FM for Toddlers

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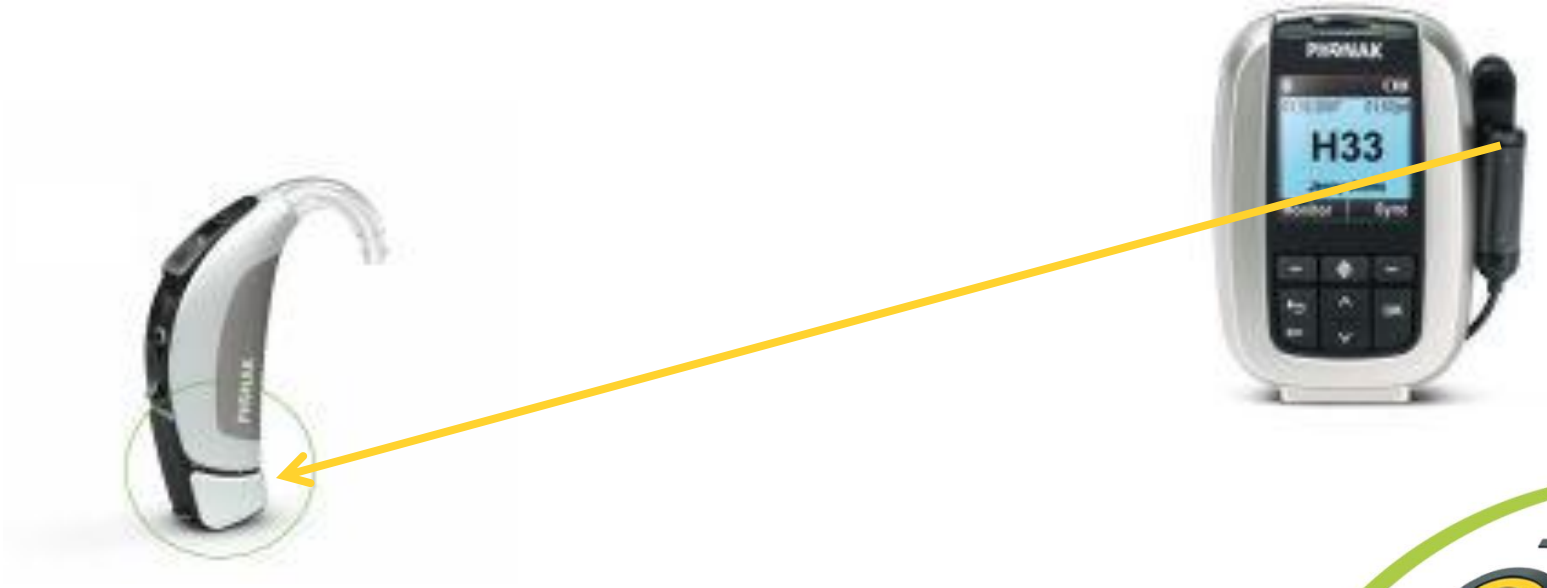
What do we know?

- Younger children (6 years) with normal hearing require significantly higher SNR values (>+15dB) 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
- Efffects 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

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

FM technology

- One known and effective way to significantly improve SNR and reverberation times is through the use of FM technology



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FM with toddlers (under 3)

Limitations of previous studies (Brackett, 1992; Moeller et al, 1996) including preschool FM use:

- Little or no data on actual use of FM
- Age range was considerable: 2-8 years (early years not focus)
- Equipment was cumbersome and bulky making it unsuitable for really young children

Earlier identified children + improved FM technology= opportunity for FM use with pre-school children

Overarching Questions

- how parents and carers of pre-school hearing aided children incorporate the use of FM technology into their daily routines?
- what were the potential benefits of FM technology use with pre-school hearing aided children?
- what were the views and experiences of parents and carers using FM technology?

Study

Four strands:

- Verification of Autoconnect feature
- Quantitative analysis of early FM use
- Qualitative analysis of early FM use
- Language ENvironment Analysis: FM vs without FM

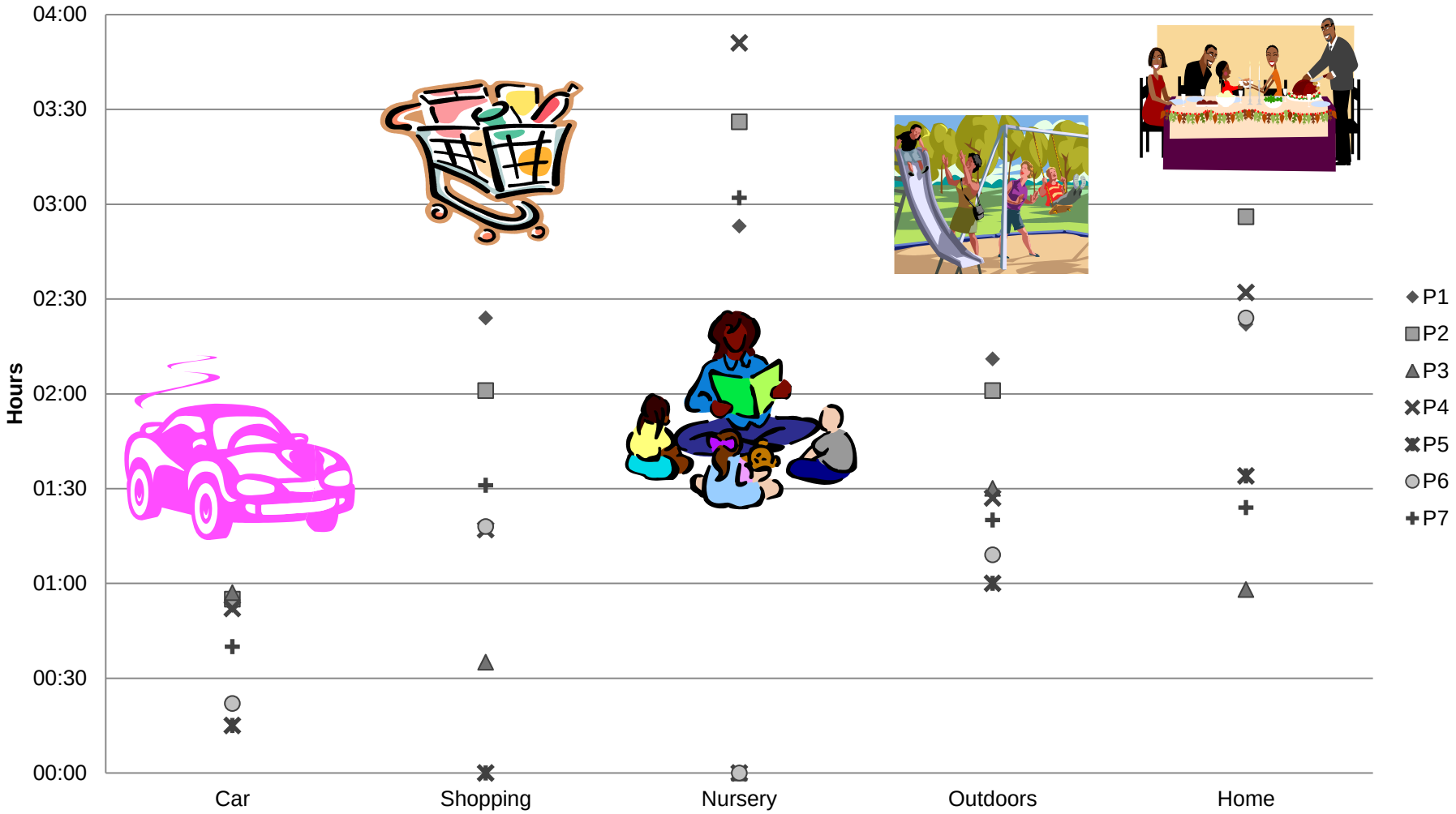
Participants and Equipment

	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	Ml11i	Ml10i	Ml12i	Ml11i	Ml11i	Ml11i	Ml12i
FM Transmitter	Inspiro	Inspiro	Inspiro	Inspiro	Inspiro	Inspiro	Inspiro

Usage

	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 (81)
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

Situational Use



Listening with FM

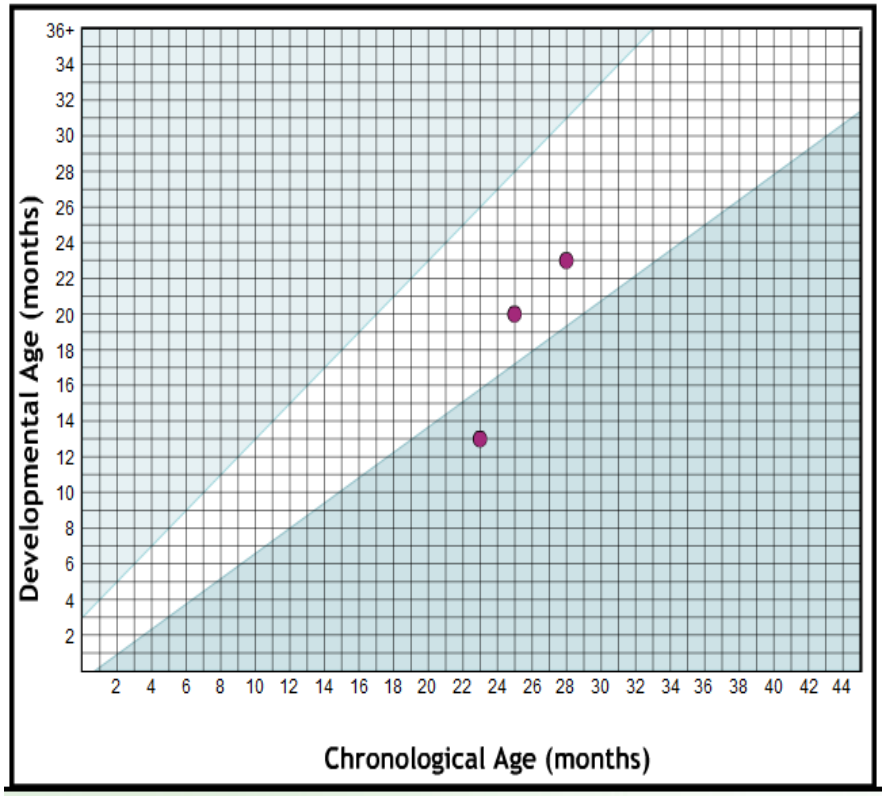
- FM Listening Evaluation for Children (FMLEC; De Conde Johnson: Gabbard, 2003)
- Scores: listening in quiet, noise, distance, auditory only and total
- Total scores improved by 12-48% overtime (after 1 month of FM use compared to end)
- Biggest improvements in noise and distance

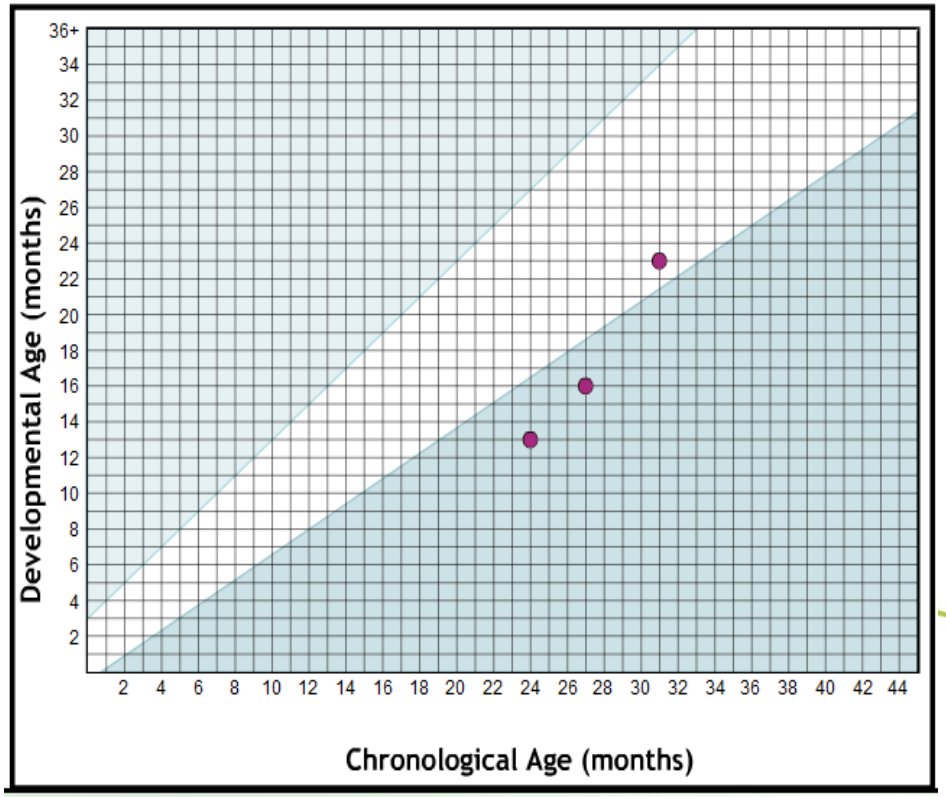
Language

- LENA developmental snapshot (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"

Language Trends

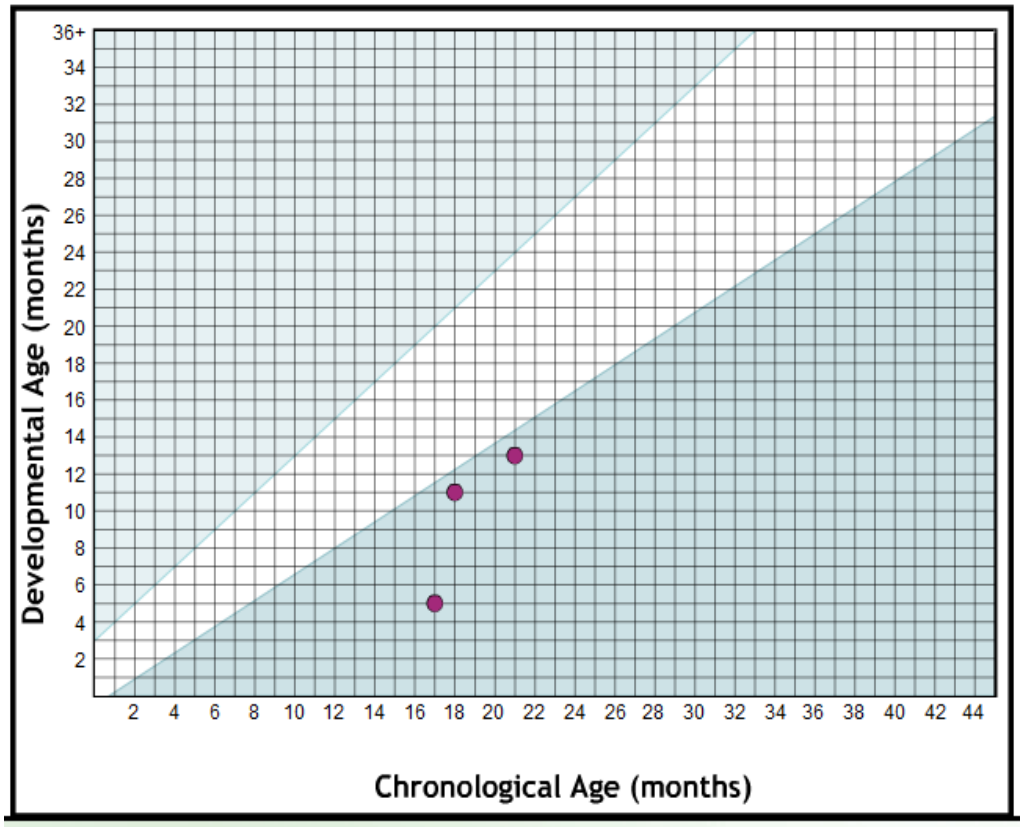
Users of FM (at risk): P1 (left) and P4 (right)





Language Trends

Users of FM (significantly at risk at beginning): P6



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Qualitative Analysis

- The study 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 then compared in an iterative process
- Codes collapsed and clustered into themes

Qualitative analysis

- Six main themes (sub themes: 27):
  - Access to speech (5)
  - Listening (7)
  - Language (2)
  - Wellbeing (4)
  - Engagement/Ownership (4)
  - Practicalities of FM use (5)

Access to Speech

- Child position: car, pram, walking:

P6: “I can talk to him whilst we are walking and point to things and tell him what they are... In the morning on the way in to school we saw a rabbit and I was talking to him about it. He loved it... I also taught him stop, look and listen at the road today”.

Access to Speech

- Reduced access to HA microphones: winter hats, horse riding and cycling helmets etc.

P4: “we had it in the winter, we started off in the winter. Very useful with the hats on. [My daughter] has hats that cover her ears... so we notice a big difference using the FM outside. She could still hear you. We found it most useful outside. Very, very useful outside”.

Listening

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*” and
  - overall being “*more alert*” when the FM was in use.

Listening

Locating FM user: Parents and nursery staff all commented on their positive observance of how "*accurate*", "*quick*" and "*instant*" their 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"*

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

Listening

- 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

- 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.*

Engagement/ownership

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.*

Engagement/ownership

Increase in consistency of hearing aid 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, he fell asleep.

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”.

Consistency of HA use

Consistency of hearing aid use:

Moeller et al., 2009:

Only 2 out of 7 children from families of highly motivated parents had consistent use of hearing aids in ‘easy to monitor’ and ‘difficult’ listening situations by 16 months of age.

Both families used FM.

For the other 5 children by 28 months of age consistency of HA use had reached between frequent to always for most (not all) situations listed.

(Situations: car* , play outside, family outings)

Practicalities

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”.*

Practicalities

Barriers to FM use (moulds, infections, HA, age):

P3: "[My son] started with an ear infection on the Sunday so we haven't used it since... Not used as [my son] isn't keeping aids in long enough, only 10 minutes at a time as ear moulds are too small... I would say especially with [my son], the problems we have had is with earmoulds, getting them back to us quick enough,

P5: "At the time more her age and the moulds going, and her not wearing the hearing aids – that would be the main thing that would stop us and sometimes she would keep the aids in and then take the aids out after a minute or two and we would think what's the use".

Practicalities

Challenges (mic positioning, pulling, mute):

- *P1: “The microphone turns over when used with light clothing... the clip and wire on the microphone fit better with mic to skin”.*
- *P5: “if I was holding [my daughter] she would pull on the wire so that would come off sometimes and she would pull off the mic”.*
- *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)

Advice to other parents

- *P2: “Definitely give it a go. It has been brilliant for [my son] but that is not to say it will be great for somebody else. I suppose it depends on the child and also the parents, all different circumstances. Definitely give it a try because you can’t say it is going to be beneficial or not until you have tried it”.*

Take home message

- Young children need improved SNR's
- FM can provide required SNR's
- Carers can make effective use of FM

Further research

Current:

- Professionals' views on early FM provision: UK based questionnaire study

?Future

- Extend current study
- Cost effectiveness of early FM: SROI, QofL
- LENA: counseling, identify where FM may benefit

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Thank You for Listening

Link to electronic copy of thesis:

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