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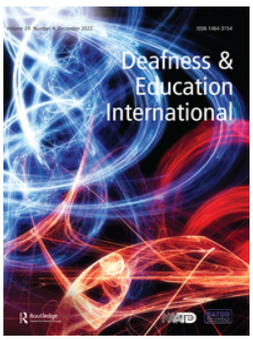

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Pragmatic development in deaf and hard of hearing children: A review

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ABSTRACT

Despite the advances in technology and sign language awareness, many Deaf and Hard of Hearing (DHH) children have language delays as a consequence of difficulty accessing a language model. These delays are often particularly pronounced in the domain of pragmatics, where the language user takes into account the people they are communicating with and their shared access to current context. This review considers the effect childhood deafness can have on pragmatic development, reviewing studies of the pre-linguistic stage, early linguistic communication and more advanced pragmatics as measured both by general pragmatic checklists and more specific assessments of information structure and inference, deception and non-literal language (including sarcasm), and conversation. Where present, delays are consistently explained by the cumulative effects of access to a fluent natural language model, which affects both the acquisition of linguistic forms and the social and cognitive skills needed to use them in interaction. Implications for educators are briefly considered.

KEYWORDS

Language; hard of hearing; learning; prelinguistic; information structure; referential communication; inference; narrative; discourse; conversation; irony; sarcasm; deception

Introduction

Despite advances in technology and increased sign language awareness, many Deaf and Hard of Hearing (DHH) children have language delays as a consequence of difficulty accessing a language model. These delays are often particularly pronounced in the domain of pragmatics, where the language user takes into account the people they are communicating with and their shared access to current context (Paul et al., 2020). Differences can be observed from the pre-linguistic stage, to early linguistic communication, and to later language use as measured both by general pragmatic checklists and more specific assessments of information structure and inference, deception and non-literal

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language (including sarcasm), and conversation. Where present, delays are consistently explained by the cumulative effects of limited access to a fluent natural language model, be it a signed or spoken natural language or both. Pragmatic skills set the stage for linguistic development, since tuning into one's interlocutor, their current endeavour and attentional state is important for understanding how words and sentences work. In turn, many linguistic devices are used specifically to manage perspectives and information flow between conversational partners. For example, pronouns like "*it*" are used when a referent is accessible to interlocutors and discourse connectives such as "*because*", "*however*" or "*so*" make the relations between utterances in a discourse clear.

In any given moment a DHH child might not access language, and interaction can break down as a consequence. However, a deeper explanation for delays and difficulties is that consistent limited access affects both the acquisition of linguistic forms, and the social and cognitive skills needed to use them (Most et al., 2010), including such resources as social cognition and theory of mind (Yu et al., 2021), temporal cognition (Eden & Leibovitz-Ganon, 2021), and memory and executive function (Marschark & Knoors, 2012; Pierce et al., 2017). In essence, pragmatic development must be conceptualised as the learning of a complex set of skills that draw on many other cognitive resources. Deafness does not just stand to affect children in the moment of using pragmatic skills, it can fundamentally affect how children acquire them in the first place. That is, when talking, the way in which a child (1) attends to and updates representations regarding the environment and their interlocutor and (2) draws on a still-developing set of linguistic tools, will shape what they take away from an interaction for the next time they strike up a conversation. Effective programmes to support DHH children, their families and friends appear to work by maximising everyone's insight into and practice with everyday interaction.

The following review first provides an overview of both pragmatic development and childhood deafness before considering the relation between the two. It will explore pre-linguistic communication and the linguistic pragmatic skills that gradually build up as children master the use of words, sentences and connected multi-sentential tracts of language. The studies reviewed have included a very diverse range of DHH children and their families and have explored development both with general check-lists that cover pragmatics broadly and with methods that focus on specific pragmatic skills including handling information structure, deceit and non-literal language (including sarcasm) and conversation.

An overview of pragmatic development

Children learn about language through participating in dialogue and bring to bear ever more sophisticated inferencing skills as their knowledge of communicative tools and linguistic forms expands. Early on, infants are quick to discover

that they can direct others' attention through gestures and vocalisations in coordination with eye-gaze, facial expressions, touch and so on. With this, they become able to initiate *joint attention,* the state where caregiver and infant are both attending to the same thing (e.g. an object, event or property) and are mutually aware that they are doing so. This is important as a primary function of language is to coordinate attentional states with others. Indeed, once they have a grasp of joint attention, infants soon learn that words (spoken or signed) allow them far more control over the process of getting their precise message across. They thereby break into conventional language, with all the expressive power that linguistic symbols afford.

Once they have practised using words for a while, they come to be able to put them together (e.g. to say or sign "*He's chasing Buster!*"). This increased grammatical sophistication not only allows them to convey complex *semantic* information, like agent-patient relations – in this example who's doing the chasing and who is being chased – but also complex *pragmatic* information, like information structure – in this example, that there is some "he" who is given and that the new thing we are commenting on is what he is doing, namely chasing Buster. Languages around the world (signed and spoken) use different tools to express semantic and pragmatic information (including word order, morphology and prosody, for example) and children need to figure out how their language or languages achieve the expression of different kinds of information, all with one linearly unfolding utterance.

As they are getting a grasp of grammar, children also start to understand that we can connect sentences together using expressions like "*and*", "*then*", "*but*" "*so*" or "*because*". As they master extended discourse and narrative, they become able to build whole mental models in other people's minds by linking sentences using connectives and anaphoric devices (like pronouns that refer back to something we mentioned earlier) and by presenting information in ordered, manageable chunks. They become increasingly sophisticated in understanding when someone else is building a model for them, and can make inferences to connect different utterances, together with world knowledge and common ground, as they strive for coherence.

This process of learning takes years but, from early on, children can be very playful with language, using it to joke or mess around. With time, they learn that language is not always used truthfully and become able to deceive people (an unpleasant but important development). They also learn how to twist language to highlight attributes of what they are talking about and make analogies or metaphors. Finally, the use of non-literal language reaches a pinnacle when children become able to use irony. For example, in the sarcastic utterance "*What a great prime minister we have!*", we can exploit common ground (e.g. perhaps we know she is not great at all) or normative expectations and say something deliberately incongruous in order to convey our attitude, often one of mockery or distancing.

A major challenge for children (and adults for that matter) is to use all these linguistic and communicative skills in the rapid fire of conversation, where a partner's message and social intent needs to be gleaned incrementally such that a reply can be planned for production as soon as a turn is given over. When this process breaks down, as it often does for everyone, repair processes need to be launched so we remain on the same page and engaged. Quick repair allows the conversation to flow on, with each person moving the topic forward gradually, sharing the floor in a way that is mutually enjoyable. Everyone has their own style when it comes to communicating, and there are cultural differences at the group level too, but some degree of competence with pragmatics is deeply important for children to take part in family, peer and wider societal relationships.

Deafness and language development

Deafness is common (e.g. approximately 1 in 500 babies in the US are born deaf or hard of hearing; National Center on Birth Defects and Developmental Disabilities, 2019) and often causes language delay including pragmatic delay. Audiologically speaking, how loud a sound needs to be before it is heard by the better ear is used to define degree of hearing loss, which ranges from mild (21–40 dB), moderate (41–70 dB), severe (71–95 dB) to profound (95 + dB) in the UK, with slight variations worldwide depending on country-specific classification systems.

Children in the mild-moderate range (hard of hearing) would struggle to hear a whispered conversation (about 30 decibels) whereas children in the severe-profound range (audiologically deaf) would not be able to hear a typical conversation (about 60 decibels). Regardless of audiological levels, individuals may or may not use a sign language or mix extensively in the Deaf community. Use of a capital D has traditionally been used to signal this community membership whereas the term deaf (with a lowercase d) or D/deaf tends to be used to include everyone, regardless of community membership (although see Kusters et al., 2017).

In recent decades, there has been greater recognition of the Deaf community, Deaf scholarship and the status of signed languages as having the full complexity of spoken languages (e.g. De Meulder et al., 2019). Some examples include British Sign Language (BSL), American Sign Language (ASL) and Language de Signes Française (LSF). All these sign languages are just as complex as spoken language with a phonology (in terms of hand configuration, location and movement Sandler, 2012) and grammar.

Alongside the recognition of these languages, there have also been advances in technology that led to the rollout of Newborn Hearing Screening programmes across the world since the early 2000s (resulting in early identification and thus earlier intervention for many deaf infants) and increasingly functional

hearing technologies such as hearing aids of different types, FM systems and cochlear implants. Children thus differ considerably in terms of the amount of time and the degree to which they have had access to communicative interaction (due to degree of hearing loss, accessibility of a spoken or fluently signed language model, age of diagnosis and intervention, and degree of intervention success). Altogether, these changes over recent history and the children's individual differences mean it is important when reading research in this area to attend to the time and place of research and the description of the specific group of children participating.

There is great diversity in the caregiving experiences of DHH children. The vast majority of DHH infants are born into hearing families who have little prior experience of deafness (Mitchell & Karchmer, 2004). For a number of reasons, the majority of these families have spoken language(s) as the main language of the home (e.g. English; Lederberg et al., 2013). Many also support spoken language use with an element of sign. For example, using Sign Supported English (SSE), where English is spoken and signs are simultaneously used following the syntax of the spoken language to provide visually accessible models of the spoken language. It is worth noting, however, that the signed component of sign supported speech such as SSE (or indeed of Alternative and Augmentative Communication systems such as Makaton) does not constitute a complete signed language and the use of these signs alone (in the absence of access to a full language) would not be expected to support the full breadth of cognitive development, although it might support communication in the moment and/or the longer-term acquisition of a spoken or signed language. In other words, children would ideally learn at least one "full" language.

Some parents are able to provide their children with access to both a fluent spoken language (e.g. English) and a fluent sign language (e.g. British Sign Language, BSL). While many would consider bimodal bilingualism an ideal outcome in terms of the opportunities it opens up for the child (i.e. the option to interact with hearing as well as D/deaf communities) and the sharing of communicative effort, this is a relatively rare outcome, since few parents are fluent in a sign language already (or can learn a new language to a high standard fast enough; DeLana et al., 2007) and access to other signing caregivers or peers is often limited. Of course, some DHH infants are born into a family with at least one fluent signing caregiver who interacts with the child on a regular basis. While this group is in the minority, it is worth noting that children who have regular access to a fluent signed language model typically learn sign language on roughly the same schedule as typically hearing children learning a spoken language (e.g. Petitto et al., 2001) such that there are no language delays nor knock-on delays in other domains of development such as social cognition (see, e.g. Schick et al., 2007; Yu et al., 2021 on language access and Theory of Mind). Some such children will still learn a spoken language.

Finally, once old enough, it is increasingly common for DHH children to attend mainstream schools. As a result, many will be the only deaf child in their class although some attend specialist schools or a mainstream school with specialist provision. Overall, the many differences in the communication preferences, personal circumstances, and capacities of DHH children's caregivers have implications for pragmatic development before children are old enough to make decisions for themselves about how they would like to communicate.

Given the many different paths a family might take, there has been significant debate regarding how to best support DHH children's language development (e.g. Spencer & Marschark, 2010). Some advocate for an aural-oral or auditory-verbal route based on findings that suggest focusing on verbal communication will maximise the chance of positive outcomes with the spoken language of the family and wider community (e.g. English; Geers et al., 2003; Dettman et al., 2013), although, the need for more robust evidence is recognised (Demers & Bergeron, 2019; Binos et al., 2021). Others note that using spoken language puts the burden of communication heavily onto the child (in that it prevents them from learning to communicate in a language that is perceptually easier to access for deaf people) and runs the risk of the child learning no language at all if, for example, a profoundly deaf child is unable to derive any benefit from a cochlear implant or other hearing technologies, resulting in language deprivation (Lillo-Martin et al., 2021). They thus recommend access to a signed language as a basic right (Murray, 2019). Some take a Total Communication (TC) approach and use any means, signed, spoken or other, to help a young child get their message across and understand others, although precisely how TC is defined and whether it provides access to a language model remains unclear (Mayer et al., 2016). In professional practice, many Teachers of Deaf Children and Speech and Language Therapists adapt recommendations given the particular resources, hopes and needs of the family (Rees et al., 2015).

Deaf children and adults themselves can contribute a valuable perspective in families' ongoing decision process by explaining their lived experience and what they might have preferred (Young et al., 2020). Overall, while there is a vast body of research on this topic, and many passionate advocates, there are many outstanding empirical and ethical questions regarding how best to support different DHH children, their families and friends. Progress in this field is hard won given the rapidly changing landscape noted above, the difficulty of running research with large numbers of families with very young infants and children at what is an emotionally vulnerable time for many, and the polarisation of some of the research and broader community. Studies therefore often comprise quite small and/or heterogeneous samples.

With these complexities in mind, below we will review some of the research on DHH children's pragmatic development and highlight key questions. We will start with differences in prelinguistic pragmatics before turning to early linguistic pragmatic skills (often measured with general checklists) and then

investigating specific advanced skills of managing information structure and making inferences, understanding deceit and non-literal language, and holding a conversation. Studies draw on a range of methods that are either intended to tap a specific skill or to give a broader overview of a child's pragmatic ability using a checklist. When such an overview of DHH children's pragmatic development is needed by professionals, Toe et al. (2020) recommend using two tools to provide as rounded a picture as possible, the Pragmatic Checklist (Goberis et al. 2012) and the Pragmatic Protocol (Prutting & Kittchner, 1987) which we will discuss in the relevant sections below.

Differences in prelinguistic pragmatics and early word learning

It is notable that early pragmatic delays as a consequence of childhood deafness are sometimes observed both in the vocal and the gestural modality. In one recent study (Kelly et al., 2020), 12- and 18-month-old deaf infants who were primarily learning a spoken language and did not have cochlear implants were observed to be delayed in the very pre-linguistic behaviours that are known to be predictors of spoken language, namely *give* and *show gestures*, *index finger pointing* and *gaze co-ordinated vocalisations*. The fact that even manual gestures appeared to be used less frequently suggests that pre-linguistic communication is not impacted solely because it is difficult to imitate signals in the vocal modality (see also Lichtert & Loncke, 2006). Rather, lack of access to sound when interacting with a caregiver who intuitively relies on it to regulate attention can disrupt the interactions in which infants learn to communicate. For example, hearing parents often use non-linguistic vocalisations such as gasps in temporal synchrony with action to regulate infants' attention. Such multimodal synchrony is understood to support learning (Gogate et al., 2000) but can be easily missed by DHH infants. Hearing parents often adapt sensitively to their children's needs (Gabouer et al., 2018; Lavelli et al., 2018) but generally do not do so as easily as fluent signing DHH parents who intuitively use visual or tactile strategies to achieve joint attention to a greater degree (Beatrijs et al., 2019; see Lammertink et al., 2022 for a review). In addition to receiving accessible synchronous multimodal cues, DHH infants with DHH parents also often learn to use the visual modality alone but in sequence to coordinate joint attention. These dyads (i.e. these caregiver-child pairs) learn to actively alternate visual attention to their partner and the topic of conversation, which supports communicative alignment (Lieberman et al., 2014; MacDonald et al., 2020; Spencer, 2000). The upshot of this is that deaf-deaf dyads and hearing-hearing dyads generally develop different but equally effective means of regulating joint attention. The risk for deaf-hearing dyads is that a mismatch in strategies can lead to communicative attempts that misfire or break down more easily (Bortfeld & Oghalai, 2020; Lederberg & Everhart, 2000). Indeed, a recent meta-analysis found that deaf-hearing dyads were less likely to successfully

initiate episodes of joint attention and tended to remain in joint attention for a shorter duration than hearing-hearing dyads (Lammertink et al., 2022). It is therefore important to test out hypotheses regarding how exactly early interactions are affected for deaf-hearing dyads, how they can be supported (e.g. with multi-modal synchrony and/or sequential use of a single modality) and how best to support the early stages of development for DHH infants given different family circumstances and additional needs, and given that even those who will have a cochlear implant (CI) will need to learn without one for many months of the first year of life when significant pragmatic development is taking place. Research to date suggests encouraging early, prelinguistic communication is important (both for communication and cognition more generally: Bavin et al., 2020; Fagan, 2019) and viable (Roberts, 2019).

As children move from communicating pre-linguistically to using language, synchrony between the child's attentional state and the caregiver's communicative acts continues to be important. A recent head-mounted eye-tracking study assessed the attentional states of five DHH infants aged 27–37 months who were matched with two groups of typically hearing infants for chronological age and hearing age respectively (Chen et al., 2019). It found that, even though across the groups caregivers named things equally and infants spent similar amounts of time in sustained attention, the *coordination* between caregiver naming and infant attention differed according to hearing status. Caregiver utterances that involved naming objects were more likely to be aligned with the children's attentional states for the two hearing groups. The authors suggest it may be possible to train caregivers to tune into children's attentional state and talk to them about what has already caught their attention. A recent feasibility study suggests this would be a good approach but that it needs to be carefully undertaken to ensure it has the intended effect (Kelly et al., 2022). In addition to considering parent adaptations, it would appear that DHH children this age who have hearing parents also adapt somewhat to the potential for mismatch by tracking their parent's attention not only by watching their hand movements (as matched typically hearing children do) but also by following their gaze (Chen et al., 2020). Further research is needed to establish to what extent such differences are signs of useful adaptation or signs of developmental delay (see also Mercure et al., 2018 for very early differences in infant allocation of attention to the eyes and mouth).

Differences in early linguistic pragmatics

Once children are starting to use conventional language, the general pattern found is that the more they have access to a language model, be it signed or spoken, the more pragmatic development, and language development more generally, benefits. Traditionally, studies have found that DHH children without easy access to a language model tend to produce fewer intentionally

communicative acts (particularly questions) than matched peers during the first four years of life (Nicholas & Geers, 1997). However, there is evidence that the earlier profoundly deaf children primarily learning a spoken language are able to access this language, the less delayed they are.

Thus, Guerzoni et al. (2015) asked parents of profoundly deaf children to complete an Italian version of the Social-Conversational Skills Rating Scale, rating their child's ability to assert and respond in dyadic interaction with them. The children all received Audio Verbal Therapy and a cochlear implant between 8 and 24 months. Their analyses suggest that the earlier the children received the implant, the better their age-scaled scores on the rating scale were one year after implant. The same was the case for vocabulary development, again suggesting pragmatic development and formal language development generally go hand in hand. Children in this study (who the authors note are not representative of the full diversity of deaf children) who received an implant within the first year of life scored similarly to typically hearing children.

A similar effect of access to a language model was reported by Goberis et al. (2012) who charted the pragmatic development of over 30 parent-reported skills in a large group of DHH children aged between 2 and 7 years. They found that the proportion of skills reported to have been "mastered" (expressed with complex language) on their Pragmatic Checklist (adapted from Simon, 1984) increased with age for all children but the pace of learning was slower for DHH children and was explained by degree of hearing loss (mild, moderate, severe or profound.). Typically hearing children in a comparison group had mastered 44% of items by 3 years of age and 95.5% of items by 4 years. For DHH children, items not generally mastered by 7 years included repairing incomplete sentences, requesting clarification, retelling a story, asking questions to problem solve, ending conversations, and making promises (a skill also late-acquired for typically hearing children). Some of these more advanced pragmatic skills have been studied in more detail, including managing information structure, understanding deceit and sarcasm, and engaging in conversation.

Differences in information structure and inferencing

Information structure concerns the use of language to convey information in a way that is sensitive to the purpose of the communicative exchange and the interlocutor's mental states, especially what they are aware of or can easily access from memory (Lambrecht, 1994; Roberts, 2012). It can be organised into two elements: information packaging and information status. *Information packaging* (Chafe, 1974) involves linking what is currently being said to the speaker's model of the world and the prior discourse – most importantly to the *topic* or the *Question Under Discussion*. *Information status* involves making the referents in a discourse identifiable and accessible by choosing appropriate referring expressions (e.g. saying "*my dog*" the first time this referent is

introduced but "*he*" thereafter). The development of information structure is relatively understudied for DHH children, and studies that do exist tend to focus on information status (e.g. using appropriate referring expressions to avoid or repair ambiguity) or else assess this as part of narrative development.

In one study of oral referential communication skills, Lloyd et al. (2005) used a task that required either giving or receiving instructions to put everyday items in a configuration determined by a set of photographs. They observed a developmental lag in the use of referring expressions for severe-profoundly deaf children aged between 7 and 12 years who used hearing aids or cochlear implants. Similarly in a study of 70 children with cochlear implants aged 5–13 years, Boons et al. (2013) observed difficulties with narrative production and selecting what content to include, although precisely how and why these differences manifested themselves would require further investigation.

The flipside of managing information structure when producing language is making inferences when comprehending it. Some studies of language comprehension suggest DHH children tend to have difficulty with making inferences. For example, Mastrantuono et al. (2019) found severely and profoundly deaf adolescents had difficulties that were particularly pronounced for predictive inferences. However, other studies of cochlear implant users report promising outcomes for tests of reading comprehension (Mayer et al., 2016). Overall, research in this area is in its early stages.

Differences in deceit and non-literal language

When it comes to handling deceit and non-literal language, there is evidence that many DHH children struggle well into later childhood and sometimes beyond (Gregory et al., 1995). Again, it is clear that access to language explains the extent of delay. For example, DHH children at risk of reduced language access have been observed to understand lies far later than typically hearing children, whereas DHH children learning British Sign Language, who had early access to a fluent and accessible language model, do not appear to show delays (Kelly et al., 2019; see also González-Cuenca & Linero, 2020).

The most challenging type of non-literal language, irony, is particularly affected by lack of access to a language model and delays in handling sarcasm have been observed right into adulthood (Gregory et al., 1995; O'Reilly et al., 2014). For the comprehension of both deception and irony, a major hurdle can be understanding the communicative intentions of the interlocutor, which involves mental state reasoning that itself can be delayed due to lack of access to conversation. For example, to understand that someone is being sarcastic when commenting "*what a great day for a picnic*" on a rainy day, one needs to be confident that the statement is not literally true, that the ironist is not mistaken, nor are they lying, that all of the facts are in common ground (i.e. shared and understood) and that the ironist's motivation

is to convey their attitude with dry humour. A high degree of confidence not only in how language is used but also in mental state understanding is required to pull this off (Winner, 1988).

Differences in conversation

Perhaps the most challenging pragmatic hurdle for DHH children is mastering extended discourse in the form of conversation. The fast flowing, unstructured exchanges taking place between peers with differing language access or preferences have received particular attention. As the nature of peer relationships shifts from play with the immediate surroundings to deeper relationships founded on shared values and moral support, the role of conversation becomes increasingly important. Indeed, social skills and pragmatics go hand in hand throughout childhood and even children with unilateral and mild hearing loss have been reported to struggle with social skills (Laugen et al., 2017).

There is an art to holding a good conversation. As well as having a broad social purpose (affiliative, practical, persuasive), the nuts and bolts involve appropriate turn taking (Casillas, 2014), good topic management (responding to the content of the previous turn to build on it or move along in an acceptable way; Abbot-Smith, Matthews, Malkin, Hobson, & Nice, in prep; Bloom et al., 1976), sharing the floor (usually this means not monologuing, being verbose or being entirely silent), and repair of communicative breakdowns (Church et al., 2017). The study of conversational skill has involved an especially broad set of methods, ranging from qualitative approaches such as Conversational Analysis (Filipi, 2014) to quantitative analysis of elicited conversation to parental questionnaire ratings. For DHH children, spoken conversation can be a challenge not only due to the immediate risks to auditory access but sometimes also because of cognitive or social delays (due to prior lack of access to language) and/or because of lack of experience in fast-flowing, free-ranging oral interaction (Most et al., 2010).

Research on the oral conversational skills of DHH children using cochlear implants reveals extremely mixed findings (Crowe & Dammeyer, 2021). This is likely due to variability in children's hearing and experiences, because different aspects of conversation are measured and because sample sizes are often small. While some studies report children performing in the normal range on standardised assessments and considerable growth in skills such as turn-taking over time, other observational studies report marked differences in middle childhood. For example, Paatsch and Toe (Paatsch & Toe, 2016; see also Toe & Paatsch, 2013) found that DHH children aged 8–12 years tended to ask more questions, initiate more topics and take longer turns when conversing with a hearing friend (compared to when two hearing friends conversed). It might be that some of these differences are a result of strategies that children have developed to avoid conversational breakdown. For example, it might feel easier to start a new topic rather than to constantly have to ask someone to

repeat themselves or clarify. Or holding the floor might reduce the opportunity for others to say something that may lead to a breakdown. Indeed, a particularly large study of 181 DHH 8-9-year-olds (Tye-Murray, 2003) found that cochlear implant users spent far more time than hearing peers in managing communication breakdowns, as well as in silence, and were judged less positively as a consequence. In that study, children's formal language comprehension and the intelligibility of their speech were the greatest protective factors from higher rates of breakdown. This is in line with the finding that bimodal bilingual children are more pragmatically advanced in the language in which they are also more linguistically advanced (Most, 2003).

A research tool that has proved especially valuable in this domain is the Pragmatic Protocol (Prutting & Kittchner, 1987), a 30-point checklist that Toe et al. (2020) recommend adapting for use alongside Goberi's et al.'s (2012) Pragmatic Checklist mentioned above to provide a rounded picture of DHH children's pragmatic development. To use the pragmatic protocol, a researcher observes a recording of a child in conversation and rates aspects of *verbal*, *paralinguistic* and *nonverbal* interaction as appropriate or inappropriate. For example, the verbal dimension of *contingency* is described as "An utterance that shares the same topic with a preceding utterance and that adds information to the prior communication act". Paralinguistic dimensions include vocal quality and intensity, intelligibility and prosody. Non-verbal dimensions include eye-contact, using gesture, physical proximity and posture. In their study of 24 DHH children who used oral language as their primary mode of communication (most of whom were diagnosed around 2 years and observed around 7 years), Most et al. (2010) found that DHH children were very similar to typically hearing peers in terms of the non-verbal and paralinguistic dimensions of conversation (except for speech intelligibility) but showed some marked differences for some verbal dimensions, most notably contingency, responding to listener speech acts and specificity (e.g. underspecifying referents leading to ambiguity). Of course, if a prior turn is not perceptually available, it is almost impossible to respond contingently and children may have developed all manner of ingenious techniques for circumventing this problem. Most and colleagues note this, but also consider other possible explanations for delayed or different pragmatic development including delayed language acquisition and social cognition, limited exposure to conversation with a variety of more-or-less supportive (vs demanding) partners, and limited opportunities for incidental learning from an onlooker perspective (see also Szarkowski et al., 2020). Further research is needed to understand where infelicities in conversation are due to momentary degraded access to conversation and where deeper difficulties arise (such as holding the floor to avoid problems or struggling to respond contingently in time due to lack of linguistic fluency).

In the long term, it is also quite possible that children's experience of adapting to the demands of oral conversation could result in strengths too.

Anecdotally, one prominent pragmatic researcher has noted they felt that being hard of hearing as a child sparked an interest in communication and unique insights into it (personal communication). Perhaps the frequent need to guess what might have been meant by what might have been said provides practice in the domain of inference. And perhaps bimodal bilingualism gives further insight into the arbitrary differences and possibilities of communication systems. Finally, it is possible that the value of picking up on any extra available information from non-verbal channels results in strengths in attending to or reading them. These speculations would need empirical investigation – a challenge given the need to control for confounding factors. Indeed, overall, a far more detailed picture of the range of strengths, weaknesses and differences is needed as is greater inclusion of pragmatics in the assessment and support of DHH children's language development, and in the education of all children so that they can share the effort – and reap the rewards – of communication across conversing partners (Szarkowski et al., 2020).

Summary and implications for education

To sum up, DHH children are a highly heterogenous group and have families who are also very different in terms of communication preferences, capacities and personal circumstances, all of which has implications for pragmatic development from infancy. Generally speaking, each step in pragmatic development is facilitated by experience of interaction and access to a fluent language model. Since pragmatic development is a cumulative learning process, lack of access at any stage can lead to delays both in "downstream" pragmatic skills and associated social and cognitive abilities. This can have consequences for social wellbeing that are felt keenly in the classroom, playground and beyond. Supporting children to thrive in such contexts requires deep insight into the nature of communicative development. Educators also require the time to be able to tune into everyday interactions between children, spot strengths and difficulties between conversational partners, and provide feedback or modelling to encourage interactions in a positive direction. It is likely that explicit meta-linguistic discussions about how we communicate and differences in communication preferences will also help children to better understand and adapt to each other. To date, there is relatively little evidence regarding how effective different pedagogical techniques are for promoting pragmatic development. Such an evidence base will require open collaboration between researchers, teachers, deaf adults, families, and children themselves.

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