Parent–Child Interactions in Deafness Children

Subjects: Health Care Sciences & Services Contributor: Martina Curtin

Despite early identification and advancements in cochlear implant and hearing aid technology, delays in language skills in deaf children continue to exist. Good-quality parent–child interaction (PCI) is a key predictor for the successful development of deaf children's signed and/or spoken language. As good-quality PCI is widely acknowledged to be significant for child language development in deaf children, then we must have the necessary tools to assess it. This review answers three questions: Which parent behaviours are assessed in PCI? How are they assessed? And which parent interaction behaviours are positively correlated with deaf children's language skills?

deaf	parent–child interaction	assessment	early interaction
sneech a	and language therapy		

1. Introduction

Much research describes the importance of good-quality parent-child interaction for children's language development ^[1]. Parents are seen as the main provider of the social and linguistic stimulation required for successful child language development ^[2].

Children develop the foundations of language through the 'serve and return' of communicative interactions with their caregiver. This happens first through vocal and visual means (exclamations, babbling eye contact, facial expressions, gestures and pointing) and then through language use ^[3]. Parents scaffold this development through prompts and contingent reactions to their child's behaviours ^[4]. These behaviours in turn encourage and reinforce a child's communicative intentions ^[5]. For example, relationships have been found between a parent's responses to child gesture and vocalisation, and child vocabulary development ^[6].

1.1. Parent-Child Interaction (PCI) and Deafness

Despite earlier identification and advancements in hearing aid and cochlear implant technology, delays in receptive and expressive language skills in deaf children continue to exist ^{[7][8]}. Many studies have found the quantity and quality of parental interaction to be one of the main predictors of deaf children's language outcomes ^{[9][10][11][12][13]}. Parents who have not yet developed skills in effectively communicating with their deaf child may provide lower-quality language input ^[14], which in turn affects the child's language development.

To illustrate, studies have reported that hearing parents of deaf children can often be more directive in their interactions compared to deaf parents of deaf children and hearing parents of hearing children ^{[7][15]}. This manifests as increased interruptions to the child's attention by parents initiating new, unrelated activities ^[16]. Hearing parents also elicit language from their deaf child through requests rather than conversations, meaning deaf children have less experience of two-way interaction and receive less feedback on their communicative attempts ^[17]. An important foundation for language development is joint attention, i.e., two people with a mutual focus. Hearing parents struggle to establish and maintain this behaviour with their young deaf infants ^{[18][19]}. Higher rates of directive behaviours from hearing parents of deaf children ^{[15][20]}, are less conducive for maintaining attention. The mismatch of hearing status means that hearing parents need to adapt their communication skills to attain successful joint engagement in by gaining or waiting for the deaf child's attention before starting to communicate and sequentially shifting attention between the environment/objects and each other. In comparison, deaf parents are using these social engagement strategies at an early age with their deaf infants ^{[21][22]} and we see an earlier tuning in of the deaf child's gaze ^[23].

1.2. Improving Parent's Skills in Interaction

Despite the association between parental interaction and child language development, enhancing hearing parents' communication with deaf children is a complex issue. Parents of deaf children receive multiple home visits and attend appointments for medical and audiological purposes where they learn about deafness, communication, and future education ^[24]. To reduce the communication difficulties that can cause increased family stress ^[25], hearing parents are required to adapt their communication style and often receive family-centred interventions that incorporate new strategies to enhance their interaction skills. The level of parental involvement in these interventions varies and can be associated with acceptance of the child's deafness, parental self-efficacy, and the amount of support a family receives ^[26].

2. Parent–Child Interactions Assessment in Deafness Children

2.1. Parent Behaviours Are Being Assessed in PCI Studies

2.1.1. Attention-Getting Behaviours

Attention-getting behaviours can be defined as explicit bids, made by the parent, with the intent of gaining or directing their deaf child's attention. The bid for attention can use one or more modalities. Fourteen (14) of the 61 studies (papers 1 to 14 in **Table 1**) observed this aspect of parent behaviour. Data from these papers have been synthesised into four modalities: visual, auditory, tactile, and multi-modal.

Table 1. Papers included in the review (n = 61) and the associated research questions.

Paper No	First Author	Year	Reported Country of Study	Study Design	Degree of Hearing Loss	No of Dyads	PCI Behaviours Assessed	PCI Measure (Method)	Child Lang	Risk of Bias
1	Beatrijs. W., et al. ^[21]	2019	Belgium	Two between- groups, observational studies	No Report	13	Attention- Getting Strategies	Coding	Ν	Moderate
2	DesJardin, J. L. ^[27]	2006	USA	Within-group, observational study	Mod– Prof	32	Attention- Getting Strategies and Parental Communication	Coding	Y	Moderate
3	Loots, G. et al. ^[28]	2003	Belgium	Between- groups, observational study	Mod– Prof	33	Attention- Getting Strategies	Coding	Ν	Low
4	Waxman, R. et al. ^[29]	1997	USA	Between- groups, observational study	Mild– Prof	77	Attention- Getting Strategies	Coding	Ν	Moderate
5	Chasin, J. et al. ^[30]	2008	UK	Between- groups, observational study	Profound	9	Attention- Getting Strategies and Child Eye Gaze	Coding	Ν	Moderate
6	Harris, M. et al. ^[31]	1989	UK	Within-group, longitudinal observational case series	Profound	4	Attention- Getting Strategies and Child Eye Gaze	Coding	Y	Serious
7	Harris, M. et al. ^[32]	1997	Australia and UK	Between- groups, observational study	Profound	11	Attention- Getting Strategies and Child Eye Gaze	Coding	Ν	Critical
8	Harris, M. et al. ^[32]	2005	UK	Between- groups, observational study	Profound	26	Attention- Getting Strategies and Child Eye Gaze	Coding	Ν	Moderate
9	Lederberg, A. R. et al. [<u>33</u>]	1998	USA	Between- groups, observational study	Sev– Prof	40	Attention- Getting Strategies and Child Eye Gaze	Coding	Y	Moderate

Paper No	First Author	Year	Reported Country of Study	Study Design	Degree of Hearing Loss	No of Dyads	PCI Behaviours Assessed	PCI Measure (Method)	Child Lang Assessed?	Risk of Bias
10	Prendergast, S. G. et al. [<u>34</u>]	1996	USA	Between- groups, observational study	Sev– Prof	16	Attention- Getting Strategies and Child Eye Gaze	Coding	Ν	Moderate
11	Gabouer, A. et al. ^[35]	2018	USA	Between- groups, observational study	Sev– Prof	18	Attention- Getting Strategies and Joint Engagement	Coding	Ν	Serious
12	Loots, G. et al. ^[22]	2005	Belgium	Between- groups, observational study	Mod– Prof	31	Attention- Getting Strategies and Joint Engagement	Coding	Ν	Low
13	Nowakowski, M. et al. ^[36]	2009	Canada	Between- groups, observational study	Sev– Prof	56	Attention- Getting Strategies and Joint Engagement	Coding	Y	Moderate
14	Tasker, S. et al. ^[37]	2010	Canada	Between- groups, observational study	Sev– Prof	53	Attention- Getting Strategies and Joint Engagement	Coding	Y	Low
15	Barker, D. H et al. ^[Z]	2009	USA	Between- groups, observational study	Sev– Prof	185	Joint Engagement	Coding	Y	Low
16	Cejas, I. et al. ^[8]	2014	USA	Between- groups, observational study	Sev– Prof	276	Joint Engagement	Coding	Y	Moderate
17	Roos, C. et al. ^[38]	2016	Sweden	Within-group, observational study	Sev– Prof	12	Joint Engagement	Coding	Ν	Moderate
18	Spencer, P. E. ^[39]	2000	USA	Between- groups, observational study	Mod– Prof	80	Joint Engagement	Coding	Ν	Serious

Paper No	First Author	Year	Reported Country of Study	Study Design	Degree of Hearing Loss	No of Dyads	PCI Behaviours Assessed	PCI Measure (Method)	Child Lang Assessed?	Risk of Bias
19	Dirks, E. et al. ^[18]	2019	The Netherlands	Between- groups, observational study	Mod	51	Joint Engagement and Parental Sensitivity	Existing Scale + Coding	Y	Low
20	Gale, E. et al. ^[40]	2009	USA	Between- groups, observational study	Sev– Prof	15	Joint Engagement and Parental Sensitivity	Coding	Y	Moderate
21	Janjua, F. et al. ^[41]	2002	UK	Within-group, observational study	Sev– Prof	13	Joint Engagement and Parental Sensitivity	Coding	Y	Serious
22	Lederberg, A. R. et al. [<u>42</u>]	1990	USA	Between- groups, observational study	Mild– Prof	82	Joint Engagement and Parental Sensitivity	Novel Scale + Coding	Y	Moderate
23	Meadow- Orlans, K. P. et al. ^[43]	1993	USA	Between- groups, observational study	Mod– Prof	80	Joint Engagement and Parental Sensitivity	Novel Scale + Coding	Ν	Moderate
24	Meadow- Orlans, K. P. et al. ^[16]	1996	USA	Between- groups, observational study	Mod– Prof	80	Joint Engagement and Parental Sensitivity	Novel Scale + Coding	Ν	Moderate
25	Abu Bakar, Z. et al. ^[44]	2010	Not reported	Between- groups, observational study	Sev– Prof	18	Parental Sensitivity	Novel Scale	Ν	Serious
26	Meadow- Orlans, K. P. et al. ^[45]	1995	USA	Within-group, observational study	Mild– Prof	43	Parental Sensitivity	Novel Scales	Ν	Moderate
27	Lam- Cassettari, C. et al. ^[46]	2015	UK	Between- groups, intervention study	Mod– Prof	14	Parental Sensitivity	Existing Scale	Ν	Moderate
28	Meadow- Orlans, K. P. [<u>47</u>]	1997	USA	Between- groups, observational study	Mod– Prof	40	Parental Sensitivity	Novel Scales	Ν	Moderate

Paper No	First Author	Year	Reported Country of Study	Study Design	Degree of Hearing Loss	No of Dyads	PCI Behaviours Assessed	PCI Measure (Method)	Child Lang Assessed?	Risk of Bias
29	Pressman, L. J. et al. [<u>48</u>]	1998	USA	Between- groups, observational study	Mild– Prof	42	Parental Sensitivity	Existing Scale	Y	Moderate
30	Pressman, L. J. et al. [<u>49</u>]	1999	USA	Between- groups, observational study	Mild– Prof	24	Parental Sensitivity	Existing Scale	Y	Low
31	Spencer, P.E. ^[50]	1996	USA	Between- groups, observational study	Mod– Prof	43	Parental Sensitivity	Novel Scale	Y	Low
32	Vohr, B. et al. ^[51]	2010	USA	Between- groups, observational study	Mild– Prof	58	Parental Sensitivity	Existing Scale	Y	Low
33	Waxman, R. et al. ^[52]	1996	USA	Between- groups, observational study	Mod– Prof	30	Parental Sensitivity	Coding	Ν	Moderate
34	Ambrose, S. E. ^[53]	2016	USA	Between- groups, observational study	Mild– Prof	48	Parental Sensitivity	Coding	Y	Low
35	Caissie, R. et al. ^[54]	1993	Not reported.	Between- groups, observational study	Sev– Prof	11	Parental Sensitivity	Coding	Y	Serious
36	Eddy, J. R. [55]	1997	Australia	Between- groups, observational study	Sev– Prof	18	Parental Sensitivity	Coding	Y	Serious
37	Glanemann, R. et al. ^[56]	2013	Germany	Between- groups, intervention study	Mod– Prof	29	Parental Sensitivity	Coding	Y	Moderate
38	Wedell- Monnig, J.; et al. ^[57]	1980	USA	Between- groups,	Sev– Prof	12	Parental Sensitivity	Coding	Ν	Serious

Paper No	First Author	Year	Reported Country of Study	Study Design	Degree of Hearing Loss	No of Dyads	PCI Behaviours Assessed	PCI Measure (Method)	Child Lang Assessed?	Risk of Bias	
				observational study							
39	MacTurk, R. H. et al. ^[58]	1993	USA	Between- groups, observational study	Mod– Prof	40	Parental Sensitivity and Child Eye Gaze	Novel Scales	Ν	Serious	_
40	Choo, D. et al. ^[59]	2016	Australia	Within-group, observational study	Sev– Prof	12	Parental Sensitivity and Parental Communication (Comm.)	Novel Scale	Ν	Moderate	
41	James, D. et al. ^[60]	2013	UK	Within-group, intervention study	Profound	3	Parental Sensitivity and Parental Comm.	Existing Scale + Coding	Y	Serious	_
42	Nicastri, M. et al. ^[11]	2020	Italy	Between- groups, intervention study	Profound	Not reported: 22 parents of 14 children	Parental Sensitivity and Parental Comm.	Existing Scale	Y	Moderate	ttentio holdir objec
43	Preisler, G. M. ^[61]	1995	Sweden	Within-group, observational study	No Report	14	Parental Sensitivity and Parental Comm.	Coding	Ν	Serious	-j spac
44	Quittner, A. L. et al. ^[12]	2013	USA	Between- groups, intervention study	Sev– Prof	285	Parental Sensitivity and Parental Comm.	Scales (×2 existing, ×1 novel)	Y	Low	ord suc
45	Quittner, A. L. et al. ^[62]	2016	USA	Between- groups, observational study	Profound	285	Parental Sensitivity and Parental Comm.	Scales (×1 existing/ ×1 novel)	Y	Low	
46	Ahmad, A. et al. ^[63]	2016	Australia	Between- groups, observational study	Mild– Prof	16	Parental Communication	Coding	Ν	Moderate	ne chile 1bs; ar

vibrations, and physically adjusting the child's position to direct their attention.

Multi-Modal Cues

Combinations of the above—multi-modal cues—were also coded. For auditory-visual combinations, a parent might say 'uh oh!' and gesture as a toy rolls under the table. For visual-tactile, a parent may turn a child sat on their lap and then point to a new toy out of their current visual field. Other combinations may be auditory-visual-tactile, e.g., holding a child while talking to them and pointing to a toy.

Coding in papers that included deaf parents of deaf children also featured 'waiting' as an attention-getting strategy ^{[1][3][10][15]}, e.g., it was noted when parents did not initiate the interaction or any expression but actively waited until their child was looking at them before communicating. This could be seen as an attention-getting strategy, as a

Paper No	First Author	Year	Reported Country of Study	Study Design	Degree of Hearing Loss	No of Dyads	PCI Behaviours Assessed	PCI Measure (Method)	Child Lang Assessed?	Risk of Bias	parents
47	Brown, P. M. et al. ^[64]	2004	Australia	Between- groups, observational study	Profound	20	Play and Parental Communication	Coding	Y	Moderate	ו-gettin
48	Chen, D. ^[65]	1996	USA	Between- groups, observational study	Mod– Prof	12	Parental Communication	Coding	Y	Serious	nd child
49	DeVilliers, J. et al. ^[66]	1993	USA	Within-group, observational study	Profound	2	Parental Communication	Coding	Ν	Critical	⊤ed in th
50	Morelock, M. et al. ^[67]	2003	USA/Australia	Between- groups, observational study	Profound	9	Parental Communication	Coding	Ν	Serious	ere bot
51	Roberts, M. [<u>68</u>]	2019	USA	Randomised controlled trial	Mod– Prof	19	Parental Communication	Coding	Y	Moderate	ngeabl akema
52	[<u>79</u> Koester, L. S. et al. ^[69]	2010	USA	Between- groups, observational study	[<mark>80</mark>] Mod– Prof	61	Parental Communication	[<u>81</u>] Coding	Ν	Serious	bserve
53	Paradis, G. et al. ^[70]	2015	USA	Between- groups, observational study	No Report	60	Touch and Parental Sensitivity	Existing Scale + Coding	Ν	Moderate	l rule
54	Pipp-Siegel, S. et al. ^[71]	1998	USA	Between- groups, observational study	Mild– Prof	48	Touch and Parental Sensitivity	Existing Scale + Coding	Ν	Moderate	as thre age a Similarl
55	Abu-Zhaya, R. et al. ^[72]	2019	USA.	Between- groups, observational study	Mild– Prof	24	Touch	Coding	Ν	Moderate	minate h varie
56	Gabouer, A. et al. ^[73]	2020	USA	Between- groups, intervention study	Sev– Prof	18	Touch	Coding	Ν	Serious	

Some authors differentiated between 'supported/passive' joint engagement, with the parent joining the child in an activity and helping to support the joint engagement, without the child acknowledging the parent, and 'coordinated', wherein both parent and child exclusively engaged with each other and the activity. Interactions may be physical and/or visual (body movements, facial expressions, tickles) or may be 'symbol-infused', which refers to the use of language (signed, spoken or referential gesture) within a period of joint engagement.

The authors of the current review use 'joint engagement' as the term suggests parent and child are active participants, doing more than simply attending to the same thing.

2.1.3. Parental Sensitivity

Paper No	First Author	Year	Reported Country of Study	Study Design	Degree of Hearing Loss	No of Dyads	PCI Behaviours Assessed	PCI Measure (Method)	Child Lang Assessed?	Risk of Bias	une and
57	Spencer, P.E. ^[74]	1993a	USA	Between- groups, observational study	Mod– Prof	36	Other: Maternal Comm. Modality	Coding	Υ	Low	ithin the equently
58	Spencer, P.E. ^[75]	1993b	USA	Between- groups, observational study	Mod– Prof	7	Other: Maternal Comm. Modality	Coding	Y	Moderate	nts were
59	Lederberg, A. R. et al. [<u>76</u>]	2000	USA	Between- groups, observational study	Sev– Prof	40	Other: Maternal Comm. Modality	Coding	Y	Moderate	ve body
60	Depowski, N. et al. ^[77]	2015	USA	Between- groups, observational study	Sev– Prof	8	Other: Type and Use of Gesture	Coding	Ν	Serious	e affect,
61	Lieberman, A. et al. ^[<u>78</u>]	2014	USA	Between- groups, observational study	Mod– Prof	8	Other: Maternal and Child Eye Gaze	Coding	Y	Moderate	eir child.

Opposite: Passive, bored, and disengaged.

Contingent and Responsive

A parent that follows their child's lead and pace and responds with contingent, on-topic behaviours or language. Opposite: Directive, intrusive, dominant, and regularly initiating new topics.

Emotionally Sensitive

A parent who is emotionally attuned and adaptive. Able to recognise and respond to distress and disinterest, and repair or resolve misunderstandings or conflict. Opposite: Lacking or unhelpful emotional responses, unwillingness to soothe or resolve incidents causing discomfort.

Structure and Stimulation

A parent who is able to support a child's interest by guiding and developing the interaction with appropriate play and language. The parent will be flexible and accept a change in play or routine put forward by the child. Opposite: Overpowering, structuring the play, inappropriate pace or activity, highly authoritative, inflexible, or formally teaching the child.

Consistency

A parent who can absorb a range of child emotions and behaviours, whilst remaining mostly constant in their behaviours, predominantly striving for a positive interaction. Opposite: Unpredictable behaviour that changes regularly in the interactions from positive to negative.

Most of the papers also included a rating of the child's levels of responsiveness (also termed compliance or eagerness to respond) and involvement (initiations made, willingness to share). Some codes and scales rated the dyads for overall synchronicity, reciprocity, enjoyment, and communicative competence (understanding of one another). Papers 39 to 44 assessed parental sensitivity along with parental communication behaviours.

2.1.4. Parental Communication Behaviours

Parental communication behaviours are language-focused strategies used by parents during moments of interaction with their deaf child. Though most are explicitly linked to exposing the child to signed or spoken language, some behaviours are centred around increasing the child's *access* to spoken or signed language. Papers that *only* recorded and analysed parent's verbal interactions were excluded (n = 43) and are listed in <u>Appendix C</u>. Thirteen papers assessed parents on a range of communicative behaviours (papers 40–52 in **Table 1**) and these are summarised below:

Increased access to language: Some papers assessed parents on their ability to communicate within the child's line of sight or whilst being face to face; others observed parents' use of timing, i.e., waiting for the child to look before communicating. Others observed parents' use of child-directed speech or child-directed sign, i.e., where parents modify their speech or sign to be more child orientated. For example, a parent may adapt the palm orientation of a sign so the child can see more of the hand; they may increase the size and range of movement of signs, they may exaggerate the non-manual features of accompanying signs (facial expressions), use exaggerated vocal pitch or acoustic/sign highlighting, where the parent adapts their amplification of words or signs closer to the child.

Language input: This category refers to signed or spoken languages. Similar to parental sensitivity, parents were assessed on their contingent talk and number of connected turns, as well as their off-topic initiations (i.e., directives, requests and questions). Parents' use of language stimulation was coded and assessed on how they: labelled items or feelings; commented; described; made accompanying sounds; interpreted their child's behaviour with language; repeated their child's utterance; expanded their child's language by adding 1 or 2 new words, or rephrased it with correct grammar. Parents' mean length of utterance (MLU) was assessed in one paper. Parents' use of praise, affirmation and encouragement was assessed through language use, intonation, their gesture, and facial expressions. Assessment of less frequent behaviours included the parent modelling play, and the parent opposing the child, either by rejecting their communication, correcting their communication, or prohibiting their child's behaviour.

2.1.5. Use of Touch

The frequency and function of parents' use of touch when interacting with their child was also assessed in a small set of studies (Papers 53–56 in **Table 1**). The authors of these papers were interested in the type, location, and duration of parent-initiated touch. One paper looked at the temporal alignment between touch and parents' utterances ^[72]. Two papers also measured parental sensitivity ^{[70][71]} with Paradis and Koester ^[70] creating a coding system to analyse the function of parental touch, e.g., affectionate, attention-getting and instructive.

2.1.6. Other

Five papers included in the review sit within this category (papers 57–61 in **Table 1**). Three papers ^{[74][75][76]} focused on the communication mode of parents (i.e., how often they signed, used gesture or spoke). One paper looked in detail into the type and function of gesture used ^[77] and another transcribed American Sign Language and documented eye gaze between mother and child ^[78].

2.2. Parent Behaviours Assessed

Most papers (66%, n = 40) used a coding system to assess PCI, often watching and coding films frame by frame, using software such as INTERACT (Mangold) and ELAN (Max Planck Institute). This method allowed an in-depth analysis of the behaviours focused on in RQ1. Thirteen (13) papers (22%) used Likert scales instead of coding and some scales were well-known and validated, while others were developed for the specific research study with little mention of pilot testing prior to their use. The Emotional Availability Scales ^[82] were used in 7 of the 11 papers that used validated scales. Nine papers (12%) used a combination of coding and scales. See **Table 2**.

Table 2. Methods of assessing PCI between included papers.

Method of Assessing PCI	<i>n</i> Papers (%)
Coding	40 (66%)
An existing, validated scale	7 (12%)
A novel scale	4 (7%)
A mix of validated and novel scales	2 (3%)
Coding and a validated scale	4 (6%)
Coding and a novel scale	4 (6%)

2.3: Which Parent Behaviours Are Associated with Higher Child Language Scores?

2.3.1. Joint Engagement

Higher child language scores were related to more time in higher level engagement states with a parent (i.e., coordinated joint engagement and symbol-infused joint engagement)^[8]. Deaf children spent significantly less time in these states when compared to their hearing peers and therefore used less language ^{[7][40]}.

Dirks and Rieffe ^[18] add further evidence to this finding: deaf children and their hearing parents are less successful in establishing joint engagement and have briefer episodes when they do. These authors found positive correlations between total duration of joint engagement and receptive and expressive language skills. Interestingly, Gale and Schick ^[40] and Dirks and Rieffe ^[18] found correlations between non-intrusiveness and joint engagement

in mothers who followed their toddler's interests, rather than directing, and this was also linked to more instances of joint engagement.

2.3.2. Parental Sensitivity

Maternal sensitivity was positively correlated with expressive language and predicted language growth over time ^{[12][62]}. In their study of 285 deaf children with cochlear implants, Quittner and team found parents with aboveaverage skills in maternal sensitivity and language stimulation had children with 1.52 years less of a language delay ^[12]. Dirks and Rieffe ^[18] also found positive relationships between parental sensitivity and receptive and expressive child language *and* total duration of joint engagement. Children with better language experienced longer interactions with their parents and this was linked to parents with higher levels of emotional sensitivity (ibid).

In their 1999 study, Pressman and colleagues found that maternal sensitivity was not correlated with children's initial expressive language scores, but was positively correlated in their follow up assessments 12 months later ^[49]. In their regression analyses, maternal sensitivity positively predicted expressive language scores and accounted for 10% of the variance. In their 1998 study, they uncovered that maternal sensitivity had a larger positive effect on language in the sample of deaf children compared to their hearing sample ^[48].

2.3.3. Parental Communication Behaviours

In the study from Nicastri et al. ^[11], parents received nine whole-group sessions and three individual sessions of training over 10.5 months. The intervention was based on the 'It Takes Two to Talk' Hanen program ^[83] and involved video modelling, where parents had opportunities to put their training into practice at home. Strategies within the program included waiting and observing the child, following the child's lead, interpreting the child's behaviour, parallel talk, and expanding and recasting the child's language. The authors reported significant gains in parent communication behaviours and parental sensitivity post-intervention and noted that parents in the treatment group had children with significantly better language skills, when formally assessed three years post treatment.

A pilot RCT ^[68] involved parents receiving weekly, hour-long sessions for six months, where they were explicitly taught to use strategies to promote early communication. The authors referred to methods such as enhanced milieu teaching ^[84], prelinguistic milieu teaching ^[85], and The Hanen Program It Takes Two to Talk ^[83]. Examples of strategies include sitting face to face, using gestures, imitating/mirroring the child's actions, and turn taking. The study reported that parents in the treatment group increased their use of communication support strategies by 17% compared to 2% in the control group., There was a large effect size of 1.09 (p = 0.03) for the difference in gains in deaf children's prelinguistic speech skills between the treatment and control groups.

3. Summary

The four main areas of PCI uncovered have some parallels with the review on children with language difficulties by Roberts and Kaiser ^[86], where the three most measured parent strategies were: parent responsiveness, use of language models and rate of communication. Similarly, a review by Holzinger and colleagues ^[87] on children with

cochlear implants uncovered family involvement and parental linguistic input as key themes in their results. Additionally, within PCI research in the hearing population, the same set of behaviours are commonly measured [88].

The most prominent way of assessing PCI was with coding systems to analyse interactions. However, coding methods differed depending on the authors' research focus. Some of the coding systems referred to well-known frameworks such as those from Waxman and Spencer ^[29], where attention-getting behaviours are well described and the coding scheme from Adamson, Bakeman, and Deckner ^[79], which includes 11 states of joint engagement. Other coding systems were created for the purposes of the particular study and papers did not report on the piloting of coding prior to their use.

Behavioural observation is the ideal method for assessing the quality of interactions and reduces the risk of bias that may arise from the use of self-reporting tools ^[89]. Lotzin et al. ^[88] also limited their review of PCI assessments to objective instruments, with all 24 of their included measures being validated rating scales.

Longer periods of joint engagement, increased parental sensitivity and a range of facilitative language techniques were all correlated with higher levels of language in deaf children. Parents with higher rates of maternal sensitivity and language stimulation have a greater effect on their child's expressive language scores over time ^{[11][49]}.

An important correlation highlighted by Vohr et al. ^[51] was that parents with more support and higher SES had decreased intrusiveness, directiveness and negative regard. The better supported a parent is, the more sensitive, responsive, and positive they will be in their interactions. Hintermair ^[90] mirrored this finding in his study with parents of deaf children showing that child development profits from parents accessing 'personal and social resources' that influence their coping process and significantly lower stress. Furthermore, Zaidman-Zait et al. ^[91] found that higher levels of child acceptance were associated with lower levels of parenting stress in parents of deaf children.

4. Recommendations

We make the following recommendations for future research on PCI and deafness:

- Provide full details with regard to participant information, for both the child and their parents including level of deafness, amplification use, child communication profile and parent-to-child communication profile (see 'Language Access Profiles' from Hall ^[92]).
- 2. Report all methodological details of parent–child interaction assessment including who filmed the PCI, location of the assessment, instructions given to parents, length of the recording and length of film analysed.
- 3. Use validated scales to assess PCI. We refer readers to Lotzin et al. ^[88] for their comprehensive list of psychometrically tested measures, where Biringen's Emotional Availability Scales ^[82] are listed. This was the

most commonly used validated scale in this review. In addition, reliability statistics should be reported.

- 4. Use frame-by-frame coding as a detailed method of analysis. Coding schemes should be explained in detail and their development and pilot testing described. Reliability statistics should be reported.
- 5. Recruit more representative samples of families with diverse socio-economic status and ethnicity.
- Recruit and/or include deaf children with additional needs for similar reasons. The proportion of deaf children with additional needs is 22% ^[93].
- 7. Carry out more RCTs to explore causation between parental interaction and deaf children's language growth.

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