills of the deaf children in both their signed and spoken language comprehension and production. We found that despite some children having large vocabularies, the conversational experience they had was limited compared with same-age hearing children. Possibly, it is not only the child's vocabulary that is important but also the parent's perception of that child's conversational and cognitive abilities.

Parents use their native spoken languages but still produce a restricted amount of mental state language. Rather than characterizing socio-cognitive development as being a result of the child's linguistic skills, it is more accurate to claim that parent–child dyad's communication skill encourages

the parent to employ more sophisticated mental state language in conversation (Meristo, Hjelmquist, & Morgan, 2012). At this point we see both of these factors as contributing equally to the general ToM delays found in this population. It might be the case that early successful turn-taking is a prerequisite to language development and, later, parents will respond to this milestone by beginning to talk about mental states with their communicative and engaged children. Future research should address this question specifically by looking at younger deaf infants (perhaps at about 9–12 months) and early proto-conversations and reference establishment (Matthews, Behne, Lieven, & Tomasello, 2012).

While typically developing infants are not explicitly taught ToM abilities, they obviously do receive relevant input, since most go on to acquire a ToM. Through a continual process of communicative exchanges where child and adult engage in a culturally appropriate set of conversational turns, the processes underpinning belief attribution can be practiced and automatized. We do not maintain that hearing infants have a grasp of the meaning of terms for mental states but that, even at a very early age, they can benefit from the pragmatic context of verbal and gestural communication in joint attention when these terms are employed.

It could be said that the mothers in our sample with deaf children interacted entirely appropriately, as they matched their mind-minded talk to the language skills their offspring had developed. They did refer to emotions and desires but less often to epistemic mental states such as beliefs. This means that mothers may have adapted their language by using simplified conversations that are more appropriate for young children (Peterson et al., 2012). Characteristics of the deaf child drive conversation in that the words, gestures, and signs used by hearing parents in an effort to communicate on their level enable effective reference to concrete and observable concepts but inhibit reference to abstract notions such as beliefs.

If this were the only difference in our data, we might predict that as the child's language develops, parents would eventually begin to use more mental state language, as observed in older deaf children's interactions (Moeller & Schick, 2006). However, potentially more problematic is the reduced amount of connected conversation in deaf-child/hearing-mother dyads. Ensor and Hughes (2008) reported strong predictors of social-cognitive development come from the amount of connected conversation children experience.

It is striking that the deaf children in our study have very little exposure to well-connected conversation, they are not experiencing shared talk about joint references and, thus, they are having less time in a 'culture of minds' (Nelson, 2005). Moreover, unlike hearing infants (Akhtar, 2005), deaf infants cannot easily learn from overhearing conversations of others.

Only 2–5% of the total utterances made by participants in our hearing groups referred to cognitive mental states. This suggests that, for deaf children, just a small increase in talk about mental states could make an important difference. However, increasing language input may not be enough. Parents of deaf children communicate with children who might need more sequential processing of input when directing attention to an object or picture. This is relevant for planned social-cognitive interventions. Future early interventions for families with deaf children should include training in conversation about mental states as well as regular speech and language therapy that includes strategies for managing effective turn-taking during communication.

Acknowledgements

This investigation was supported by an EU 6th Framework Marie Curie Chair (Project ALACODE–Contract MEXC-CT-2005-024061) and grants from the Swedish Council for Working Life and Social Research (FAS dnr 2007-1088), the Economic and Social Research Council (Grant 620-28-600 Deafness, Cognition and Language Research Centre), and the Italian Ministry of Education PRIN 2009 programmes.

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