

Roger™ for young children
When a child can hear more words, life is on



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A Sonova brand

Agenda

1. Building the foundation for brain development
2. The Complete System - it takes two!
3. Evidence



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Pediatric commitment for 45 years

- Foster professional development
- Work closely with our International Pediatric Advisory Board
- Conduct internal and external research studies
- Host our global pediatric conferences

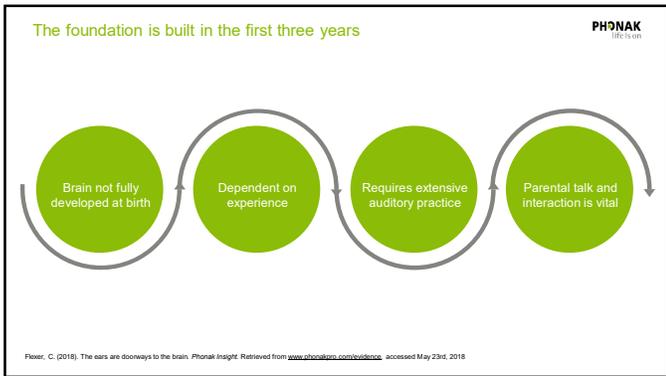
Our Why



At Phonak we want to give **every child** the opportunity to hear and understand in **every situation** so they can develop speech, communicate effectively, play, laugh, and **be confident in everything** that they aspire to be or do.

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1 Building the foundation for brain development



How many words does a child need to hear to be ready for school?

- A. 1 million
- B. 5 million
- C. 20 million
- D. 45 million

| | | |
|----------------------------|---|--|
| 11 million words a year | | 150 wpm avg English speaker's rate ¹ |
| 31 thousand words a day | 45 million words pathway to language | 131 words Goodnight Moon |
| 51 words a minute* | | 1.08m words the entire Harry Potter Series |

Voice Quality. National Center for Voice and Speech. <http://www.ncvs.org/research/clinical/voice-production/quality.html>. Accessed on 1/27/2018

To be ready for school children need to

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- Hear approximately 45 million words by the age of 4 years.¹
- Have 20,000 hours of listening in infancy and early childhood as a basis for reading.²
- Have back and forth exchanges and be engaged in conversation.³

¹Hart, B. & Risley, T. (1995). Meaningful differences in the everyday experience of young American children. Baltimore, MD: Paul H. Brookes Publishing.
²Cheney, S. (2009). Reading in the Brain: The Science and Evolution of a Human Invention. New York, NY: Viking.
³Ryffin, A. (2018, February 13). Back-and-forth exchanges boost children's brain response to language. MIT News. Retrieved from <http://news.mit.edu/2018/communication-boost-children-brain-response-language-02-14>. Accessed May 23rd, 2018

Ears are the doorway to the brain

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- We hear with the brain and not our ears!
- The brain can only learn to understand information that actually reaches the brain
- Quality and quantity matter - "Garble in, garble out!"
- Modern hearing technology breaks through the doorway

Listening in noise and over distance

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40% of speech in a child's typical day comes from a distance of over six feet and/or with 'overlapping' noise

Mills, I & McCracken, W. (2014, April 6). The Use of FM Technology for Pre-School Children with Hearing Loss. PHD publication.

What percentage of language is learned incidentally

A. 0-50%
B. 80-90%
C. 100%
D. I don't know

Incidental language learning

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Roger allows a child to hear more
A large percentage of language is acquired through incidental learning

Akhtar, N., Jipson, J., & Callanan, M.A. (2001). Learning words through overhearing. *Child Development*, 72(2), 416-430.

Outcomes of Children with Hearing Loss (OCHL)

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Ongoing multi-site longitudinal study

- University of Iowa
- Boys Town National Research Hospital
- University of North Carolina at Chapel Hill

317 kids

Between 5 months and 17 years

Mild to severe hearing loss

McCreery, R. W., Walker, E. A., Sprofford, M., Bentler, R., Hobe, L., Roush, P., & Moeller, M. P. (2015). Longitudinal predictors of aided speech audibility in infants and children. *Ear and Hearing*, 36 Suppl 1, 24-37.

Guarding against language delay for children with hearing loss

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3 key predictors of better outcomes:

- Well fit hearing aids
- Consistent hearing aid use
- Quality language input

McCreery, R. W., Walker, E. A., Sprofford, M., Bentler, R., Hobe, L., Roush, P., & Moeller, M. P. (2015). Longitudinal predictors of aided speech audibility in infants and children. *Ear and Hearing*, 36 Suppl 1, 24-37.

2 Roger – the complete system – It takes two!

Why the name Roger?

- Roger comes from aviation
- It means *message received and understood*



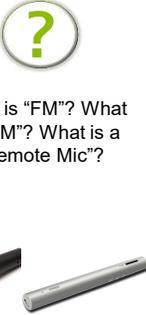
What makes a complete Roger system?



Hearing instrument + Roger receiver + Roger microphone



What is "FM"? What is "DM"? What is a "Remote Mic"?



Components of an FM system

- A personal frequency modulation (FM) system uses radio waves to send speech and other signals to hearing devices
- FM is the same type of signal as your FM radio, only it's tuned to a frequency band designated for personal use
- There are two basic components of a personal FM system
 - Transmitter/microphone
 - Receiver
- Like most things today, we have gone digital, or "DM"



What is the purpose of an FM (DM) system?

- Reduce background noise
- Improve clarity
- Hear from a distance
- Reduce fatigue

Why FM/RM Technology?

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Normal hearing children and adults

| Age Group | Word recognition up-close in quiet (1.8 m) | Word recognition with distance noise (7 m) |
|-----------|--|--|
| 4 years | 88.3% | 67% |
| 5 years | 94.3% | 84% |
| 6 years | 98% | 86.7% |
| Adult | 99.3% | 97.0% |

Adapted from Johnson 1996

- All children are at a disadvantage when listening to a distant speaker or in background noise
- Hearing impaired children have an even greater disadvantage in these environments
- FM overcomes the factors of background noise and distance from sound source

Legend for the following slides

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- Noise = Ruby bars
- Speech = Blue bars
- Arrows = Signal-to-noise ratio

SNR without a wireless microphone

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Talker

Listener

No wireless: poor SNR

- Noise is often equally distributed throughout a room
- Speech level drops over distance

SNR with traditional FM

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With traditional FM: Better SNR, but not as good as at the source

Compression

FM signal + HI mic signal = FM + M

SNR with traditional FM at higher noise levels

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Higher ambient noise: improvement in SNR stays, but benefit shrinks

Compression

FM signal + HI mic signal = FM + M

With a Roger receiver...

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Roger adaptive gain: benefit restored

Compression

FM signal + HI mic signal = FM + M

The Roger strategy

1. Bringing the microphone **to the source**
2. Optimizing SNR at the source with **beam former**
3. **Adaptively** mixing wireless mic signal and ear-level microphone
 - **increasing** the gain of the Roger receiver in higher ambient noise levels
4. **Reducing the gain when no voice is present**



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"Homes are pretty quiet places."



LeBeau V.V. and Cimmins M. Roger For Very Young Children, 2016, Advanced Bionics

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"Homes are pretty quiet places."



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"Homes are pretty quiet places."



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"Homes are pretty quiet places."



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"Homes are pretty quiet places."

| | |
|--------------------------|-------------------------|
| Baby's cry (100dB) | TV audio (70dB) |
| Food processor (95dB) | Shower (70dB) |
| Lawn mower (90dB) | Background music (60dB) |
| Food blender (88dB) | Air conditioner (60dB) |
| Dishwasher (80dB) | Refrigerator (50dB) |
| Living room music (76dB) | Computer (40dB) |

LeBeau V.V. and Cimmins M. Roger For Very Young Children, 2016, Advanced Bionics

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Toddler Life PHONAK
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Infants and toddlers face challenges of poor acoustic environmental conditions (Nozza et al. 1990)

| Environment | SNR |
|-------------------|-----------------|
| Car Seat (70 mph) | -10 dB |
| Bus | -10 dB |
| Stroller | -8 dB |
| Shopping Cart | -5 dB |
| Wind Noise | -3 dB to -10 dB |

Infants and toddlers with normal hearing required up to +25 dB SNR

LeBeau V.V. and Cimmins M. Roger For Very Young Children. 2016. Advanced Bionics

Personal DM PHONAK
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- Better access to the speech and language in challenging listening environments
- Improved SNR
- Improved audibility
- Considerations for use
 - Noisy and reverberant environments
 - Multiple talkers
 - Listening at a distance

Roger is helpful in many situations PHONAK
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At home



In a stroller



In the car



At the park

Video(s) PHONAK
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Roger is the solution PHONAK
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 Roger is a digital, wireless remote microphone system

 Roger provides speech and language access in noisy situations and over distance



Roger remains the digital standard PHONAK
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| | |
|--------------------------|---|
| Transmission | Proprietary 2.4 GHz wireless protocol |
| Adaptive behavior | Receiver gain adjusts automatically based on ambient noise level |
| Fully compatible | Receivers can be used with virtually all hearing instruments Multiple microphones can be used together in the same network |

A choice of Roger microphones PHONAK
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Roger Touchscreen Mic



Roger Pen™



Roger Select™



Roger Clip-on Mic

Roger receivers for young children PHONAK
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Roger 18 ★



Roger 19 ★



Roger X



Roger 17



Roger 20



Roger 21

★ IP68 rating and tamperproof available for children 0-3 years old

Remote Microphone Technology: Car PHONAK
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| | Remote Mic-A | Remote Mic-B | Remote Mic-C |
|---|--|--|--|
| Car (front seat talker, back seat listener) |  |  |  |



3

Evidence

True or False? PHONAK
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There is no research that supports the benefits of using wireless technology for very young children.

In the few studies on remote microphone use in homes, caregivers have reported:

- ↑ Improved child access to speech, incidental learning, and overhearing¹
- ↑ Improved listening skills²
- ↑ Increased imitation of words and sentences, enhanced clarity of speech and general well-being of the child³
- ↑ Improved attention, and receptive language, and reduced listening effort and fatigue⁴

¹Flynn, Flynn & Gregory, 2005; Mulla & McCracken, 2013
²Mulla & McCracken, 2014
³Mulla & McCracken, 2013
⁴Moffitt, Donaghy, Beauchaine, Lewis & Stelmachowicz, 1996

Benefits of FM Use With Very Young Children

- Encourages interaction with parents & imitation of parent's speech (Benoit, 1989)
- Attention to speaker, attention in noisy environments, consistent ability to hear on the go and in noise (Gabbard, 2003)
- Improvements in situational listening using FM over time for: noise, quiet, distance and auditory only (Mulla, 2011)

Benefits of FM Use With Very Young Children

- Use of FM technology increased hearing aid use (Mulla, 2011)
- Perceived benefit in the classroom for: improved attention, speech and language development, academic performance, behavior (Nelson et al, 2013)
- Recommended for improved ease of communication, during speech instruction and assessment, integral component to optimizing instruction in classroom (Nelson et al, 2013)

Roger system use at home positively impacts caregiver talk

10 children with hearing loss and their families

- ✓ 4 girls, 6 boys, aged 2-6 years
- ✓ 5 mothers, 4 fathers and 1 grandmother
- ✓ Hearing loss ranging from mild to profound
- ✓ Mix of hearing aids, CIs and 1 BAHA



Bentley-Barbara, C. R., Angley G., & Tharpe, A.M. (2018). Remote microphone system use at home: Impact on caregiver talk. *Journal of Speech, Language and Hearing Research*, Vol. 61, 399-409.

Roger usage at home

Consistent use of Roger at home can be considered a significant step towards achieving the exposure to 45 million words to be ready for school.

11

more words per minute

X 8 hours =

5,300

more words a day*

*Compared to using hearing aids alone. Based on average hearing aid use time of an 8 hour day.
 Bentley-Barbara, C. R., Angley G., & Tharpe, A.M. (2018). Remote microphone system use at home: Impact on caregiver talk. *Journal of Speech, Language and Hearing Research*, Vol. 61, 399-409.

While using Roger at home



80%

of families report **greater responsiveness** and **improved communication** from a distance

Bentley-Barbara, C. R., Angley G., & Tharpe, A.M. (2018). Remote microphone system use at home: Impact on caregiver talk. *Journal of Speech, Language and Hearing Research*, Vol. 61, 399-409.

While using Roger at home





35%
report **less frustration**
in their children



30%
report **increased speech clarity**
from their children

Based on parent responses to the FM Listening Evaluation Questionnaire

Bertolo-Barrera, C.R., Angley, G., & Thorpe, A.M. (2018). Remote microphone system use at home: Impact on caregiver talk. *Journal of Speech, Language and Hearing Research*, Vol. 61, 399-409.

Perceived Barriers



| Barrier | | Solution |
|------------------|---|--|
| Cost | \$\$\$ | * |
| Child's Feedback | Unable/unreliable reporting of the signal | Listening Check-listen to all inputs Functional and behavioral listening checks Verification |
| Technology | Complicated | Digital signal Simplified *If you can press a button, you can use Roger* |

Roger is a must for young children with hearing loss





Is easy to use, reliable and safe



Provides access to more words and conversations



Improves speech understanding

Question 5



- What is Baby Beats?
- A. A brand of diaper
- B. A baby "boy band"
- C. An app from Advanced Bionics
- D. A new implantable device

Poster

Introducing the BabyBeats™ App



Early intervention resource



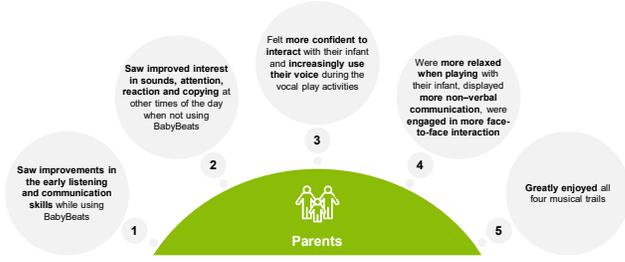
Establishing pre-verbal skills through interactive, natural musical engagement helps develop the listening brain

There is a growing evidence that music assists with early listening & language development & emotional well-being of children




Why BabyBeats?





Parents

1. Saw improvements in the early listening and communication skills while using BabyBeats
2. Saw improved interest in sounds, attention, reaction and copying at other times of the day when not using BabyBeats
3. Felt more confident to interact with their infant and increasingly use their voice during the vocal play activities
4. Were more relaxed when playing with their infant, displayed more non-verbal communication, were engaged in more face-to-face interaction
5. Greatly enjoyed all four musical trails

*Parents surveyed at the Elizabeth Foundation, UK

Together,
we change lives



Thank You!

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