

FM Technology: When to Introduce to Children

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What do we know?

- Younger children (5-6 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
- 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



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





LEARNING

NOISE

REVERBERATION

DISTANCE





Learning Condition	Learning	Reverberation	Noise	Distance
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1

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?

	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

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Use with pre-school hearing aided children?

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QUANTITATIVE



	P1	P2	P3	P4	P5	P6	P7	Total
Age at months	21	17	11	24	11	15	32	
Days in study	251	232	104	187	111	142	171	1108
Days FM used (%)	232 (92)	162 (70)	114 (11)	151 (81)	33 (30)	98 (69)	162 (95)	81
Total use	724:15	681:00	23:15	588:00	58:15	244:20	546:18	2874:17
Benefits	687:50	676:30	19:10	582:55	42:20	239:20	544:18	2851:30
FM	0.15	0.00	0.00	2.15	0.00	0.00	0.00	2.30
Net use	85:10	4:30	2:05	12:35	15:25	0:00	0:00	79:45



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)

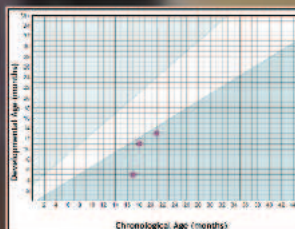
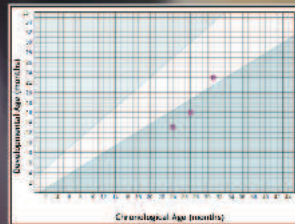
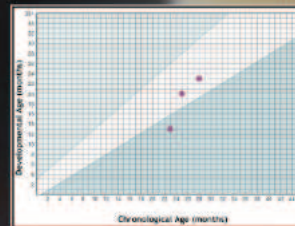
Biggest improvements in noise and distance

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"



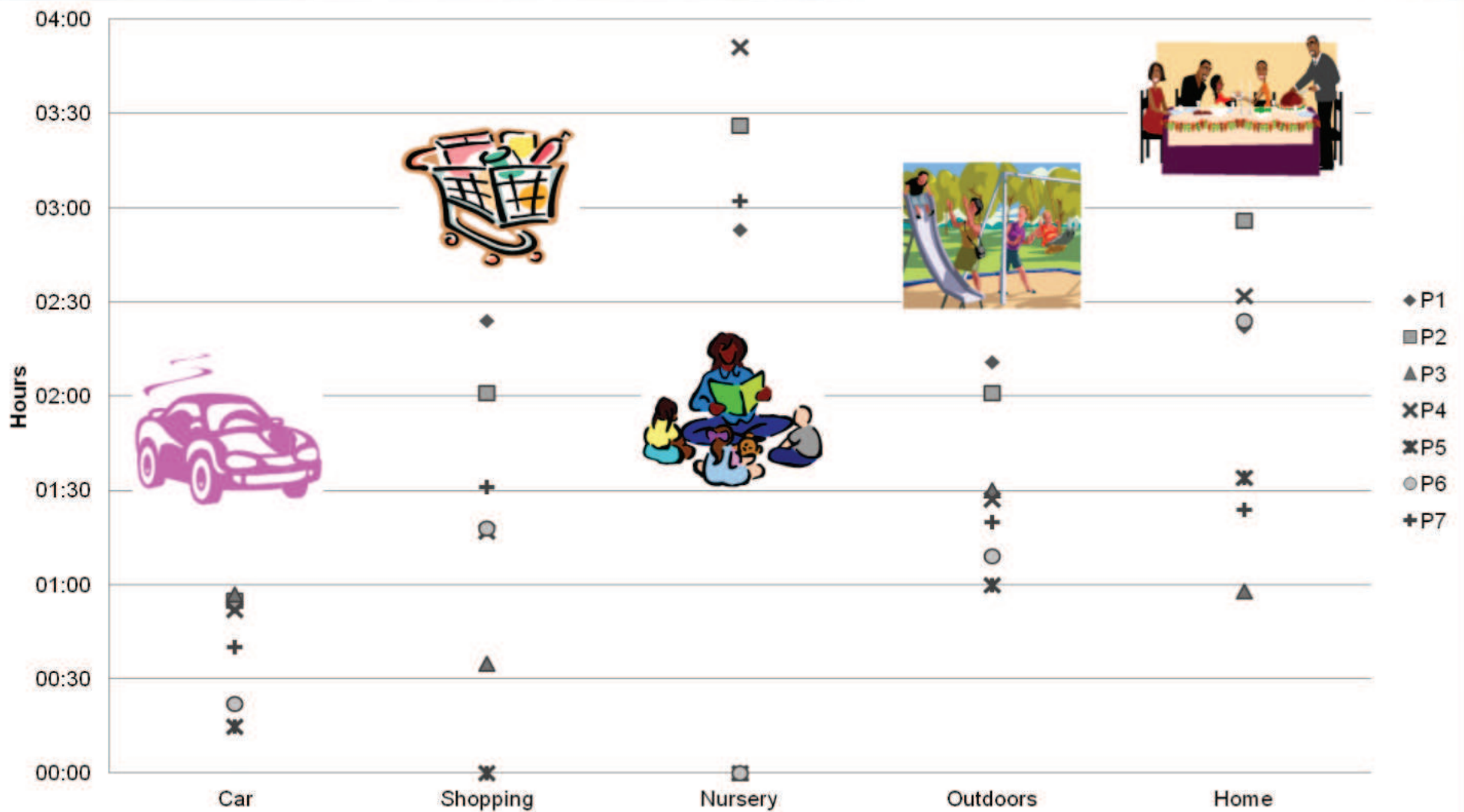
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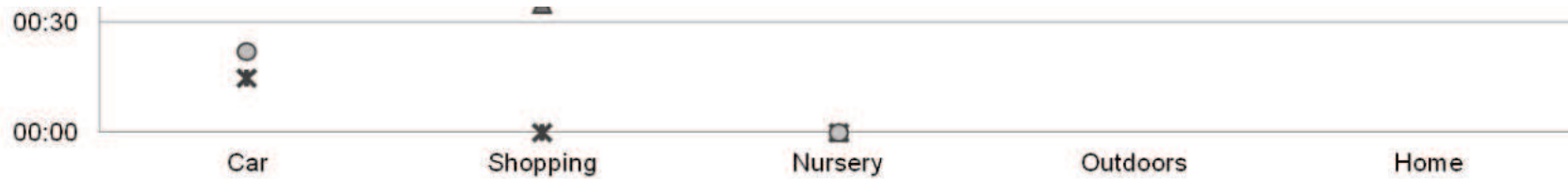
04:00

x

03:30







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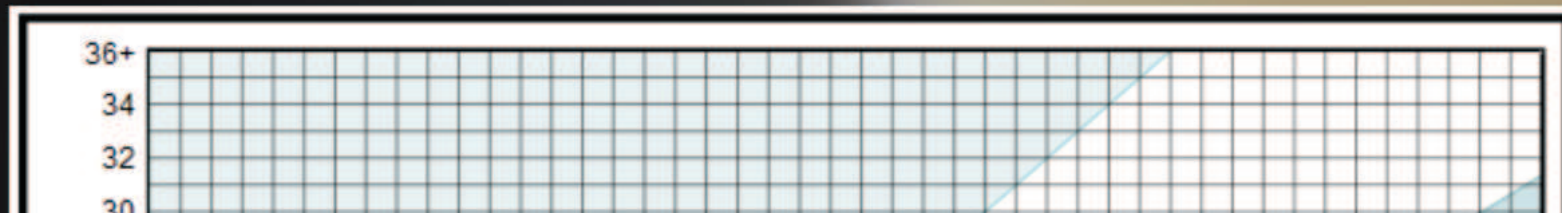
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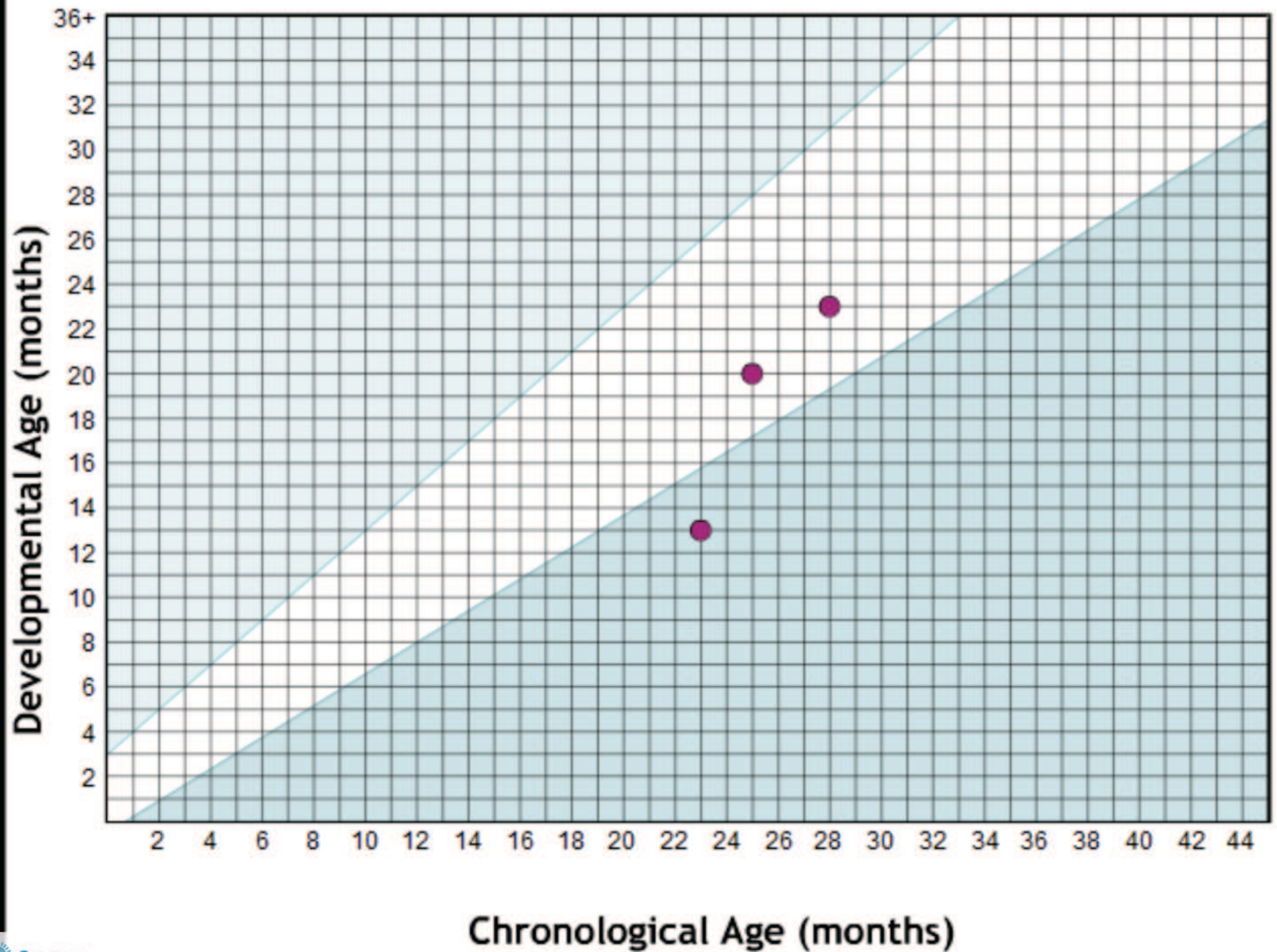
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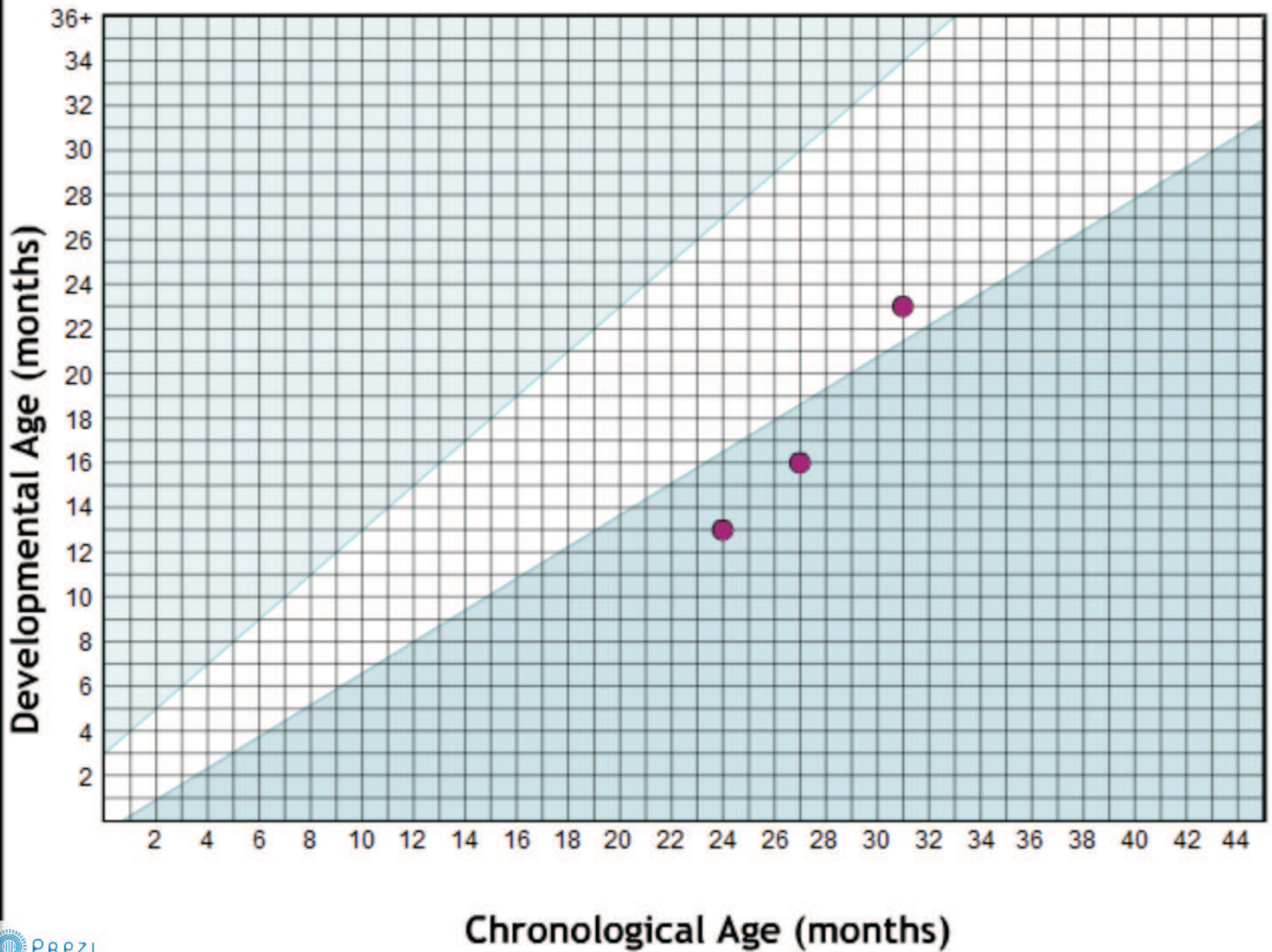
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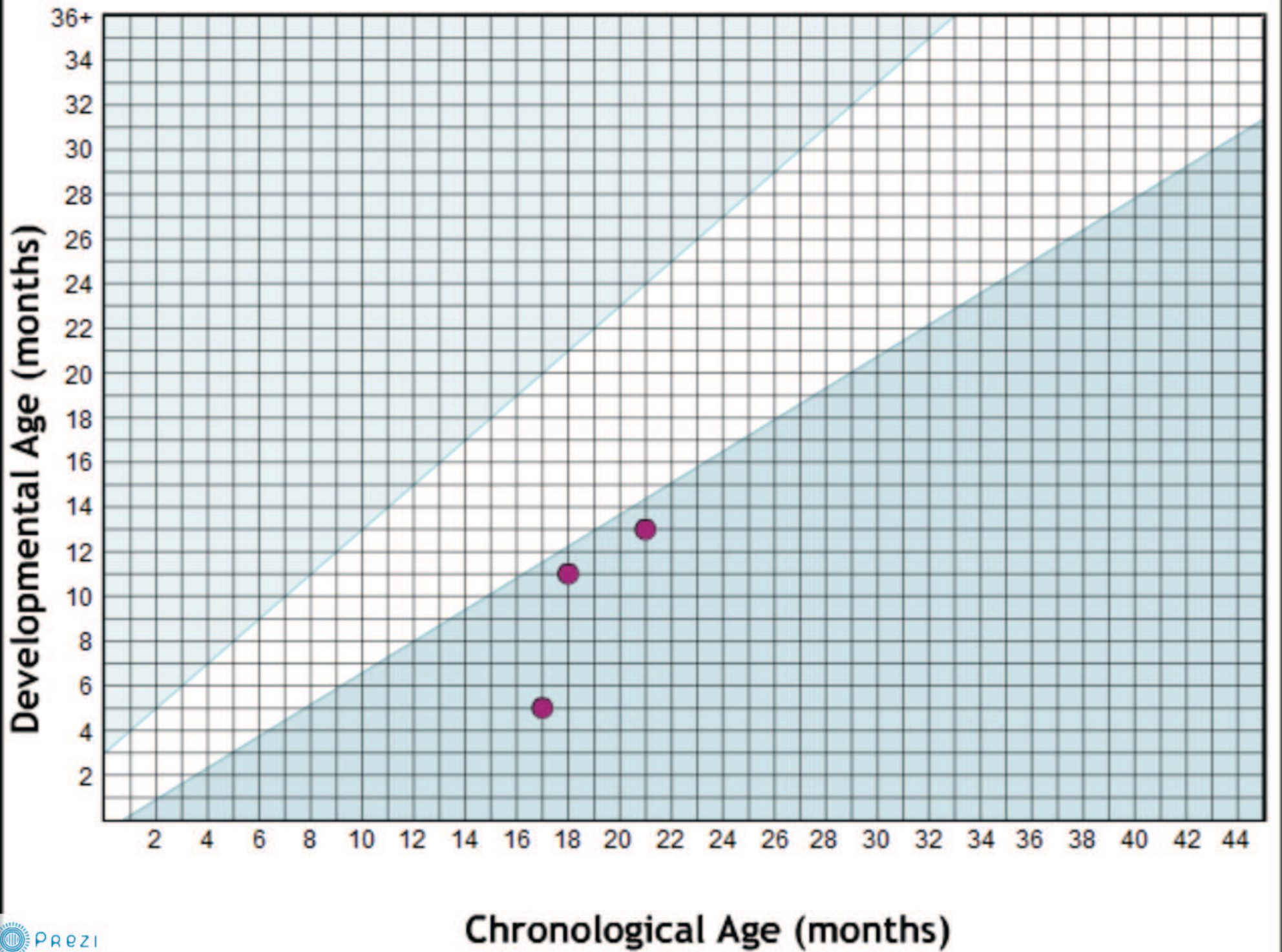
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QUANTITATIVE



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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

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**Main themes: 6
(sub themes: 27)**

Access to speech (5)

Listening (7)

Language (2)

Wellbeing (4)

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".

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."

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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",
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"

Mixon 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".

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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.

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"

Ownership

Control of own listening (children):

P7: "If I didn't have the FM..."

Increase in consistency of HA use::

...the Day one [my son] seems to be

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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".

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".

Nurserv: "Head of room is on

Barriers to FM use

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... the problems we have had is with earmoulds, getting them back to us

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

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- Language (2)
- Wellbeing (5)
- Ownership (3)
- Practicalities of FM use (5)

Access to speech

Ownership of FM
All participants had a dog and most had a cat. The majority of participants had a dog and a cat. The majority of participants had a dog and a cat. The majority of participants had a dog and a cat.

Access to speech
Participants were asked to describe their experience of using the FM. The majority of participants had a dog and a cat. The majority of participants had a dog and a cat. The majority of participants had a dog and a cat.

Listening

Listening
Participants were asked to describe their experience of listening to the FM. The majority of participants had a dog and a cat. The majority of participants had a dog and a cat. The majority of participants had a dog and a cat.

Wellbeing

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Participants were asked to describe their experience of wellbeing. The majority of participants had a dog and a cat. The majority of participants had a dog and a cat. The majority of participants had a dog and a cat.

Ownership

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Practicalities

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QUANTITATIVE



LENA & FM



IN

Ratton, A. (2013) EARly in Type
epilepsy: A Review
Master's
Supervisor: Dr Tim Whiting & J

LENA & FM



hearing

I found children are playing
hard now sounds which
I can't hear at all.

I'm overreacting with noise
it's laughter off whilst
from the back seat
is what up!

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

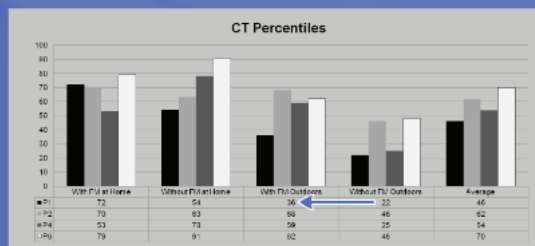
Outdoors:

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

Clear pattern of increase with CT's

Language Environment Percentiles

Comparison with normal hearing peers:
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	42
TV	9
Noise	2
Silence and Background	26

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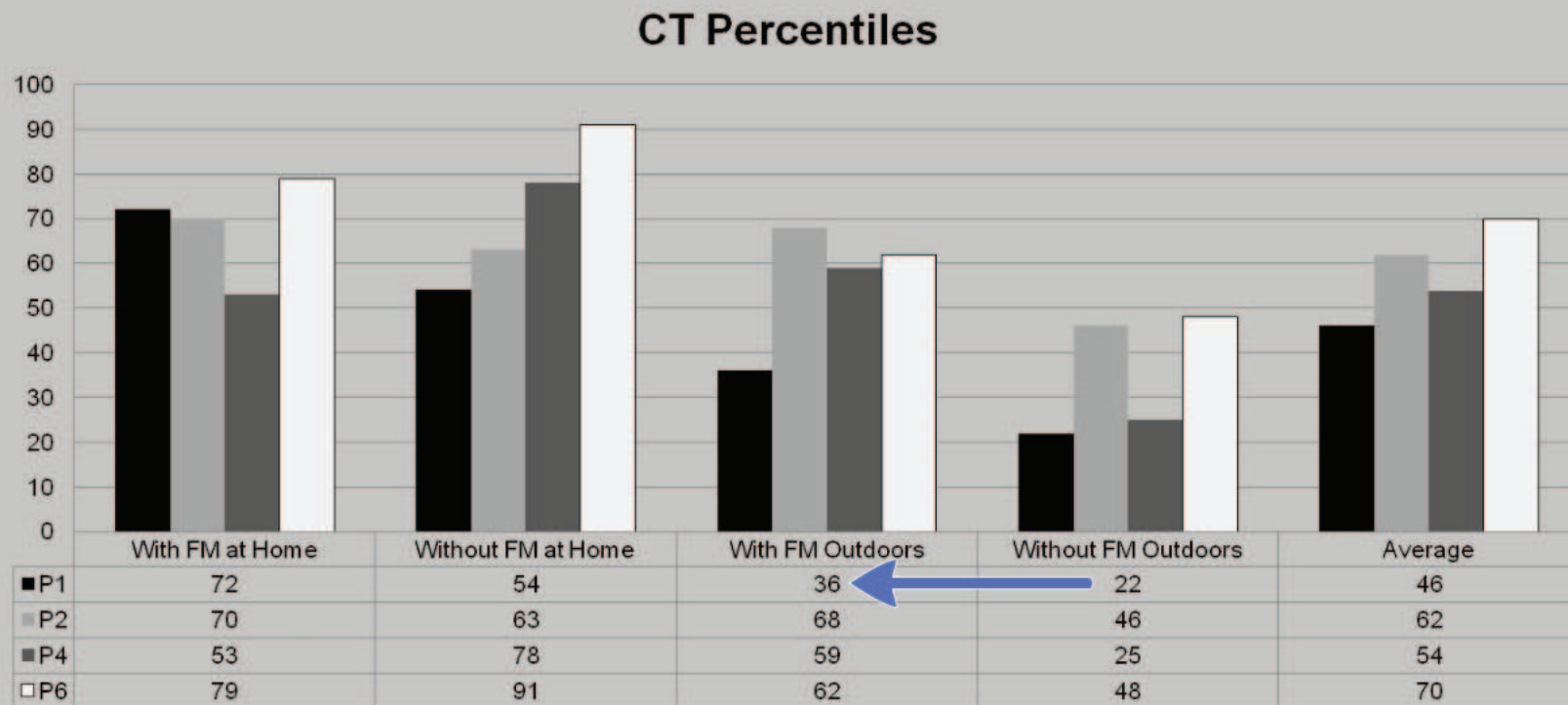
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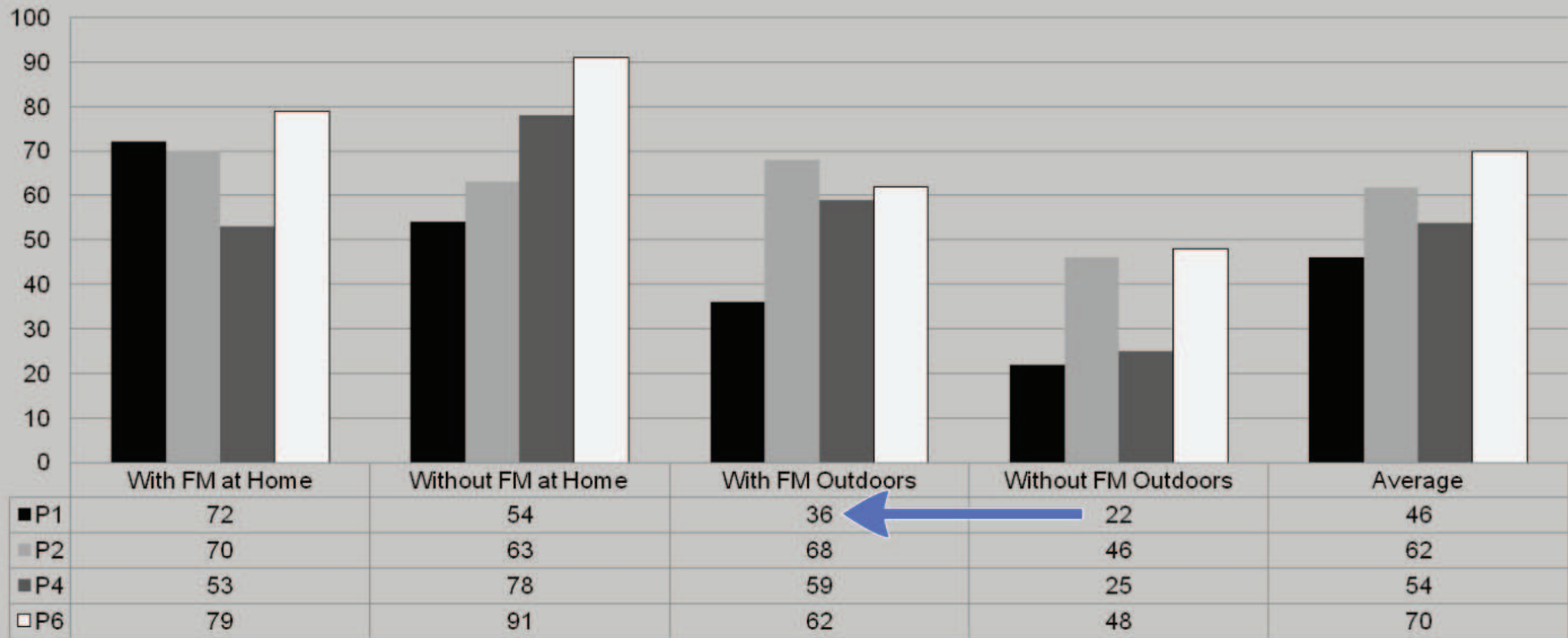
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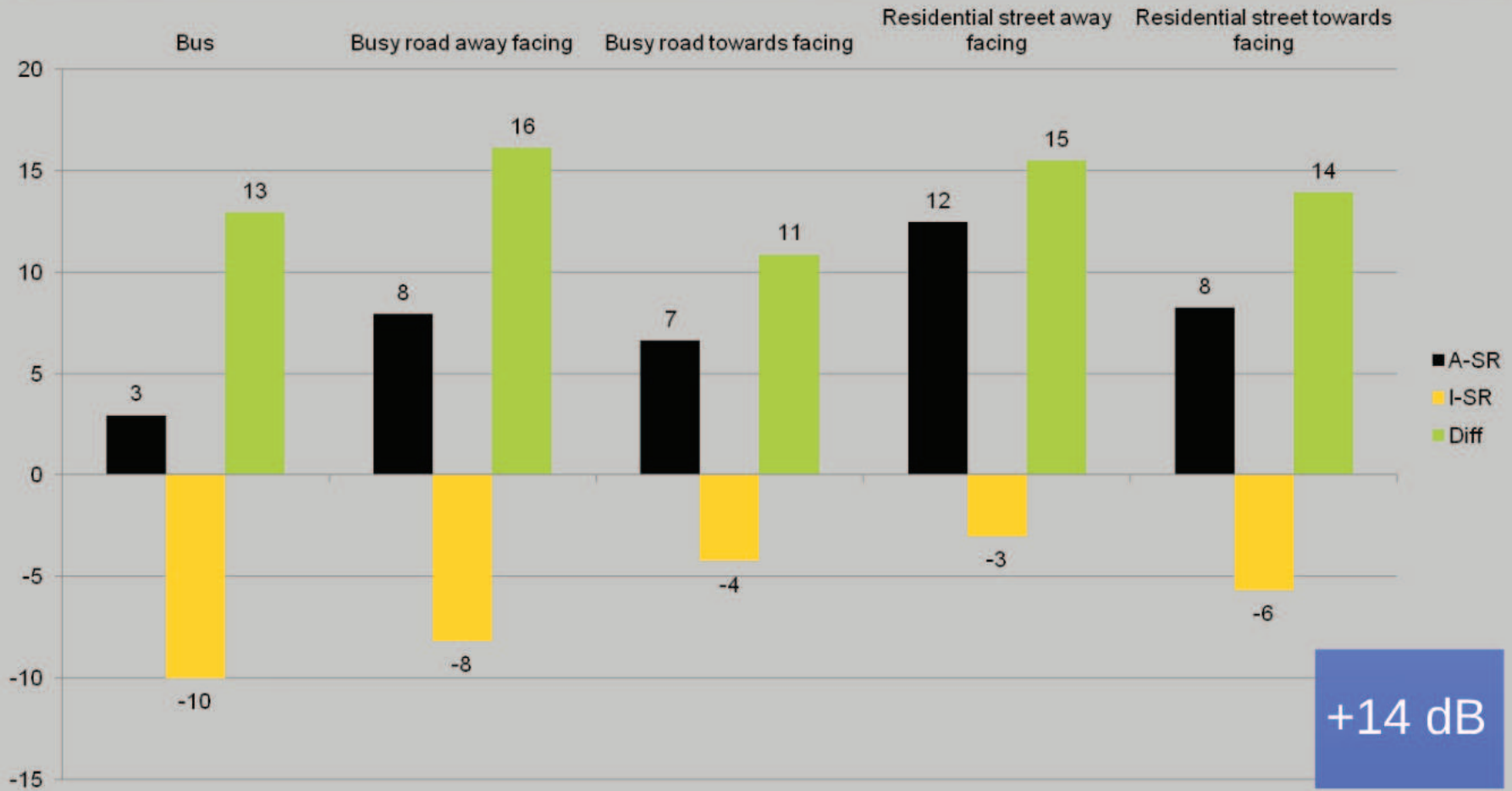
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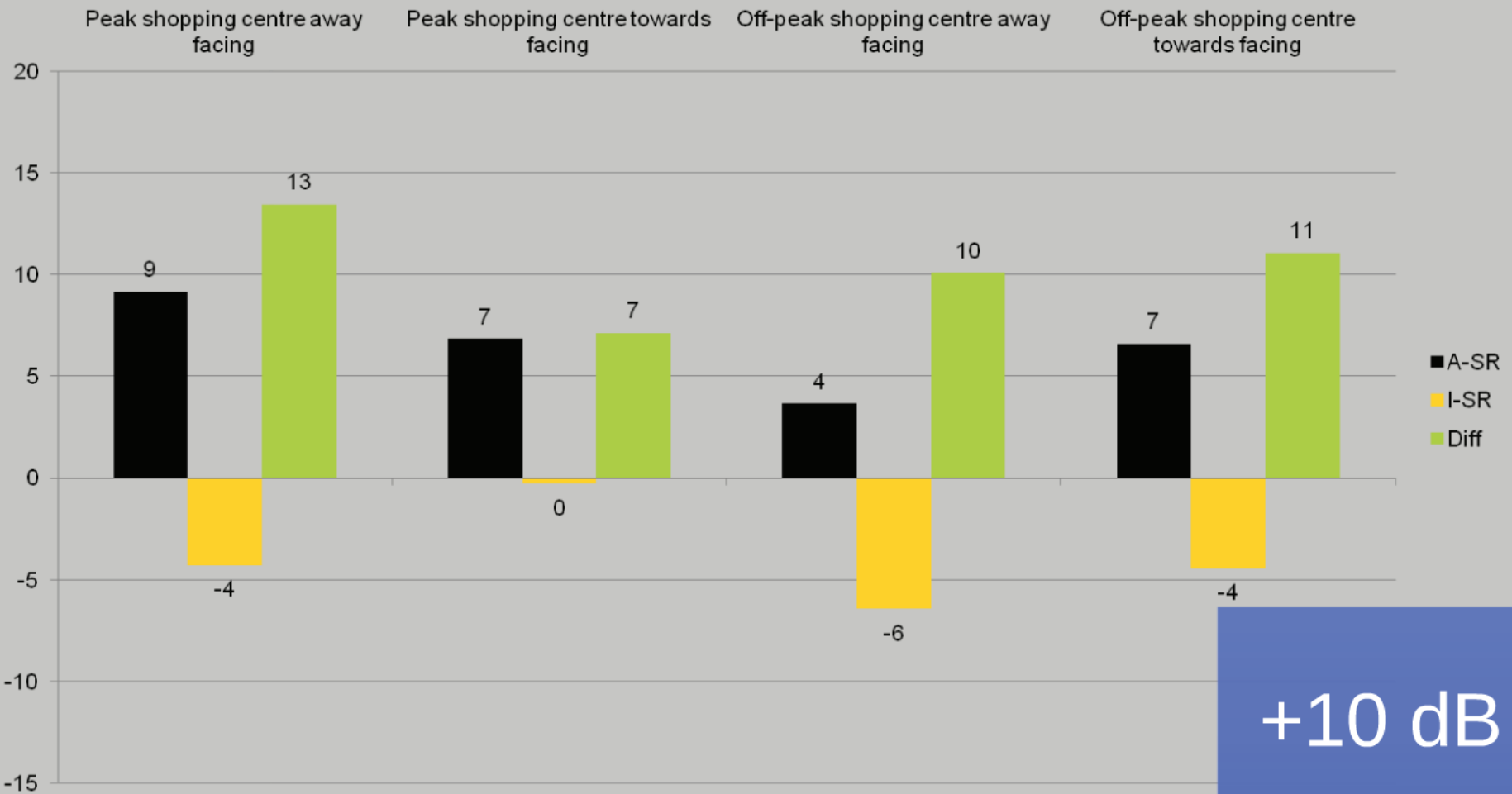
INFANT SNR's

Batten, A. (2013) SNR's in typical infant listening environments, MSc Dissertation, University of Manchester
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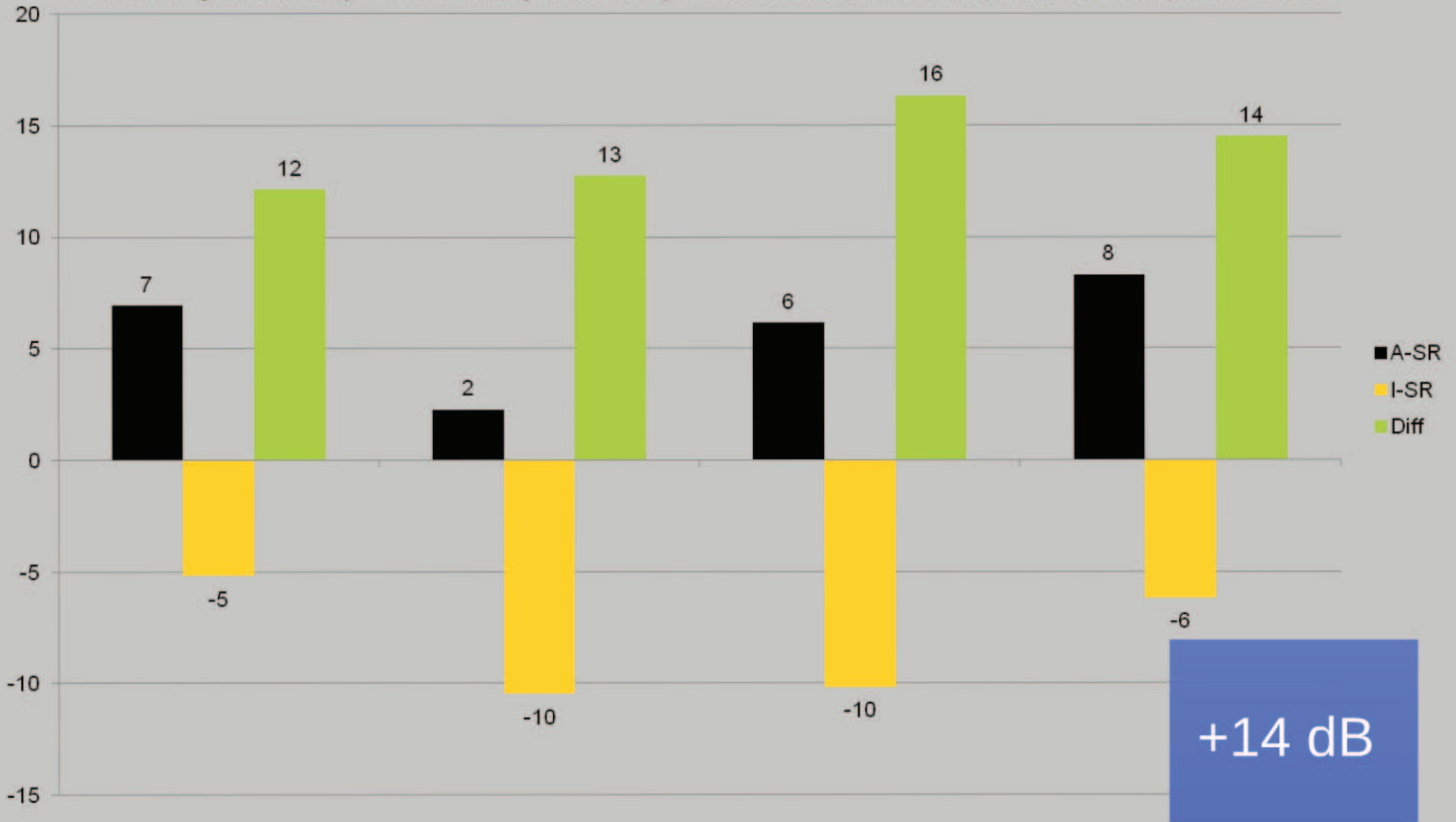


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Forward facing car seat 30 mph Forward facing car seat 70mph Reverse facing car seat 30mph Reverse facing car seat 70mph



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Young children need improved SNR's

FM can considerably improve SNR's

Carers can make effective use of FM

What age? As soon as possible!

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A very special thank you to the participants, paediatric audiologists and teachers of the deaf.

The study was funded by the Economics and Social Research Council UK

Thanks: equipment + support throughout

Parents can make effective use of FM

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Advisory Team: Dr Graham Sutton, Professor Kevin Munro & Professor John Bamford
A very special thank you to the participants, paediatric audiologists and teachers of the deaf.
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Thank you for listening!