

Radio Aid/Remote Microphone Use with Pre-School Children

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The Ear Foundation®



Learning Objectives

- Identify the increased importance of an improved signal to noise (SNR) for preschool children with a hearing loss.
- Describe situations where Radio Aid use may provide benefit to preschool children with a hearing loss.
- Describe the benefits and challenges identified by parents of children with hearing loss on the use of Radio Aids
- Associate the use of Radio Aid with increased conversational turns.
- Identify the importance of informing parents/carers of the potential language benefits with using Radio Aids.

What do we know?

- Younger children (5-6 years) with normal hearing require significantly higher SNR values ($\geq +15\text{dB}$) and reduced reverberation times for speech recognition compared to older children and adults
 - Noise: Bradley & Sato, 2008; Eisenberg et al. 2000; Neuman et al, 2010; Nishi et al, 2010; Nozza et al., 1990; Valente et al, 2012; Yang and Bradley, 2008
 - Reverberation: Neuman & Hochberg, 1983; Neuman et al, 2010; Valente et al, 2012; Yang and Bradley, 2008
- Effects of reverberation and noise have a far greater impact on hearing aid users compared to normal hearing individuals
 - Finitzo-Hieber & Tillman, 1978; Hawkins & Yacullo, 1984; Peters, Moore & Baer, 1997

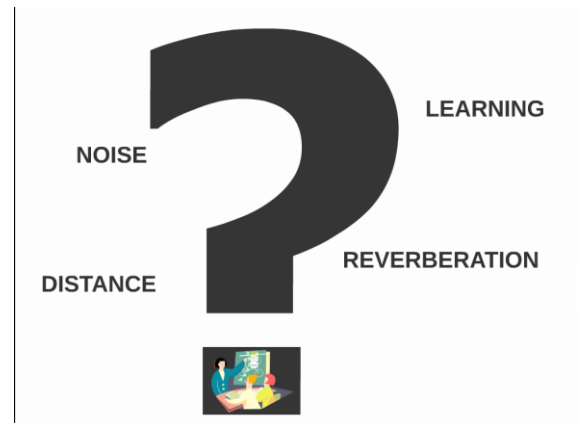
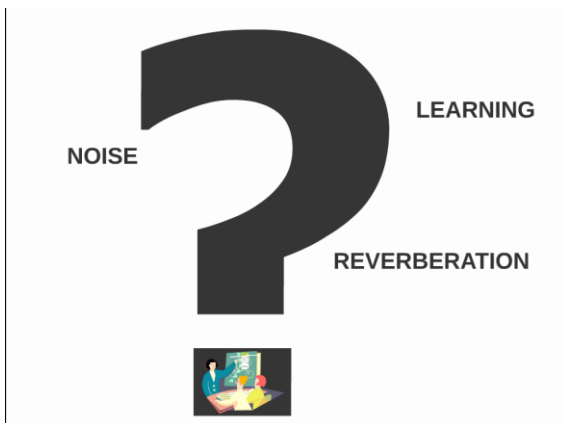
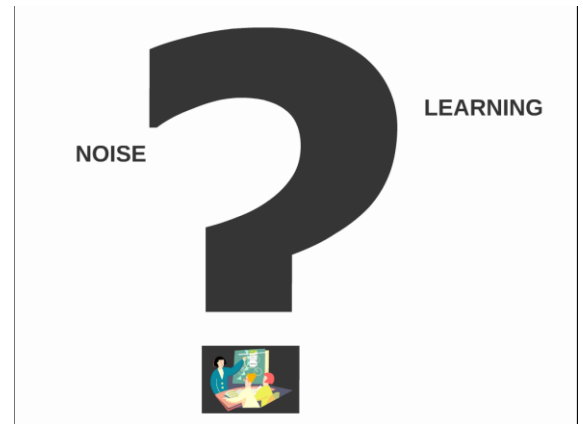
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What does this mean for really young children with hearing loss?

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First Study (2011)

- PhD Study, University of Manchester
- Supervisor: Professor Wendy McCracken



- Advisors: Professor John Bamford, Dr Graham Sutton
- Funding: Economic & Social Research Council
- Thesis: <https://www.escholar.manchester.ac.uk/uk-ac-man-scw:138160>
- Paper: <https://www.thieme-connect.com/products/ejournals/abstract/10.1055/s-0034-1383505>

Follow Up Study (2017)

- Research Report: The Ear Foundation
- Funding: National Deaf Childrens Society (UK based charity)
- Co-authors: Sarah Allen, Zheng Yen Ng, Dr Sue Archbold and Melanie Gregory
- Research report:
<http://www.ndcs.org.uk/document.rm?id=12796>

PhD Study

Overarching Questions

How parents and carers of pre-school hearing aided children incorporate the use of FM technology into their daily routines?

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	P1	P2	P3	P4	P5	P6	P7
Age (months)	21	17	11	24	11	15	32
Hearing loss (R-L)	Sev-Mod	Sev-Sev	Mod-Mod	Sev-Sev	Sev-Sev	Prof-Sev	Mod-Mod
Hearing Aids	Naida SP	Naida UP	Nios	Naida SP	Naida SP	Naida SP	Nios
FM Receivers	MI11i	MI10i	MI12i	MI11i	MI11i	MI11i	MI12i
FM Transmitter	Inspiro	Inspiro	Inspiro	Inspiro	Inspiro	Inspiro	Inspiro



QUANTITATIVE



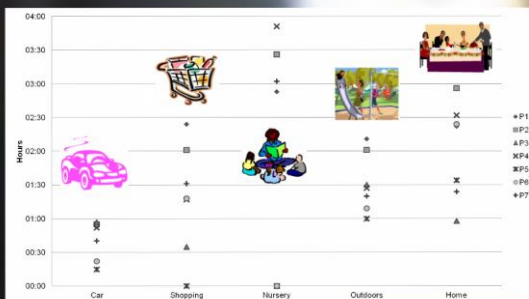
	P1	P2	P3	P4	P5	P6	P7	Total
Age in months	21	17	11	24	11	15	32	
Days in study	251	232	104	187	111	142	171	1198
Days FM used (%)	232 (92)	162 (70)	14 (13)	151 (81)	33 (30)	98 (69)	162 (95)	837 (71)
Total use	723:15	681:00	23:15	598:00	58:15	244:20	546:10	2874:15
Benefit	687:50	676:30	19:10	582:55	42:20	239:20	544:10	2801:00
No Benefit	0:15	0:00	0:00	2:15	0:00	0:00	0:00	2:30
Not sure	35:10	4:30	3:05	12:35	15:25	0:00	0:00	70:45

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FM LEC (De Conde Johnson, C.)

Scores: listening in quiet, noise, distance, auditory only and total

Total scores improved by 12-48% overtime (after 1 month of FM use compared to end)

Biggest improvements in noise and distance

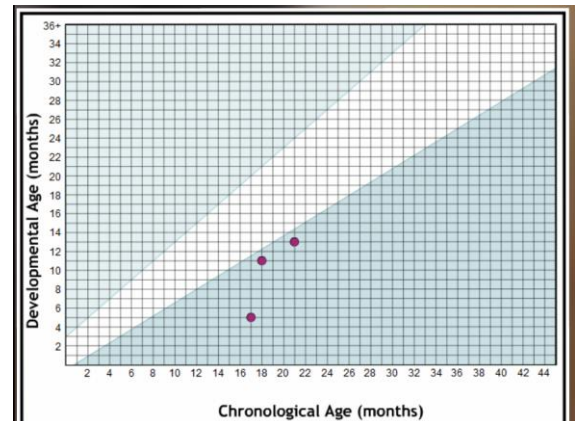
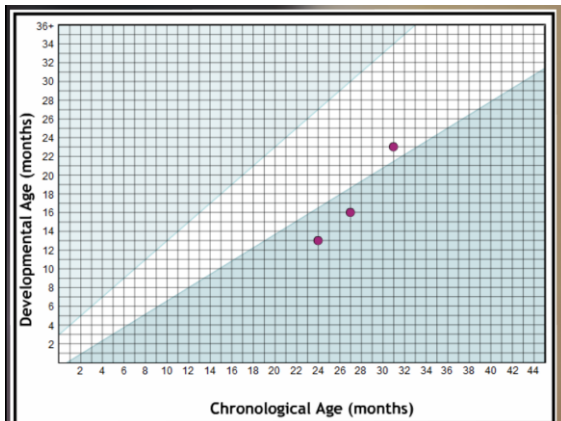
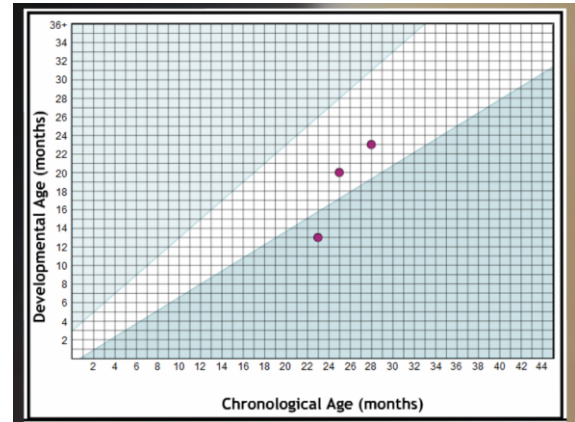
(after 1 month of FM use compared to end)
Biggest improvements in noise and distance

LDS (Gilkerson and Richards, 2008)

Assesses expressive and receptive language skills

No significant change in LDS scores for children (n=4) who started off "Within Normal Limits"

Significant improvements in LDS scores for children (n=3) who started off "At Risk"



QUALITATIVE

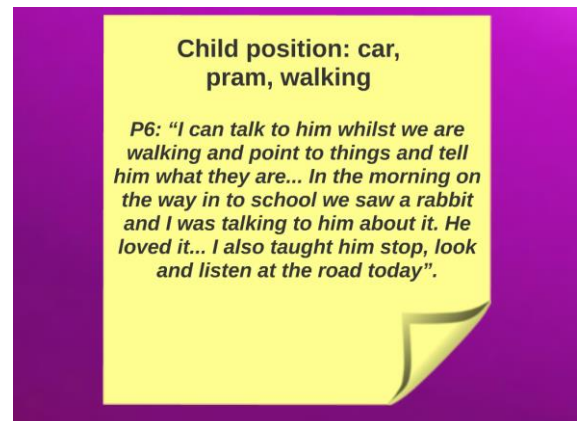
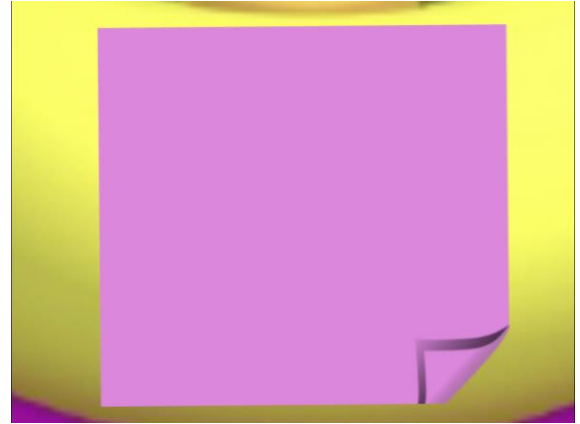
QUALITATIVE

Sought to acknowledge parents and carers as the experts and place them in the centre of knowledge generation

8 weekly diaries, 7 semi structured interviews:
Overall 8 'cases' (7 diary & interview, 1 diary only)

Thematic content analysis was carried out using NVivo 9

Codes generated independently and compared in an iterative process. Codes collapsed and clustered into themes



Attending: improved responsiveness

'Parents/carers diary entries described the child as being:

*"more responsive",
"joins in more",
"turns quicker",
"quicker reactions",
"answered more", was
more "interactive"/
"communicative",
had "more eye
contact"/"looking",
going "quiet" and "pausing",
overall being "more alert"
when the FM was in use.*

Locating FM user: Parents and nursery staff all commented on their positive observation of how "accurate", "quick" and "instant" the child was able to locate the FM user:

Nursery: "I said [child]'s name from across the room. He was sat down on a chair. He turned to look at me. As it was dinner time there were a lot of other noises going on in the room"

P4: "My mum was very impressed how instant she was to look round at her whilst outside playing"

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Maxon and Brackett (1989): FM+M localisation at normal conversational levels; when no FM, required greatly increased stimulus

Overhearing

Floor and Akhtar (2006) found children as young as 16 months could learn new words whilst distracted without any form of scaffolding.

Reduced opportunities for overhearing with HA's

P4: "I was telling my eldest daughter off whilst driving to school when from the back seat [child] said "Shut up, shut up".

Wellbeing

Ownership

Social: increased engagement

P4: "At the nursery [my daughter] never joins in with singing. She never sits in the circle just stands and watches from a distance. She sat next to her key worker who was wearing the microphone and joined in".

P1: "At play centres its very noisy, a lot of children shouting so [my daughter] was struggling whereas with the FM she can hear me even though she can't necessarily always see me which means she's a bit more confident at playing on her own or playing with the other children there doing the activities.

Safety

P7: "It meant that I didn't have to look at her, both really we didn't have to have eye to eye contact, like in the car really it's dangerous to turn round and look at her, so for me personally it was a lot easier so I could speak to her and she could still hear me and we could still chat"

Control of own listening (children):

P7: "If I didn't have the FM on she would point at her hearing aid and say "Mummy can't hear" to let me know she wanted the FM on".

P2: "as he has got a little bit older and he will tell us 'oh, I don't want you to wear that' and we have noticed we don't wear it as much but it still benefits him because we are using it when he wants us to use it, he is very aware of it.

Increase in consistency of HA use::

P6: "After Day one, [my son] seems to be keeping his hearing aids in more. It was the first time he has ever kept his hearing aids in whilst in the car.

P6: "he has always gone through stages pulling them out and then when we got the FM he started leaving them in".

P4: "[My daughter] has begun to ask for her hearing aids to be put in now".

Ease of use

P5: "same as mobile phones, so it is not too hard... it was quite easy"

P3: "It was easy enough to use..., quite self-explanatory, you know the up and down and obviously the soundcheck".

Nursery: "Head of room is on holiday but the other staff in the room are much more confident with it now".

Remembering to mute

P4: "Remembering to mute it at the times you are supposed to mute it, if you went into another room, the telephone rang"

Acknowledged + Overhearing





Monitors and provides automatic analysis of large amounts of natural child language environment data

Oller et al. (2010) Proceedings of the National Academy of Science, 107(30), 13354-13359.



Language environment basic reports: AWC, CV, CT

Characterisation of language/acoustic environments:
Meaningful, Distant, TV, Noise and Silence & Background

LENA: with vs without FM

Four families participated in this sub-study

Four recordings each: two at home and two outdoors (with and without FM)

Home situation:

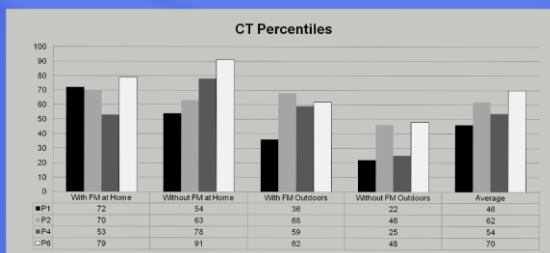
No clear trends in AWC's, CV's or CT's

Outdoors:

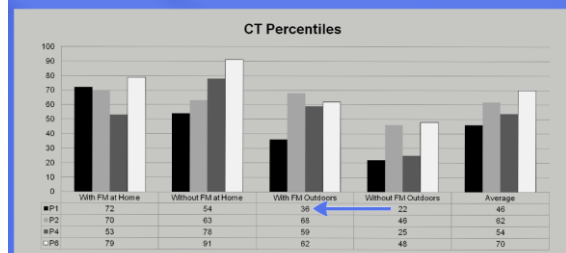
3 of the 4 showed some increase with AWC's and CV's with FM

Clear pattern of increase with CT's

Comparison with normal hearing peers:
AWC's and CV's all recordings above 50th percentile



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AWC's and CV's all recordings above 50th percentile



Characterisation of Language-Acoustic Environment

Average of all 16 recordings:

Acoustic Category	Percentage
Meaningful	21
Distant	26
TV	9
Noise	2
Silence and Background	42

Follow Up Study

Significant Improvements in Technology

- Question: What are the potential benefits and challenges of radio aid use in pre-school deaf children using any form of hearing technology?

Aims

- Understand the real-life benefits and challenges of using radio aids with young children
- Provide information to support parents in making decisions about radio aid use with their pre-school child
- Produce recommendations for professionals to support consistent policy and practice

Participants

Table 1: Individual demographics (n=13)

Participant number	Age at diagnosis (y:m)	Hearing loss ¹	Hearing technology	Age at start of RA use (y:m)	Radio aid system	Age at start of study (y:m)	Time in study (months) ²
1	0;1	Moderate-Severe	Bilateral hearing aids	2;5	Phonak Roger Inspiro	2;4	4
2	0;0	Severe	Bilateral hearing aids	2;10	Phonak Roger Inspiro	2;11	5
3	0;2	Severe	Bilateral BCIIs	3;0	Phonak Roger Inspiro	3;2	6
5	0;1	Moderate-Severe	Bilateral hearing aids	2;10	Phonak Roger Pen	3;1	5
6	0;1	Moderate-Severe	Bilateral hearing aids	1;4	Phonak Roger Pen	1;5	5
8	0;2	Severe	Bilateral hearing aids	1;9	Phonak Roger Inspiro	2;0	5
9	0;0	Mild-Moderate	Bilateral hearing aids	2;0	Phonak Roger Pen	2;0	4
11	0;2	Moderate	Bilateral hearing aids	2;6	Phonak Roger Pen	2;8	4
12	0;9	Moderate	Bilateral hearing aids	3;5	Comfort Audio	3;6	4
13	2;0	Moderate-Severe	Bilateral hearing aids	4;2	Phonak Roger Inspiro	4;2	4
15	0;1	Moderate	Bilateral hearing aids	3;8	Phonak Roger Inspiro	3;8	5
16	0;0	Moderate-Severe	Bilateral hearing aids	3;4	Phonak Roger Inspiro	3;5	4
20	1;3	Severe	Bilateral hearing aids	3;3	Genie / E-Clarity / Roger pen	2;8	4

Benefit

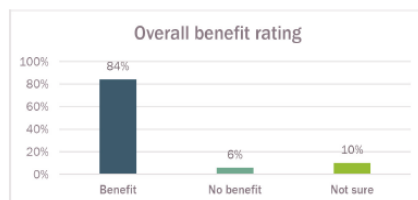


Figure 2. Overall perceived benefit of using radio aid in daily situations (n=468)

Situational Benefit

Table 2. Parent perception of benefit in different situations and activities

Activity	Benefit	No benefit	Not sure
Outdoors (close)	85%	8%	6%
Outdoors (at distance)	89%	5%	5%
Car	89%	1%	10%
Buggy	100%	0%	0%
Nursery (indoors)	84%	9%	7%
Nursery (outdoors)	88%	0%	13%
Indoors (1 adult)	59%	14%	27%
Indoors (>1 adult)	77%	13%	10%
Indoors (at distance)	88%	13%	0%
Pre-school group	92%	0%	8%
Meal time at home	88%	0%	13%
Shopping	91%	0%	9%
Party	89%	0%	11%
Soft play	91%	0%	9%
Eating out	100%	0%	0%
Family gathering	100%	0%	0%

LENA: Paired Recordings

Listening environment (No ref pass)	Adult Word Count			Conversational Turns			Child Vocalisation		
	Without radio aid	With radio aid	%	Without radio aid	With radio aid	%	Without radio aid	With radio aid	%
Car (7)	766	1994	+160%	32	78	+144%	255	309	+21%
Indoors: 1-1 with an adult (6)	5746	6712	+17%	300	401	+34%	1270	1389	+9%
Indoors: more than 1 adult (7)	4828	4399	-9%	302	267	-12%	1205	1292	+7%
Outdoors (7)	1347	2567	+92%	90	169	+88%	554	733	+32%
Shopping (3)	626	976	+56%	42	66	+57%	283	317	+12%
Nursery (4)	1790	1572	-12%	37	21	-43%	155	267	+72%

Table 3. Adult word count, Conversational Turns and Child Vocalisations without and with radio aid (n=number of paired recordings per situation)

Qualitative Findings

4.4 Practical considerations

Choose a simple, reliable system	<ul style="list-style-type: none"> • Easy to use • Reliable
Wires	<ul style="list-style-type: none"> • The fewer wires, the better
Batteries	<ul style="list-style-type: none"> • Battery safety is an issue • Battery life is affected
Size, weight & visibility	<ul style="list-style-type: none"> • Wearing the receivers • Wearing the transmitter & microphone
Valuable equipment	<ul style="list-style-type: none"> • Responsibility • Inconsistent advice from insurers

Qualitative Findings

4.6 Choosing the right time

"The right time": factors to consider

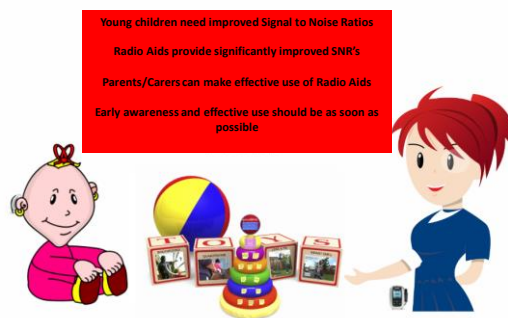
- As early as possible
- Child's mobility
- Speech & language development
- Consistency of hearing aid use
- Before starting education
- When it's right for you and your child

"The Right Time"

- P6: It would be nice to get a radio aid with the hearing aids initially really [...] I think the sooner the better really
- P5: I would have introduced it a lot sooner knowing how he copes with his hearing loss as it is now
- P20: Don't just sign up for it just as you have heard your baby is deaf, because you are going to need a couple of months to getting used to putting in the hearing aids and maintaining them [...] maybe get familiar and confident with their hearing aids and when you are alright with their hearing aids and confident with that then look into a radio aid

Early Awareness

- P12: It should be available as an option. The more you know, and the more options there are the better. If you start to close doors and you don't have them available to you and not presented those options, the doors are closed.



Thank you for listening!

11/14