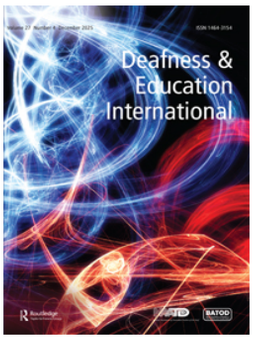

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The role of symbolic gestures in the path towards auditory rehabilitation of infants with hearing loss: a feasibility study

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ABSTRACT

Hearing parents of hard-of-hearing (HH) infants can adopt directive communicative styles that may hinder language development. Family-Centered Early Interventions (FCEI) promoting sensitive/didactic communication have shown promise in supporting infants' linguistic and cognitive outcomes. This feasibility study introduces a multimodal communication FCEI, where early auditory and speech rehabilitation is paired with a programme that incorporates symbolic gestures into everyday interactions. Seventeen families participated: nine underwent the FCEI, eight received only auditory rehabilitation. The FCEI involved workshops and hands-on sessions, with parent–child communication skills evaluated through videoanalyses. Feasibility was assessed via focus groups and through changes in parental communicative styles and infant communication. Results demonstrate multimodal FCEI's acceptability and practicality, with parents valuing its focus on communication before cochlear implantation. Improvements in constructive parental communicative styles were observed in the intervention group, though no changes in infant efficacy were noted. Challenges included group heterogeneity and parental concerns about communication development in HH infants. The need for long-term studies and comparison with other communicative FCEI are discussed.

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Introduction

When hard-of-hearing (HH) infants are born in hearing families, a variety of parental behaviours that can negatively impact communication may arise. Compared to hearing parent–child dyads, hearing parents of HH infants tend to become more directive (Barker et al., 2009), manifest interruptions to the child's attention, elicit language from their child through requests rather than conversations, and accomplish fewer and shorter moments of joint attention and vocal turn-taking (Barker et al., 2009; Lammertink et al., 2021). For the infant, these behaviours result in less communicative and linguistic stimulation, poorer interactions and less feedback from their communicative attempts (DesJardin & Eisenberg, 2007; Janjua et al., 2002; Smogorzewska & Osterhaus, 2023). Conversely, parental communicative styles that enhance infant's participation and attention positively contribute to a child's cognitive, communicative, and language development (Ambrose et al., 2015; Conway et al., 2018; Flynn & Masur, 2007; Hofer et al., 2008; Janjua et al., 2002; Mermelshtine & Barnes, 2016). Thus, enhancing such positive communicative styles should be as central as auditory rehabilitation when planning Family Centred Early Interventions (FCEI) for hearing parents of HH infants.

Parents' rediscovery of their parental role is an important part of a successful FCEI in the context of a hearing rehabilitation intervention (Lam-Cassettari et al., 2014). FCEI may be positively associated with language improvement HH infants (Curtin et al., 2021; Wright et al., 2021; Yoshinaga-Itano, 2003). It is possible to enhance parental communication by empowering parents with the use of specific communicative behaviours that have positive impact on infants' outcomes (Costa et al., 2019; Ferjan-Ramírez et al., 2020; Glanemann et al., 2013; Harrigan & Nikolopoulos, 2002; Lund, 2018; Nicastri et al., 2021; Roberts, 2019).

The present study aimed to explore the feasibility of a FCEI in which hearing parents complement their speech with symbolic gestures. It takes into consideration the guiding principles for FCEI in DHH children as described in the recent special issue of the Journal of Deaf Studies and Deaf Education, such as early intervention, family-EI provider relationship, family support, child well-being, trained FCEI-DHH providers, developmental assessment, and progress monitoring (Moeller et al., 2024).

Multimodal communication with speech and symbolic gestures

The proposal that infant-directed speech can be accompanied with symbolic gestures, in order to visually emphasize a particular word or a concept, was introduced in the 1980s (Acredolo & Goodwyn, 1985). The rationale is that such pairing can help infants learn words or concepts, and communicate them, before they can produce speech. These gestures were originally adapted from sign language and became known as "baby signs" (Acredolo &

Goodwyn, 1996). It is common to confuse baby signs (BS) with a simplified form of sign language (SL) directed at babies. SL are fully developed visual languages with distinct linguistic features that operate independently of spoken languages, i.e. not in combination with speech. They are used primarily (though not exclusively) by the Deaf community (e.g. Emmorey, 2023). In contrast, BS are always paired with spoken language and convey only lexical and semantic content. As such, BS should be understood as a multimodal support for spoken communication, rather than a fully developed language system.

In recent decades, a body of research evaluated the effects of word-gesture communication approaches in hearing infants with typical as well as atypical development (for a systematic review see Colombani et al., 2023). While some authors argue that the use of word-gesture combinations with prelingual infants cannot be definitively classified as "beneficial, harmful, or harmless" in language development (Johnston et al., 2005, p. 245; see also Fitzpatrick et al., 2014), others have highlighted significant positive effects of symbolic gestures on caregivers' communication and, in turn, language development (Amaral & Meneses, 2019; Sanchez, 2021), particularly in populations with atypical development (Dunst & Meter, 2011; Lederer & Battaglia, 2015).

Shaping parent-training to exploit the multimodal nature of human communication could be a key to supporting language development in HH infants. Given that focused attention enhances learning in infants (Poli et al., 2020), teaching parents to use symbolic gestures could be a tool to effectively centre the intervention on the child's attentional focus on one hand and elicit more consistent parental response to child's gestures on the other hand (Olson & Masur, 2015). Enhanced multimodal communication has the potential to reduce directive and intrusive communicative behaviours and enhance responsiveness and sensitivity in hearing parents of HH infants and thus support infants' cognitive, communicative, and language development (Ambrose et al., 2015; Flynn & Masur, 2007; Hofer et al., 2008; Janjua et al., 2002; Mermelshtine & Barnes, 2016; Vallotton, 2012).

The present study

To our knowledge, no FCEI based on the use of speech and symbolic gestures has been attempted with hearing parents of HH infants (Colombani et al., 2023). To encourage parents to consistently use both speech and gestures when interacting with their HH infant, a Family-Centered Early Intervention (FCEI) that includes baby signs (multimodal FCEI) was therefore recently developed. The present study was developed to assess the feasibility of such an approach in the clinical-audiological context.

The programme included a 3-hour workshop for parents, with theoretical and practical components, aimed at introducing the benefits of multimodal communication and integrating symbolic gestures into daily routines. Parents

were also offered five hands-on sessions to experiment with signs in playful contexts along with their infants. These sessions focused on five key areas of child development: feeding, sleep, interests, independence, and emotions. For each of these areas, theoretical frameworks were also provided to guide the parents' understanding and application of the signs. The multimodal FCEI developed over a time-period of 6–9 months.

The feasibility of the proposed parental intervention was systematically assessed (Bowen et al., 2009) through semi-structured focus groups with parents and professionals involved in the intervention, and through the preliminary assessment of the efficacy of the proposed FCEI. The focus groups aimed at qualitatively assessing participants' views regarding the acceptability, implementability, practicality, and possible future integrations and adaptations of the proposed multimodal FCEI (Bowen et al., 2009).

To provide preliminary efficacy testing of the intervention, communication abilities of families who underwent the multimodal FCEI (experimental group) were compared with comparable families participating in the regular activities of the audiological centre (control group). The analysis of both infant communicative effectiveness and parental communicative styles was conducted with the CC-CARE method (Child-Caregiver Communication Assessment method through Rebesco's Evaluation, Rebesco et al., 2024), which is based on the Tait's video analysis (Tait et al., 2007) and a detailed categorization of parental communicative styles in relation to linguistic outcomes (Bonifacio & Hvastja-Stefani, 2010; but see also Conway et al., 2018; Paavola-Ruotsalainen et al., 2018). Importantly, this method provides an objective view, as the data is collected through video analysis by an external collaborator rather than relying on family reports.

Methods

Participants

Seventeen infants and their families were recruited for the study through two hospitals in Italy (n = 14 in a pediatric and maternity hospital and n = 3 in an university hospital). Inclusion criteria were: presence of sensorineural hearing loss, absence of cognitive impairment, Italian as L1. Exclusion criteria were: progressive hearing loss, diagnosed cognitive impairment, single-side hearing loss, diagnosed visual impairment, and systematic use of sign language in the family environment. The case group (BS group) included 9 infants with moderate to profound hearing loss (6 female, 3 male; mean age at recruitment = 13.3 months, SD = 8.3). BS Group consisted of dyads of hearing parents and HH infants who underwent the multimodal FCEI. All of these participants had either received a cochlear implant or a hearing aid. The control group (CTRL group) consisted of 8 dyads of hearing parents and infants with profound

sensorineural hearing loss (3 female, 5 male; mean age at recruitment = 15.6 months, SD = 5.8, CI of the difference between groups = [−9.6 5.1]), all of whom had received bilateral cochlear implants. They did not undergo any parental training but were tested using the same CC-CARE methodology at three and at 12 months post implantation. All infants were regularly followed at their audiological clinic (i.e. in Trieste or Catania). Participating families were informed about the study and signed the informed consent prior to the beginning of the study. While sample size calculation was not performed for this feasibility study, the sample size was based on the number of newly recruited patients in the two clinics. The study was approved by the institutional scientific board in 2022. All methods were performed in accordance with the relevant guidelines and regulations (e.g. 1964 WMA Declaration of Helsinki and its later amendments). The testing took place in 2024.

Table 1 in Supplementary material provides information on the age of cochlear implant or hearing aid activation for each participant, the aetiology of their hearing loss and the education levels of infants' mothers.

Materials

Multimodal word-gesture parent training

The multimodal FCEI program was implemented based on the Italian adaptation of the Baby Signs® Program originally developed by Acredolo and Goodwyn (1996). The original programme focuses on providing caregivers with communication strategies to incorporate symbolic gestures into everyday interactions in conjunction with spoken language. The Italian adaptation, developed by the local provider, was modified to suit the Italian socio-linguistic context by selecting signs based on studies of early lexical development in Italian and incorporating signs from Italian sign language (LIS). The multimodal FCEI was structured in three phases: (1) the parent workshop, (2) the monitoring meeting, and (3) five practical sessions for both parents and infants (referred to as "Sign Say and Play" or SSP practicals, in Italian: Segna Canta e Gioca). Each activity was led by early-childhood professionals who held a specific certification issued by local provider.

The parent workshop was aimed at primary caregivers and lasts approximately three hours. It is designed as an interactive session in a small group setting. The objectives of the workshop include introducing the communication approach of the local provider (including its theoretical framework, research findings, and expected benefits), familiarizing participants with a set of around 32 signs, teaching strategies for introducing signs into everyday interactions with infants and engaging participants through role-playing exercises. The monitoring meeting, conducted in small groups and lasting about one hour, aims to address any challenges encountered during the programme's daily implementation. The final activity, the SSP practicals, consists of five

weekly sessions, each lasting 45 min. These sessions are specifically designed for the parent–child pair and focus on teaching 30 signs through playful, sensorimotor activities related to topics such as nutrition, sleep, autonomy, interests, and emotions.

Each family received a variety of materials integrated with signs to support their multimodal experience with the approach, including: three illustrated books, three photo books, a parent guide outlining key strategies for introducing signs, access to a video dictionary with LIS and Simplified Signs, six mini cartoons illustrating a sign, three songs, and printable A4 poster cards.

CC-CARE

CC-CARE method ("Early assessment of communicative competence in infants with hearing loss using the Child-Caregiver Communication Assessment through Rebesco's Evaluation"; see Rebesco et al., 2024 for a full and detailed description of the methodology) evaluates communicative functions in infants with hearing loss, and their hearing parents and was developed on the basis of Tait's video analysis (Tait et al., 2007). It enables the identification of communicative strengths and weaknesses in the parent–child dyad, provides a comprehensive description of single parameters and overall communicative functionality described by the Communicative Effectiveness Index (CEI). CC-care analysis has been carried out for all infants before starting the programme, and after attending both workshops.

CC-CARE describes *Linguistic parameters* (verbal part of communication), *Paralinguistic parameters* (turn taking, initiative, autonomy and eye contact), and *Metalinguistic parameters* (i.e. joint attention) all expressed in percentage scores and integrated into a weighted formula to compute CEI.

For assessing parental communication styles (PCS), i.e. *Relational parameters*, 5 categories were used following the classification of Bonifacio and Hvastja-Stefani (2010): (1) Tutorial style (parental behaviours that reinforce shared attention, including verbalizations, repetitions, and expansions designed to approve or support the child's actions and language); (2) Didactic, or supportive directive style (use of closed questions, naming objects, sometimes complex instructions, frequent requests for repetition and corrections); (3) Directive or controlling style (with the purpose of controlling or re-directing child's attention through interventions, or modifying child's action); (4) Conversational style, (use of open-ended questions, sometimes including self-responses, and with general empathetic comments aiming to share communication); (5) Asynchronous/devaluative style, (non-contingent intrusive behaviours such as overlapping turns, devaluations of the child's verbal or nonverbal behaviour, interruptions and introductions of new and unrelated activities, as well as missed responses and too complex linguistic input). PCSs are expressed in percentage scores.

Focus groups

To systematically gather information of the perceived feasibility of the intervention from parents and professionals, a focus group discussion was employed. This qualitative research method involves the moderator guiding discussion among participants within a group setting to gain insights into individuals' knowledge, perspectives, and attitudes. It is effective in collecting qualitative data where participants can build on each other's comments, stimulating thinking and discussion, and thereby generating ideas.

Parent focus group (Description). The Parent focus group was structured around feasibility questions, including parent satisfaction, usability and translational potential, organizational challenges, and difficulties encountered. The questions (Likert scale (1-5) or open-ended) were designed to progress from one topic to another, transitioning from general to specific issues. To enhance engagement and innovation, create a dynamic atmosphere and minimize parents' feelings of being judged, interactive digital tools (such as Mentimeter www.mentimeter.com) were employed.

Although it is advisable to select a physical space that fosters dialogue, the geographical separation between the participating families required the use of a virtual setting made welcoming through the creation of a dedicated PowerPoint presentation to guide parents through the questions. A moderator, experienced in parental interview techniques, and a note-taker participated. To ensure unbiased feedback, the moderator was selected from individuals involved in the process but not those directly interacting with parents during workshops.

Internal focus group (Description). Eight professionals from various disciplines collaborated in the study: two speech therapists employed by the institute, responsible for recruiting families and regular clinical follow-ups; two speech-language therapists (with a university degree in speech therapy, one of whom specialized in rehabilitation of HH infants) who served as instructors in gestural communication using the Baby Signs® methodology as developed by Baby Signs Italia; one speech-language therapist specialized in CC-CARE video analysis; and two researchers specializing in multimodal communication.

For the professionals involved, aware of the need to evaluate the pilot study and assess the feasibility of the study, a structured questionnaire was administered to gather diverse and uninfluenced perspectives on the positive potentials and challenges experienced during different procedural phases instead of a focus group. The questions were selected based on the observations reported in the parent focus group and during all the phases of the study, and based on the issues related to the feasibility of the study (Bowen et al., 2009; Wong, 2008).

Procedure

For families from the case (BS) group timing measurements and intervention was the following: (T0) video analysis through CC-CARE protocol; (T1) BS parent workshop; (T2) SSP practical; (T3) video analysis through CC-CARE protocol; (T4) focus group. All families participated in the two proposed activities always in small groups. The training took place between May 2022 and December 2023. The time interval between T0 and T3 was on average 9 months (range: 5-12). Families in the control group (CTRL) only completed the T0 and T3 phase of the study.

Analysis

Qualitative data from parents and professionals focus groups were analysed based on the dimensions of feasibility studies (Bowen et al., 2009): acceptability, implementation, practicality, integration, adaptation. Comments and suggestions were examined both in relation to the implementation of the parent training itself (i.e. to what extent the parent training could be effectively implemented in the audiological context with parents of HH infants), and in relation to the feasibility of outcome assessment procedures (i.e. to what extent it was possible to implement research steps aimed at assessing the training efficacy).

To assess efficacy, we performed quantitative CC-CARE analysis of changes in parental communicative styles and infants's communicative abilities from the beginning to the end of the intervention (T0 and T3), comparing them with a control group of parent–child dyads not exposed to the programme and tested at 3 and at 12 months after the cochlear implantation (corresponding to T0 and T3). All raw scores are reported in Table S2 in Supplementary material. An Analysis of Variance (ANOVA) with Group as between-participants factor and Measurement as within-participants factor was used to assess the potential differences between the two Measurements (T0 and T3).

Results

Acceptability

Parents' perspective

In evaluating the proposed FCEI program, family support and respect for parental decision-making emerged as key components (Szarkowski et al., 2024). Participants were overall satisfied with the programme, with families rating the programme at 3.8/5 and professional relationships at 4.1/5. Parents felt moderately confident in independently adding new signs (3.5/5), and showed awareness of changes in their communication style (3.8/5) and in their child's communicative development (3.9/5).

During the focus group, parents also emphasized the value of professional support and signs in promoting early communication before speech. They highlighted the importance of selecting signs meaningful to the child and allowing sign creation from the child themselves. A moment they highlighted was when children began using signs to express basic needs – an experience parents linked to positive emotional responses and enhanced perceptions of their child's competence. The programme was seen as especially beneficial when started early, fostering a more natural integration of signs into everyday interactions. Parents also appreciated the ease of following the programme and found the accompanying materials and books to be very supportive. However, parents expressed concerns about group non-homogeneity during training. Those with HH infants felt out of place among hearing families due to different needs, and noted age mismatches that limited the relevance of suggested strategies and reduced opportunities of exchange with other families.

Professionals' perspective

Professionals' insights, obtained during the focus group (Szarkowski et al., 2024a), highlighted strong parental engagement once families accepted the intervention. Speech therapists reported that families were particularly satisfied with the programme's support for early interactions prior to cochlear implantation. All professionals noted that even initially skeptical families, ultimately found symbolic gestures to be helpful. However, professionals also noted challenges related to group non-homogeneity, as differences in hearing status and infant age made it difficult for some parents to relate to others' experiences. One professional mentioned that a parent turned down participation, citing the added burden of research-related commitments.

Implementation

Parents' perspective

Parents highly valued the intervention, particularly the SSP practicals (e.g. games and rhymes) for enhancing parent–child interaction and fostering family cohesion (Szarkowski et al., 2024). They recommended integrating SSP practicals earlier in the intervention – immediately after the BS workshop – rather than in the second half of the training. While the online approach was appreciated for its convenience, incorporating it into their daily routines proved challenging due to home distractions, especially during the SSP practicals.

Several parents noted a lack of clear information about the natural reduction of sign use as verbal language emerged, particularly after cochlear implantation. They emphasized the need for clearer guidance on the fact that integrating multimodal communication can be a long-term process, and on the expected delay between sign exposure and child's active use. This delay sometimes caused frustration or doubt about the strategy's effectiveness. They were also somewhat surprised

that as soon as words started, the use of signs reduced. One parent expressed relief at the decline of sign use with speech emergence, and acknowledged that they were not fully aware of the difference between BS and sign language.

Professionals' perspective

Professionals faced challenges organizing the initial sessions due to fluctuating participation, leading to programme delays. One of the instructors identified a period between the workshops and the practicals during the first course when parents were not closely followed. This could have hindered the participants' ability to fully comprehend the programme's potential and continuity. This issue was mitigated for some of the parents, for whom the entire programme was conducted in a more condensed format. Planning repeated SSP practicals also proved difficult, due to external and unexpected factors and coordination with audiological follow-ups. One speech-language therapist reported difficulties in aligning assessments (e.g. video analyses) with clinical appointments and the procedures for assessing the outcome of the parent training.

Researchers highlighted the need to clearly distinguish between BS and SL during parent recruitment, as such confusion was common among hearing parents of HH infants. SL is often associated with stigma and fear sentiments, particularly among hearing parents of deaf infants who are candidates for cochlear implantation. Finally, technical issues were also noted, including inconsistent quality of the video recordings and incomplete anamnestic data collection.

Practicality

Parents' perspective

Parents reported challenges in managing their infants during the practical sessions, as children were more easily distracted by personal toys and familiar objects in the home environment.

Professionals' perspective

Professionals acknowledged that remote work limited opportunities to get to know one another, potentially hindering effective communication. Some team members reported not being fully informed about the overall research process, which led to a perceived lack of transparency in the study's progression. Coordination challenges also emerged due to the absence of a designated "case manager" with comprehensive oversight, to whom all team members could report.

Integration

Parents' perspective

Families faced several challenges in consistently integrating signs into daily routines. Some parents noted that using signs in public often attracted unwanted

attention or negative reactions, as people unfamiliar to the programme perceived it as unusual or unnecessary. This led to families frequently having to explain their choice, resulting in negative experiences and the emotional strain of justifying their decision to others. Parents of HH infants perceived this as an additional emphasis of the diversity of their infants. Overall, these experiences contributed to a greater perceived effort in the parents when interacting with others.

Difficulty also arose when trying to involve other caregivers or educators in the combined use of word and sign. The rate of sharing with others was reported as 3.8/5 on a Likert scale (5 meaning sharing the most) for family members, and 4/5 for school educators or babysitters. Despite these reported difficulties, parents reported using signs in public with a mean score of 4.4/5. Some observed that their infants were less inclined to use signs outside the home, possibly due to distractions or a sense that signing was limited to private settings. Nonetheless, parents expressed surprise and satisfaction at how infants showed a continuity between signs and words and integrated signs into daily life. One explicitly said "*infants actually learned words through signs*".

Professionals' perspective

All speech-language therapists advocated for more frequent meetings with parents to address their inquiries, potentially using guided questions to highlight their concerns and clarify their expectations. Additionally, they suggested that families could benefit from more direct feedback on communicative outcomes for both their infants and themselves and receive closer support from the professionals involved in the FCEI.

Adaptation

Parents' perspective

During focus groups, parents shared several suggestions for improving the programme. However, their feedback was primarily based on personal experiences rather than broader considerations for general adaptation.

Professionals' perspective

All participating professionals concur that expanding the programme to other families with HH infants is feasible, and the implementation of a parent training on multimodal communication along with any regular follow-ups required to test its efficacy (e.g. use of video analysis), should not impose an excessive burden on the clinical practice.

From the organization perspective, professionals emphasized the need to conduct a more detailed video analysis following the CC-Care protocol, and to organize more frequent meetings with parents to address their inquiries. From the perspective of main changes in the way the programme is presented to parents, professionals observed that parents found it challenging to think

about their own communication mode suggesting a very limited awareness of personal potential changes in communication strategies. It is therefore crucial to ensure that the designated contact person for the programme has dedicated time to introduce the training opportunity to the families, becoming a reliable point of reference for the family itself.

Preliminary efficacy testing of the intervention

Parental communication style

Parental Communication Style (PCS) was computed as a cumulative score from 5 variables of the video-analysis Importantly, the tutorial and didactic scores concur together to the percentage of aimed PCS behaviours, i.e. a constructive PCS. Directive, conversational and asynchronous scores concur together to the percentage of not-aimed PCS behaviours, i.e. a less constructive PCS. Figure 1 shows changes in PCS as a function of Group (Controls or Baby Sign) and Measurement (First (T0), Last (T3)), separately for aimed and not-aimed PCS behaviours.

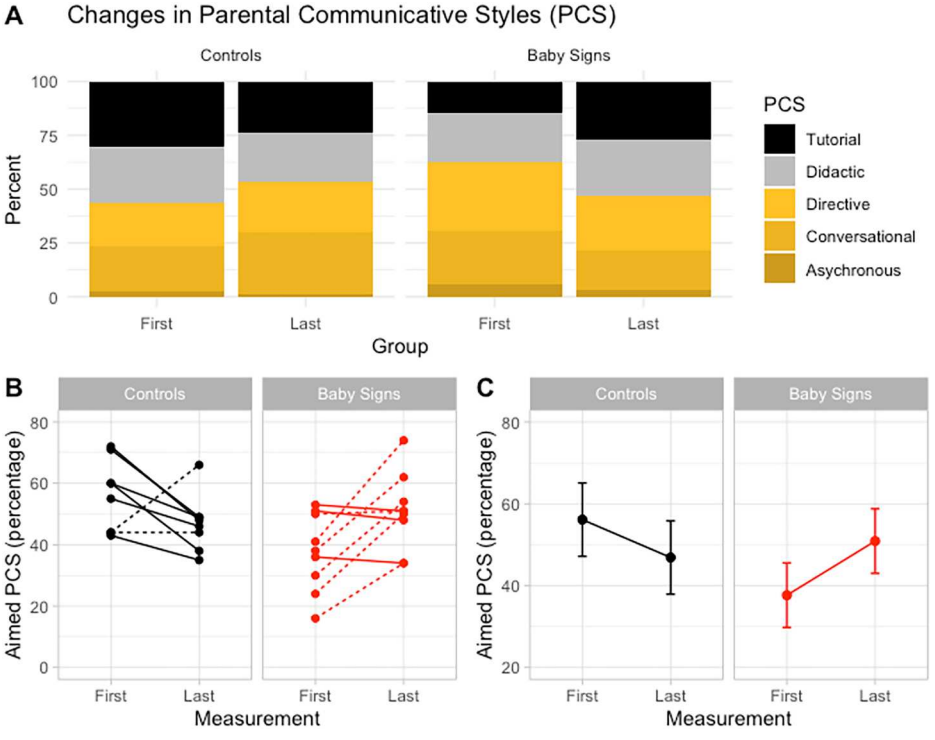

Figure 1. Changes in Parental Communicative Style as a function of Group and Measurement. 1A: Stack plot showing the contribution of each of the five different MCS behaviours (in percentage). 1B: Line graph representing changes between First and Last measurements in each individual participant (dashed lines increases in aimed PCS). 1C: Line graph representing mean changes with 95% confidence intervals for within-subjects variables (Morey, 2008; using the SummarySEwithin2 function in R), because our focus was on the change within each group.

The change in PCS behaviour in the BS group from the First to the Last measurement was examined. Five mothers out of 8 increased this constructive behaviour, whereas for the remaining 3 they remained largely unchanged. This pattern is not visible in the control group, where instead decreases in aimed PCS behaviour tended to prevail. An Analysis of Variance (ANOVA) was computed for the percentage of aimed PCS in with Group as between-participants factor and Measurement as within-participants factor. This ANOVA revealed a significant 2-way interaction ($F(1,15) = 9.737$, $p = 0.007$, $\eta^2_p = 0.394$), but no main effect (all Fs < 1). Post-hoc analysis with Tukey corrections for multiple comparisons showed that the two groups differ at the First ($p = 0.015$) but not at the Last measurement ($p = 0.9$). Interestingly, while the decrease in aimed PCS was not significant in control mothers ($p = 0.3$), it approached significance in mothers recruited in the BS group ($p = 0.07$).

Child's communication efficacy

Child's communication efficacy was computed as a cumulative score from the variables of the video-analysis (see above for details). Individual changes in child's communication efficacy across time were examined. As visible in Figure 2, no clear pattern emerged (unlike for the case of aimed PCS). This impression was corroborated by entering child's communication efficacy scores in an ANOVA with Group and Measurement factors. This ANOVA revealed no significant main effect or interactions (all Fs < 1; except for the main effect of Group: $F(1,15) = 3.109$, $p = 0.1$).

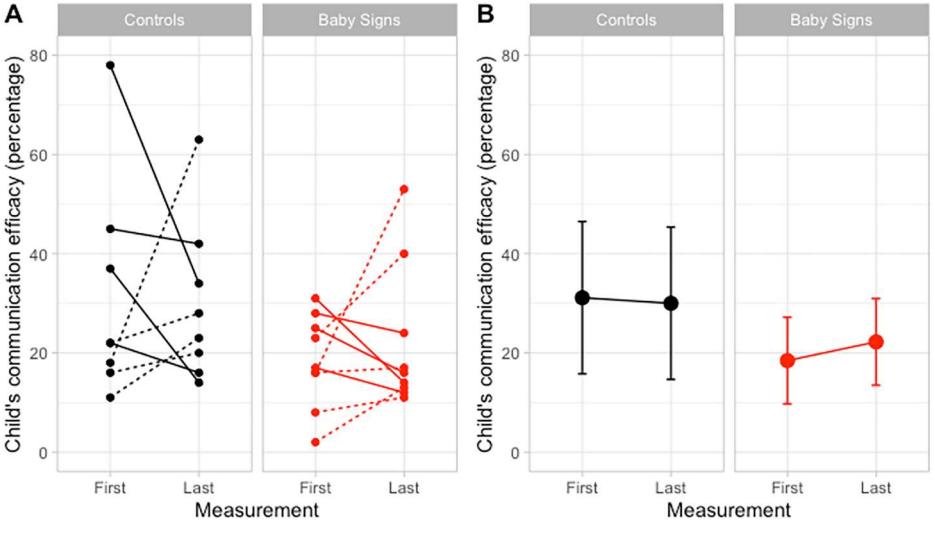

Figure 2. Changes in child's communication efficacy as a function of Group and Measurement. 2A: Line graph representing changes in child's communication efficacy in each individual participant (dashed lines increases). 2B Line graph representing mean changes with 95% confidence intervals for within-subjects variables (Morey, 2008).

Discussion

The main objective of this study was to explore the feasibility of a family-centred early intervention (FCEI) based on symbolic gestures based on the baby signs (BS) approach. This was originally conceived for hearing parents of hearing infants, and here we extend it for the first time to hearing parents of HH infants in the context of audiological clinics. The study evaluates the feasibility of this parent training through the feedback from both parents and professionals. It also provides preliminary evidence of its efficacy through video analysis.

Overall, our approach was deemed both feasible and beneficial for supporting family well-being (Szarkowski et al., 2024). Parents were generally satisfied with the programme and professional support, and speech therapists observed that families were engaged once the intervention was accepted. They considered the use of signs valuable for facilitating early communication, and they viewed them as a useful transitional and supportive tool until speech developed. Family support was thus provided for the proposed FCEI despite the initial implementation difficulties (Szarkowski et al., 2024). Professionals also highlighted that the programme was useful before cochlear implantations and noted that it could be expanded without imposing significant burdens on practitioners. Yet, a number of important indications emerged from both parents and professionals when pursuing this approach. Parents appreciated the activities during the "Sign Say and Play" practicals, but suggested including them earlier in the intervention. Professionals proposed to hold more frequent meetings with parents to address their queries, and to provide direct feedback on infants' and parents' communicative outcomes. Suggestions for improvement are discussed in the following section. In addition, while parents found the programme beneficial for communicating with their infant, they showed limited awareness of changes in their own communication style and their infant's communicative progress. Yet, results from our preliminary efficacy testing documented actual changes in parental communication styles.

How to improve FCEI based on the combined use of words and signs

For clarity, suggestions for improvement related to training content and those related to training structure are presented separately.

Regarding the *training content*, focus groups with parents showed that it is essential to clarify that BS is not equivalent to SL. This distinction is crucial for parents of HH infants, who may lack systematic information on the differences between SL and BS, often have limited knowledge of of SL itself, and may be scared of evoking the use of signs in a context in which the combination of hearing assistive technologies and signs if often described as controversial.

Parents should be well informed on the relation between signs and speech in this context, for instance that the symbolic gestures used by their infants typically decrease as verbal language emerges, and that the intervention may be more effective before and during the emegence of vebal language (Saksida et al., 2024). In addition, they may need guidance on the time delay between exposure to signs and the child's actual use of them. During the BS Workshop parents are informed that it is difficult to predict when an infant will start using signs. For this reason, they are encouraged to focus on the communicative process rather than specific language milestones. Nonetheless, parents of HH infants may have different expectations than those of normally hearing infants, and therefore, additional efforts by the BS educators may be needed to reduce potential discouragement when results are not immediately visible. In this respect, sharing experiences with parents who have been using BS may also be advisable.

The challenges of explaining the use of BS to other adults they encounter was a concern expressed by some of the parents of hearing infants. It is possible that, unlike parents of hearing infants who may feel pride in independently chosen educational tools, parents of HH infants might view BS as a necessary intervention to support their child's communication and language development and therefore a potential burden. Future research could explore this difference by comparing how these different groups of parents experience and perceive BS-based parent training.

Related to training content, it may be thus important to provide feedback on the ongoing communication changes. Parents seemed unaware of changes in their communicative behaviour; however, they noted a lack of reference points to assess their progress. Feedback that would emphasize these positive changes could help them see the impact of their efforts in altering their communication mode.

In terms of the *training structure*, parents recognized the benefits of online training, especially given the wide geographical spread of families accessing audiological centres in Italy. Online delivery addresses an essential logistical need, but parents reported challenges with the "Sign Say and Play" (SSP) practicals due to home distractions, particularly related to the presence of familiar objects like toys. Structuring the child's environment before practical activities could improve focus and help mitigate this issue. Parents also expressed a desire to integrate workshop sessions with SSP practicals during the training, to immediately apply theoretical concepts to daily activities, allowing also for guided practice. For example, introducing signs while singing nursery rhymes was easier compared to adding them in daily life contexts.

One clear concern that created discomfort in parents and could have influenced training effectiveness concerns the non-homogeneities of the training groups. One of the parents of HH infants was included in the BS Workshop

and practicals of other parents with hearing infants – thus resulting in a non-homogeneity of infant hearing status. In addition, even parents that participated in the BS Workshop addressed to parents of HH infants only remarked on the difficulty of a group in which infants differed in age – thus resulting in non-homogeneity of infant developmental stage. Due to this non-homogeneity, strategies for introducing and using signs in combination with words in daily life may not be appropriate for all parents attending, as remarked by one mother in the focus group. Clearly these sources of non-homogeneity need to be carefully considered in the future.

Taken together, the suggestions related to training content point to the importance of introducing (1) a clear distinction between BS and SL; (2) a timeline of the emergence and interplay of signs with words; (3) a more direct guide for parents for noticing communication changes in their infant and for themselves. Conversely, the proposed improvements for the training structure improval are: (1) avoid non-homogeneities related to hearing status and developmental age in training groups; (2) incorporate occasional in-person meetings for professionals to facilitate the exchange of goals and progress; (3) include introductory and interim meetings (online) for all participating families aimed at fostering a clear follow-up and managing expectations; (4) potentially integrate workshop sessions with SSP practicals during the training to allow for guided practice; (5) plan concluding individualized meetings for each family, to review and consolidate the communication changes they have implemented, as well as to generalize and stabilize the achieved objectives. For parents of HH infants, a clear understanding of the final aims, the timing and the plan of the intervention, and a thorough follow-up are necessary for a successful participation in such a programme.

Efficacy testing of the FCEI based on the combined use of words and signs

In terms of parental communicative style (PCS), the proposed FCEI appeared to have exerted a positive influence only in the BS group. Constructive PCS communicative acts (i.e. tutorial and didactic styles) increased for 5 out of 8 mothers in the BS group, whereas the control group showed a tendency towards reduced constructive communicative acts. Regarding infants' communication efficacy, no significant group-level changes emerged by effect of the intervention.

Infants' communicative efficacy is critical for their successful language, social, and cognitive development (Ambrose, 2016; Vallotton et al., 2017), and the early multimodal word-gesture parent training in conjunction with the timely audiological intervention should ultimately have an impact on these aspects of development. It is to be noted, however, that the present FCEI was centred around parents' multimodal communication, and not around infants' communicative efficacy. It is therefore possible that at the time of the last assessment, only

the effect on the PCS was observable, whereas the infants' communicative efficacy may not (yet) undergo visible changes. A potential delay in the visible effects on the infants' communicative efficacy could be measured with a longitudinal follow-up of the study, which was beyond the scope of the present feasibility study.

The observation that, in the present feasibility study, changes towards more constructive communicative styles occurred during the FCEI is encouraging. Nonetheless, it should be emphasized that the evidence in favour of the proposed parent training is limited for two main reasons. First, the sample size is very small and future studies should aim to expand the number of families included in the FCEI. In this respect, the indications listed in the previous section (4.1) on how to improve delivery and organization of the FCEI could prove critical. Second, no control group undergoing a FCEI without the use of signs was recruited in this feasibility study. For instance, it would be ideal to compare the FCEI that leverages on the combined use of words and signs, with a communication-oriented FCEI of comparable engagement, length and content which instead excludes signs from the intervention. These two FCEI could even be provided by the same professionals, to ensure that both interventions are delivered with equal competence and professional background.

Conclusions

After a severe hearing loss diagnosis to their child, hearing parents may experience sadness, grief, and anxiety, they may tend to lose self-confidence in child education, become frustrated and confused (Harrigan & Nikolopoulos, 2002). They can also become more intrusive and directive, less flexible during interactions and less responsive to their child's communicative attempts (Vandam et al., 2012). In such conditions, a direct approach that addresses parental communicative strategies might not be as successful as with families with normally hearing infants (Ferjan-Ramírez et al., 2020). A structured and well implemented family-centred early intervention (FCEI) that incorporates multimodal communication – combining words and signs – into the existing audiological rehabilitation could have more impact. As demonstrated with the present study, such a FCEI is both feasible and beneficial for hearing parents of infants with hearing loss (HL). Parents and professionals recognized the programme's value in supporting early communication in parallel with the audiological rehabilitation, particularly before cochlear implantation.

While the intervention positively influenced parental communicative styles, no significant changes emerged in infants' communicative efficacy. Future research should thus involve larger samples, longer assessment periods, diverse age groups of children, and comparisons with alternative FCEI models to establish stronger evidence for the programme's efficacy.

Contribution statement

RR, MS, AC, SP, EO and FP: Study design; AS, RR, MS, AC, SP, and FP: drafting of the manuscript. AS, RR, IM. FP: Acquisition, analysis, interpretation of data; EO and SP: Study supervision. AS and RR share first authorship.

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