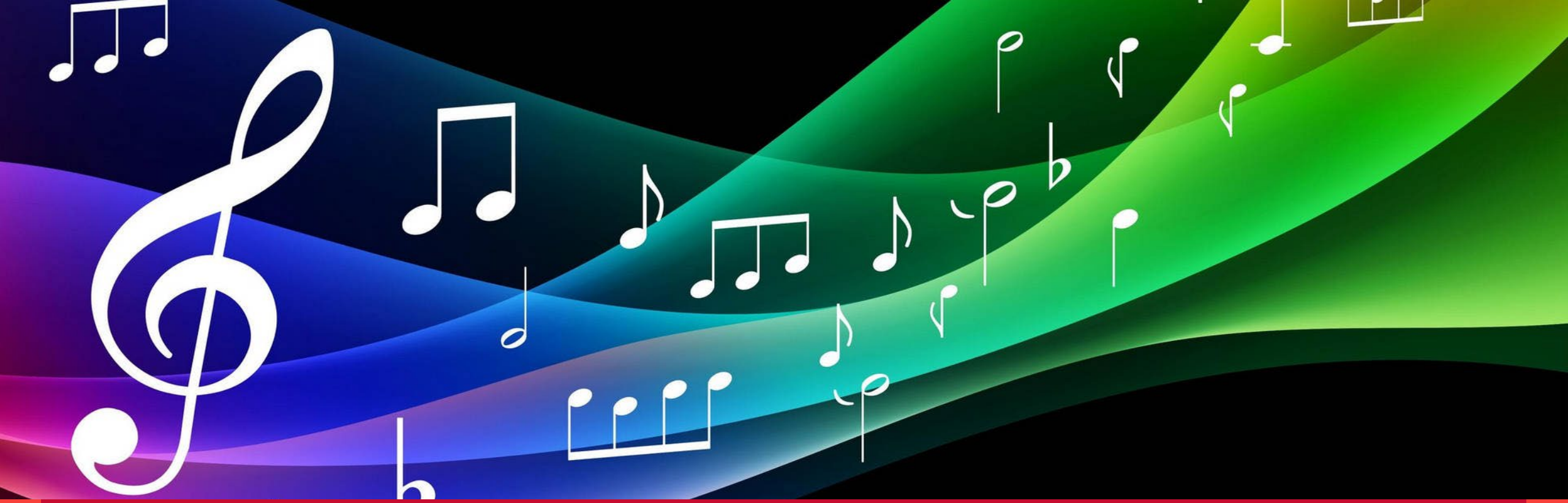

Music & Milestones with MED-EL

Risks/Benefits

- The applicability and accuracy of the course content may vary by the clinical, geographical, and cultural context; you should evaluate the course accordingly.
- As healthcare is rapidly evolving, new findings may change the validity of the information presented in this course. Providers should always consult the latest research and guidelines from professional associations.
- The interventions discussed in this course may be limited in generalizability, requiring practitioners to consider specific individual and population factors.
- The course may not cover all possible risk factors, diagnostic methods, or treatment options, and complex cases may require additional considerations.
- Healthcare providers should apply cultural competence and sensitivity to ensure effective and respectful care based on their patients' diverse needs.
- Providers should always evaluate the limitations of diagnostic and screening tools, considering their potential for false results as well as any ethical implications.
- It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.

Learner Outcomes

1. After this course, participants will be able to define FineHearing™ technology in the MED-EL cochlear implant system

2. After this course, participants will be able to outline musical and vocal milestones for children under 6 years of age

3. After this course, participants will be able to describe features of music that teach building blocks of speech

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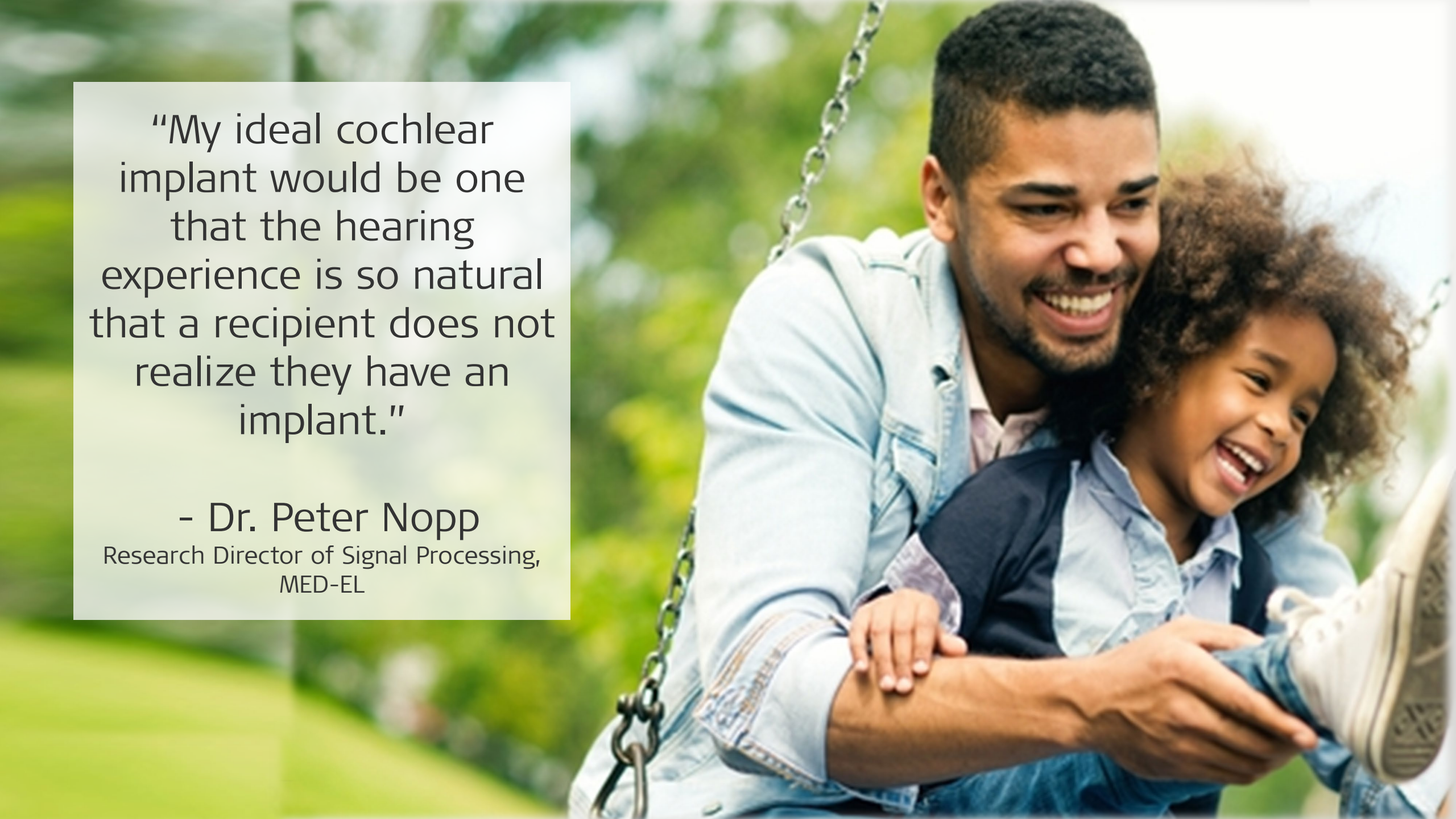

"My ideal cochlear implant would be one that the hearing experience is so natural that a recipient does not realize they have an implant."

- Dr. Peter Nopp

Research Director of Signal Processing, MED-EL

Music Appreciation

- How often do you listen to music?
- What about music do you think is important?
- Do your CI candidates ask about music appreciation?
- How do you assess sound quality after a CI?



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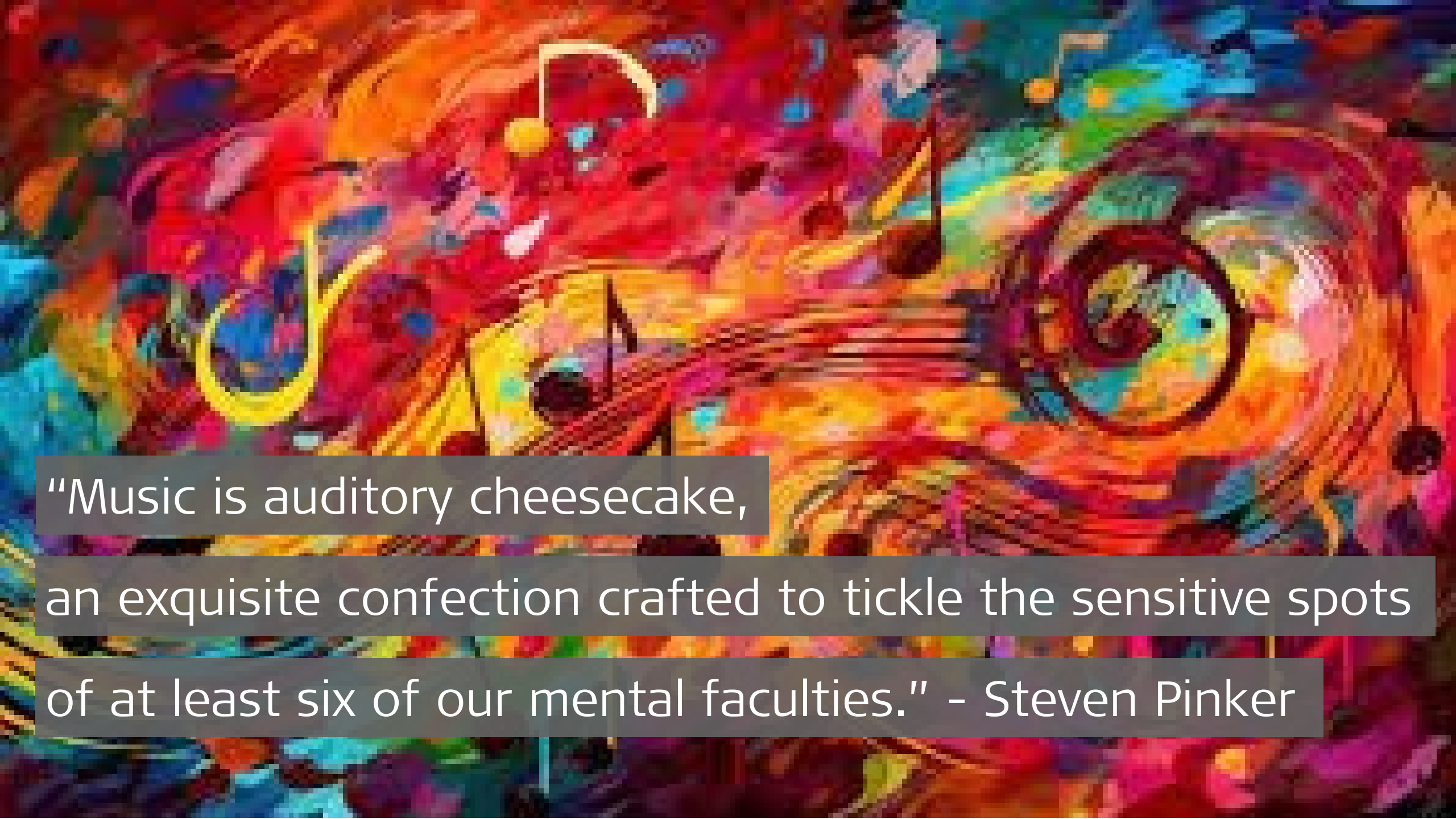
“Music is auditory cheesecake,
an exquisite confection crafted to tickle the sensitive spots
of at least six of our mental faculties.” - Steven Pinker

Advancing Sound Quality: Realistic Goals for Cochlear Implant Recipients

- Recipients have been able to understand speech in quiet and noise for *decades*
- Music has unique qualities that set it apart from speech, such as timbre which is different from loudness or pitch
- *Only* MED-EL has changed the way we process sound in the last 20 years
- Mimicking the fine structure* of sound allows cochlear implant listeners to enjoy music again



*Fine Structure sound processing is not approved on pre-lingual children in the USA

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This is why the electrode array could be considered the most important part of the cochlear implant—it is the foundation of every single sound that your patients will hear through their cochlear implant.

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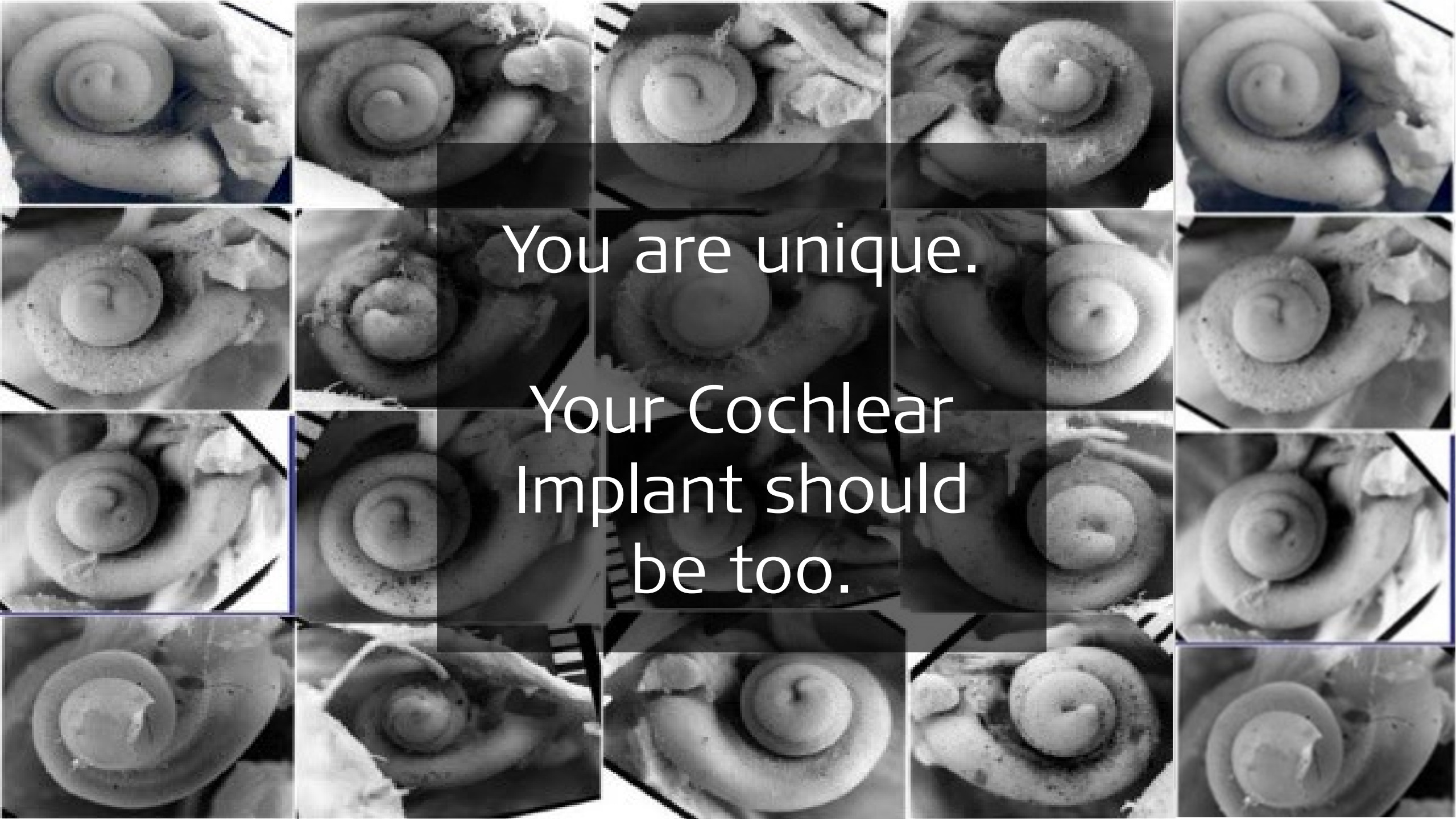

You are unique.
Your Cochlear Implant should be too.

Long Electrode Arrays

Don't Miss Half of the Cochlea

- Long enough to cover the cochlea up to 720°
- MED-EL's long arrays achieve complete cochlear coverage
- Foundation for closest to natural hearing



With Another Electrode
Up to 450°



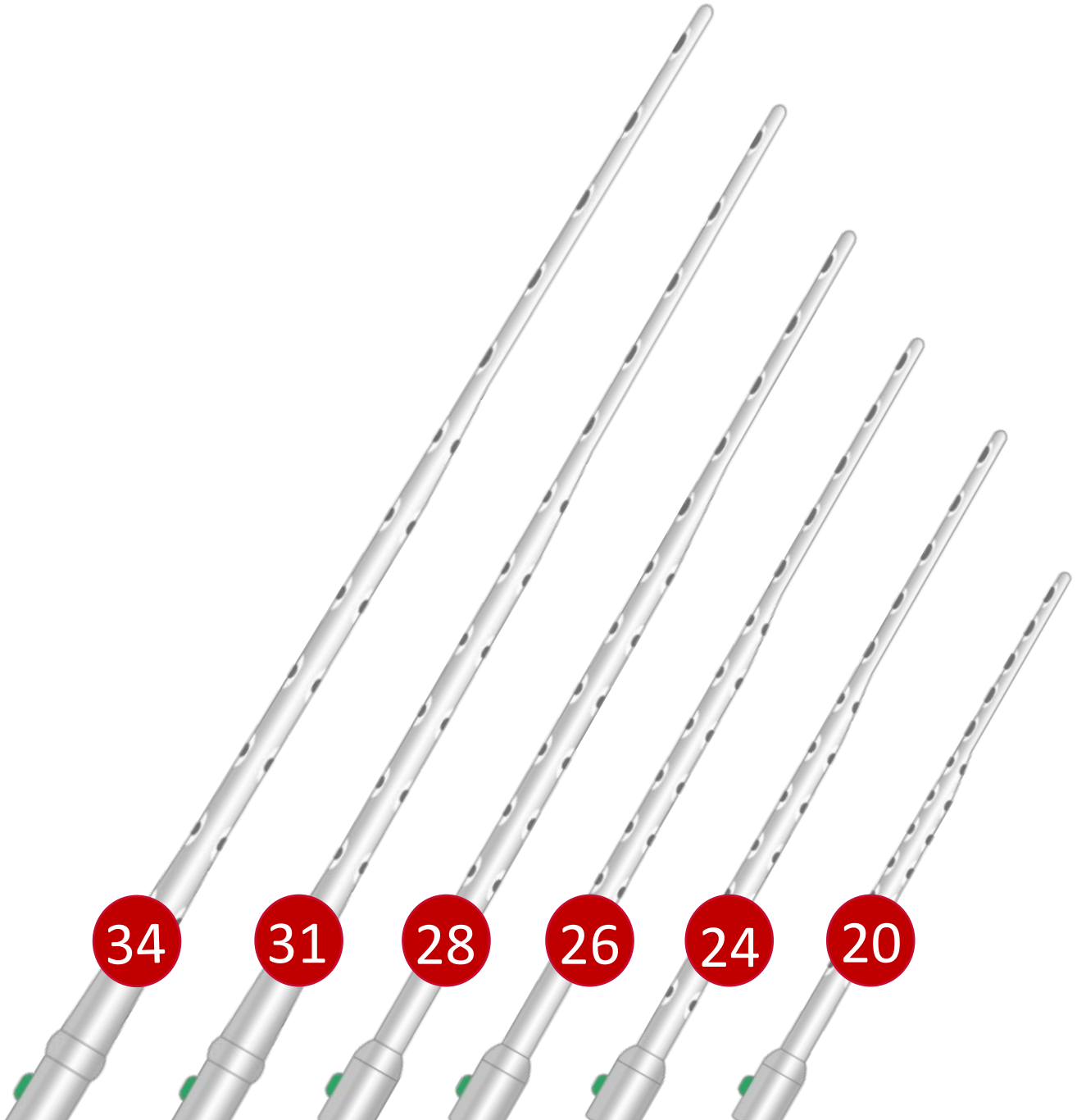
With a MED-EL Electrode
Up to 720°

This document is part of a presentation and is incomplete without oral explanation. © MED-EL

Individualized Electrode Arrays

Our FLEX Series arrays were designed to cover the full range of cochlear anatomies

Using OTOPLAN allows you to confidently select the correct electrode length for each candidate



hearLIFE

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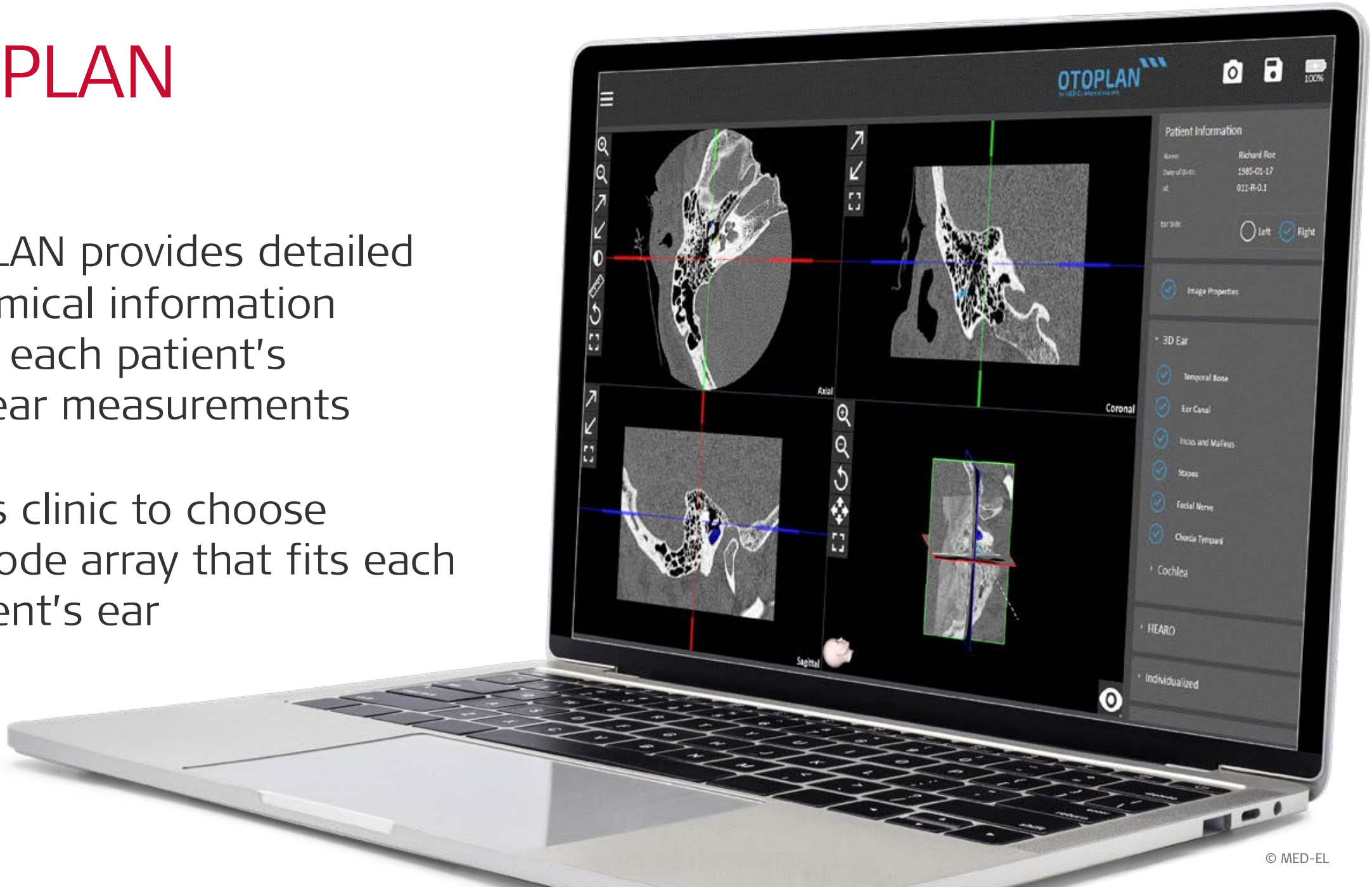
OTOPLAN

OTOPLAN provides detailed anatomical information about each patient's cochlear measurements

Allows clinic to choose electrode array that fits each recipient's ear



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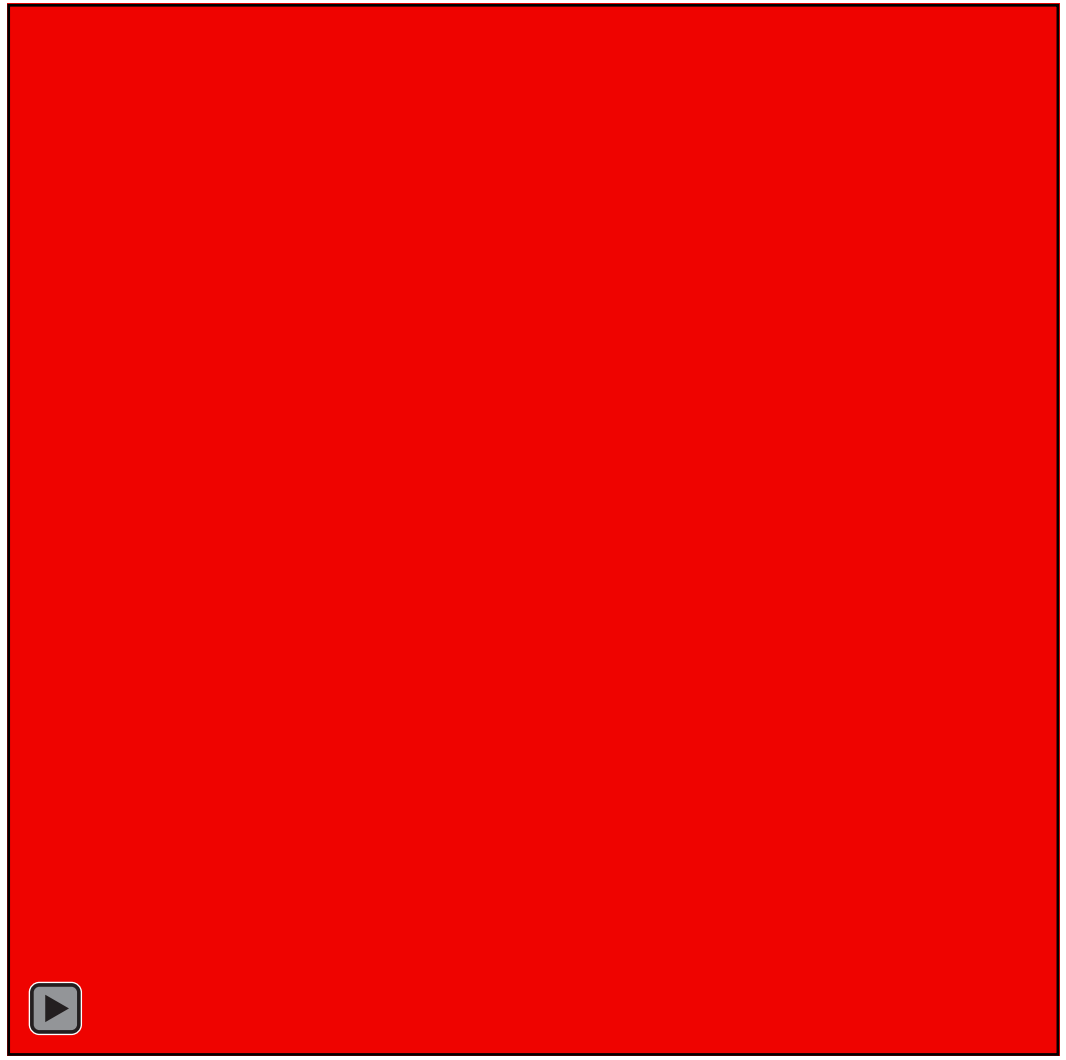
The Right Timing: FineHearing™

- The cochlea - by nature - responds differently based on incoming sounds
- You must get into the apical (low frequency) region to access this unique feature
- MED-EL's long electrodes can reach the low frequency region and the fine structure zone
- With fine structure processing listener's notice more bass frequencies and enhanced music sound quality



**Fine Structure sound processing is not approved on pre-lingual children in the USA*

© MED-EL

Closest to Natural Hearing

By combining long electrode arrays with just the right fit into the cochlea and FineHearing™, you get a more accurate and **more natural stimulation of the whole cochlea.**

Long MED-EL Electrode Arrays (Right Electrode)

+

OTOPLAN Software (Right Tool)

+

FineHearing™ (Right Timing)

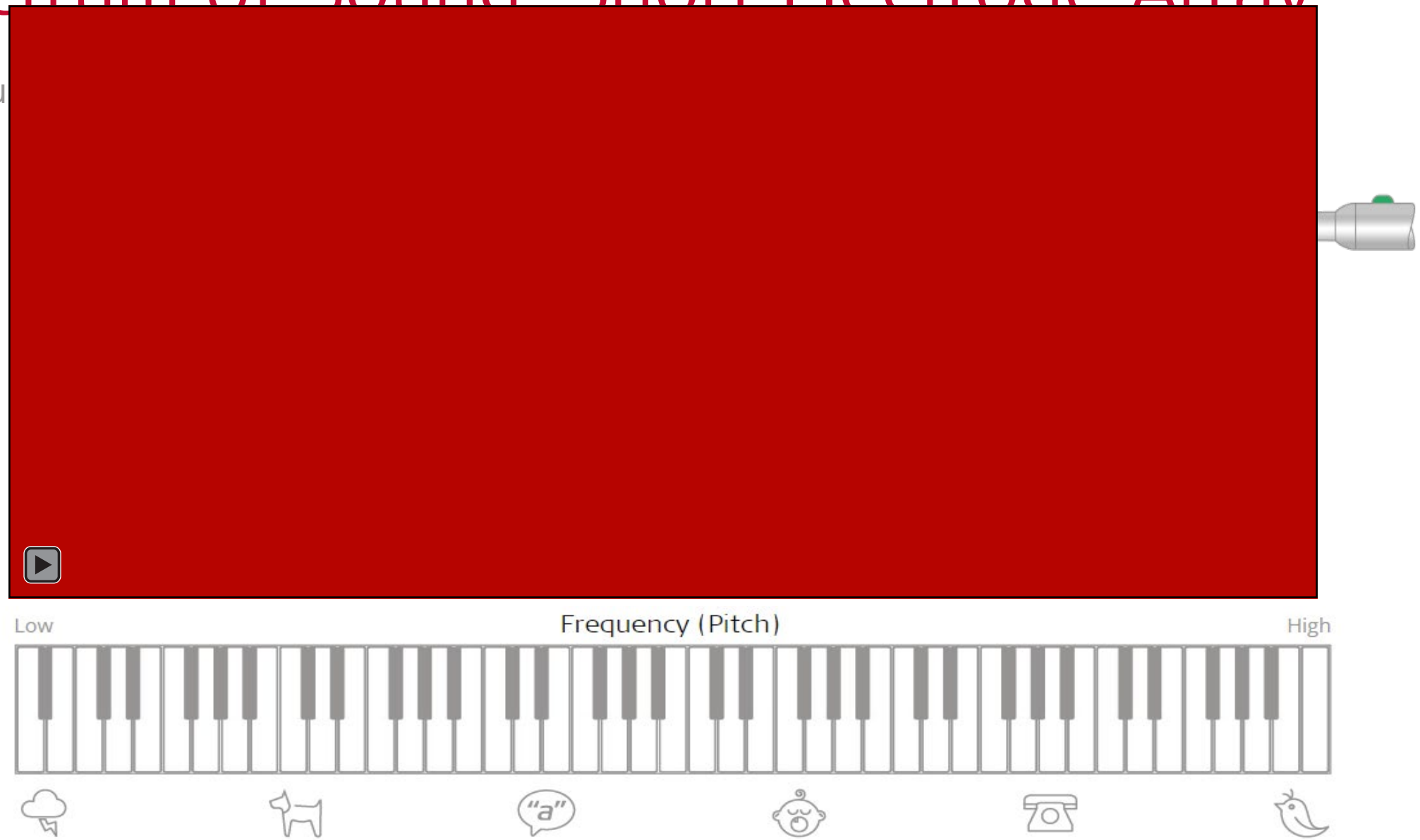
=

Closest to Natural Hearing

**Fine Structure sound processing is not approved on pre-lingual children in the USA*

Spectrum of Sound: Short Electrode Array

Dave Bru



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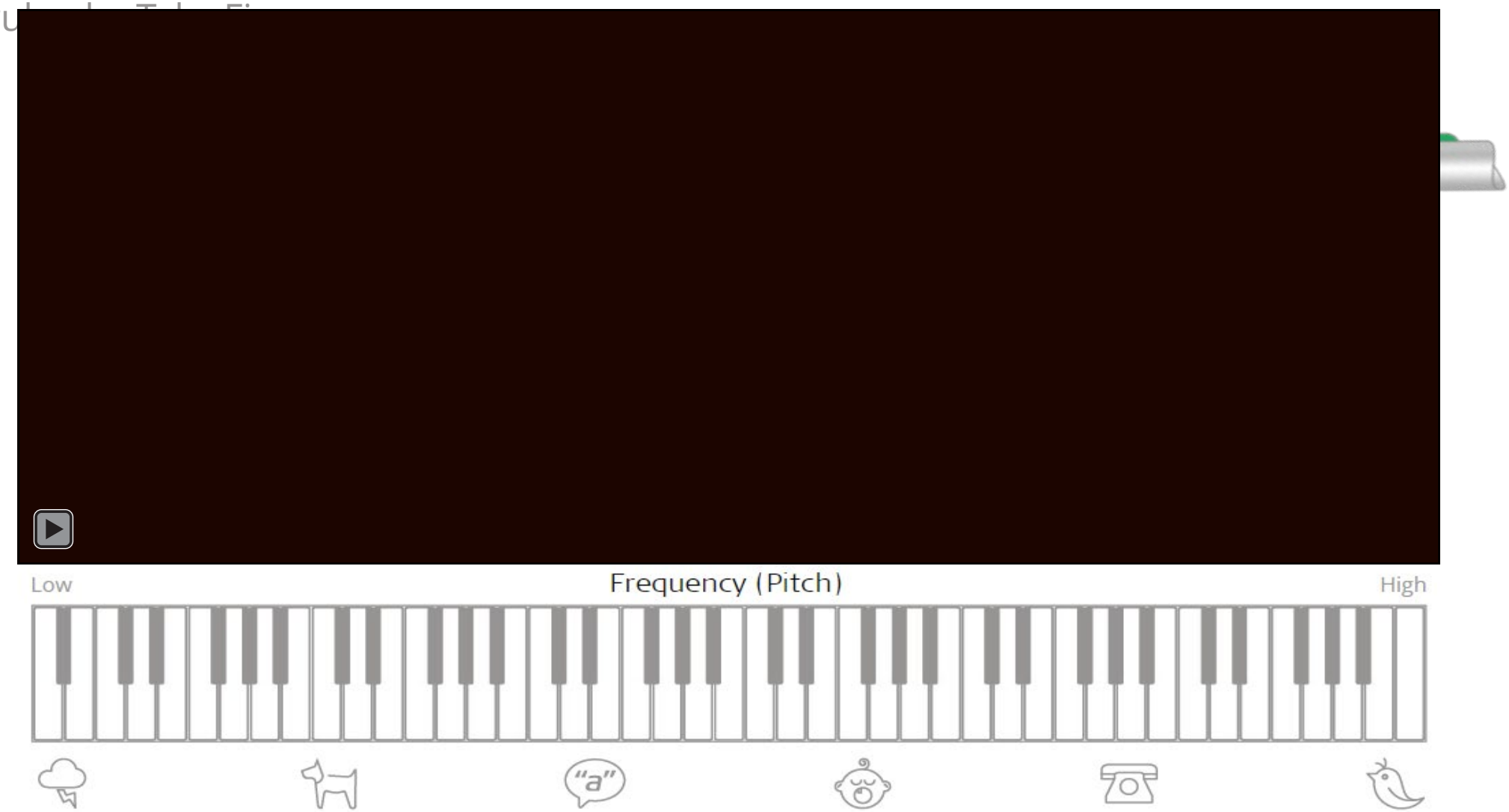
Spectrum of Sound: Long Electrode Array

Dave Bru



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Music

Only MED-EL has FDA proven benefits for music appreciation

- More natural sound
- Enhanced quality of bass tones

https://blog.medel.pro/tonal-languages-cochlear-implants/#_edn1



Musical Milestones

Julianne Papadopoulos
M.M. Community Music

Birth to Two Years Old



Infants begin cooing and babbling on one or more pitches



Caregivers' voices influence infant vocalizations



Infants display irregular movements to music

Sources: Welch, 2016; Trehub & Degé, 2016; Gilmartin & Levinowitz, 2017; Gordon Institute for Music Learning, 2024

One to Three Years Old



Children begin to sing along to the general melodic contour of a melody



Children begin to maintain a consistent tempo when moving to music



Children's voices and bodies are not usually synchronized

Sources: Trainor & Hannon, 2013; Corrigall & Schellenberg, 2016; Gilmartin & Levinowitz, 2017

Two to Four Years Old



Children sing along to the general melodic contour of a melody



Children sing without the accompaniment of a song



Rhythm is easier for children to follow when it reflects accents in the text



Children's singing and movement may be coordinated

Sources: Corrigall & Schellenberg, 2016; Gilmartin & Levinowitz, 2017; Gordon Institute for Music Learning, 2024

Three to Six Years Old



Children display increased tonal accuracy when singing



Children begin to use their "head voice" when singing



Children begin to synchronize their upper and lower body to a beat

Sources: Trainor & Hannon, 2013; Gilmartin & Levinowitz, 2017

References

Corrigall, K.A. & Schellenberg, G.E. (2016). Music Cognition in Childhood. In G.E. McPherson (Eds.), *The Child Musician: A Handbook of Musical Development* (pp. 81-101). Oxford University Press.

Gordon Institute for Music Learning. (2024). *Early Childhood Music.* The Gordon Institute for Music Learning. https://giml.org/mlt/earlychildhood/

Guilmartin, K.K. & Levinowitz, L.M. (2017). *Teaching Music Together: Teacher Training Book II*. Music Together LLC.

Trainor, L.J. & Hannon, E.E. (2013). Musical Development. In D. Deutsch (Eds.), *The Psychology of Music* (pp. 423-497). Elsevier Inc.

Trehub, S.E. & Degé, F. (2016). Reflections on Infants as Musical Connoisseurs. In G.E. McPherson (Eds.), *The Child Musician: A Handbook of Musical Development* (pp. 31-51). Oxford University Press.

Welch, G. F. (2016). Singing and Vocal Development. In G.E. McPherson (Eds.), *The Child Musician: A Handbook of Musical Development* (pp. 441-461). Oxford University Press.



Early Auditory & Vocal Expression Skills

Lindsey Kanes, MS, CCC-SLP, LSLS Cert. AVT
MED-EL Consumer Engagement Area Manager – South & Southeast Regions

Early Auditory & Vocal Expression Skills:
Infants & New Listeners



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Reference: Cottage Acquisition Scales for Listening, Language and Speech; Pre-Verbal Level; Published by Sunshine Cottage School for Deaf Children; 1999

Music has *everything* to do with creating a natural tone of voice!

- Inflection
- Rate
- Stress
- Volume
- Pitch
- Duration
- Rhythm
- Emotion/meaning
- Auditory attention

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0 to 3 Months: Listening

- Quiets/excites in response to novel sounds
- Responds or startles to loud sounds
- Shows a preference for a primary caregiver's voice

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0 to 3 Months: Vocal Expression

- Communicates immediate needs by varying the manner of whining or crying
- Uses some reflexive vowels in a musical coo-like way (ah, uh, oo)
- Opens mouth in imitation

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3 to 6 Months: Listening

- Distinguishes emotions by tone of voice
- Begins to respond to “parentese”
- Searches for the speaker/source of sound
- Begins to attach meaning to familiar sounds

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3 to 6 Months: Vocal Expression

- Produces a true vowel
- Vocalizes to express a variety of feelings
- Babbles to self, others, objects (p, b, m)
- Vocalizes in response to speech
- Repeats sound when adult echoes child (vocal volley)

© MED-EL

6 to 9 Months: Listening

- Starts to echo duration and pitch
- Attends to music/singing
- Stops activity when name called
- Enjoys listening to onomatopoeias (“Learning to Listen Sounds”)
- Locates sound source

© MED-EL

6 to 9 Months: Vocal Expression

- Babbles Consonant-Vowel-Consonant-Vowel shapes (“baba”)
- Participates in singing (vocalizing)
- Vocalizes emotions (anger, contentment, frustration)
- Uses a variety of sounds in babble (p, b, m, n, d)

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9 to 12 Months: Listening

- Responds physically to music
- Demonstrates association of onomatopoeias with objects
- Responds to simple verbal requests (“come here!”, “give it to Dada”, “clap your hands”)
- Takes conversational turns
- Understands a few words (e.g., hot, all gone, more, up, bye bye, no, mama)

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9 to 12 Months: Vocal Expression

- Vocalizes during play
- Attempts to imitate pitch change
- Attempts to imitate number of syllables used by others
- Says exclamations like “uh-oh!” or “ow!”
- Uses a consistent verbal approximation for a person or object
- Uses onomatopoeias to refer to objects some of the time
- Jabbers/uses intonation to scold, state, exclaim, greet
- Says first true words meaningfully (mama, dada, hi, up)

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Music teaches the building blocks of speech

- Duration – short/long
- Intensity (Volume) – soft/loud
- Pitch – high/low notes

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Patient L. Video

- Implanted bilaterally at 23 months old
- Activated at 24 months old
- Video session: ~ 2 years and 2 months old
  - Listening age only 2 months!
- Watch for: lots of wait time (quiet) before she vocalizes, duration cues (short/long, rhythm!)

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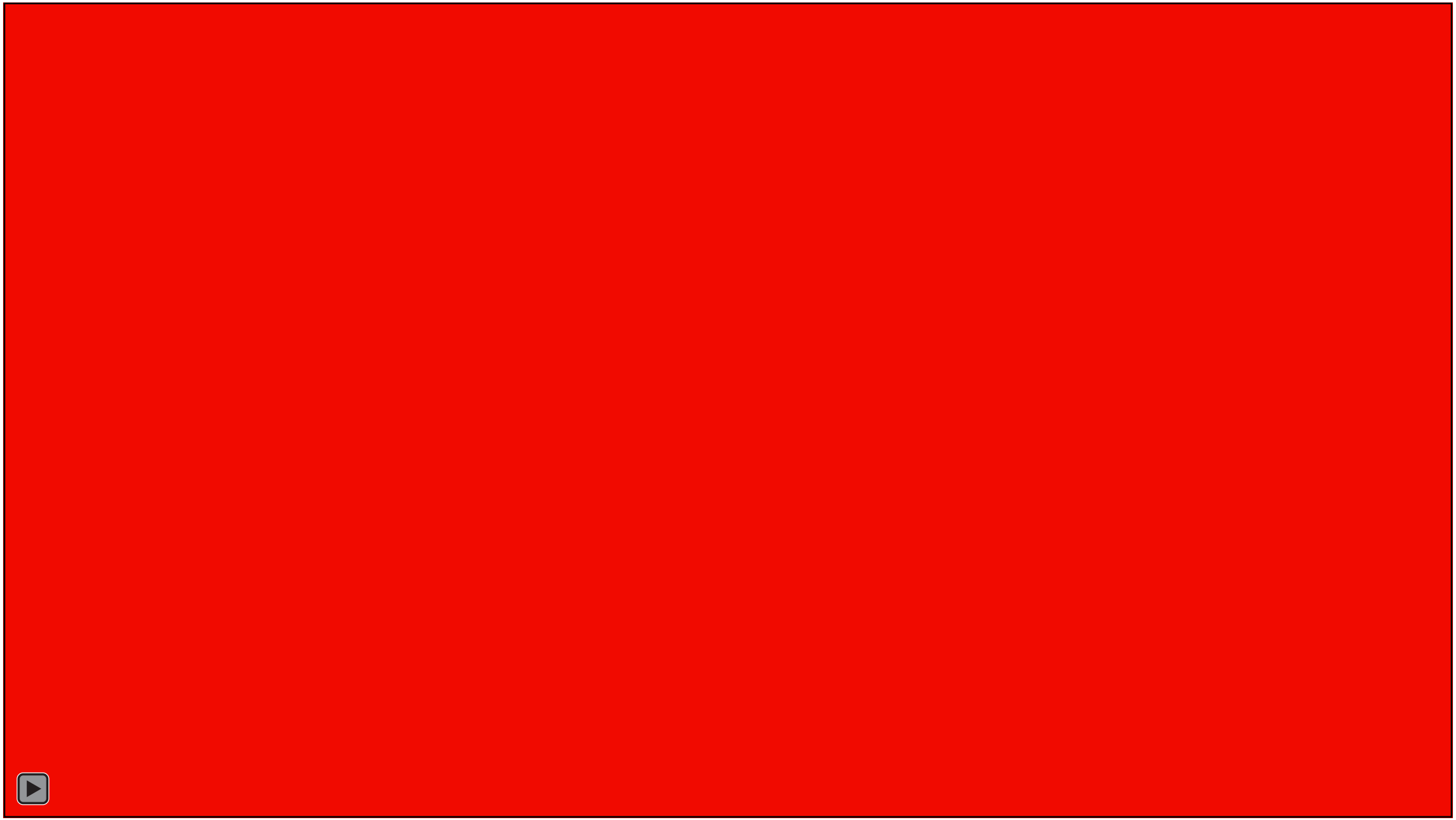

Next Steps/Goals: Intensity & Pitch Cues

Intensity (Volume)

- “Shhhh” for the baby = soft (low intensity)
- “Pop pop pop” for bubbles (whispered) = soft (low intensity)

Pitch

- Airplane sound “ahhh!” = changing pitch
- Mouse sound “eee!” = high pitch
- Cow sound “moo!” = low pitch
- Slide sound “weee!” high to low pitch

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Music has *everything* to do with creating a natural tone of voice!

- Inflection
- Rate
- Stress
- Volume
- Pitch
- Duration
- Rhythm
- Emotion/meaning
- Auditory attention

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Fast & Slow Activities



Infants or Early Listeners:

“Clap Your Hands”



Toddlers or Experienced Listeners:

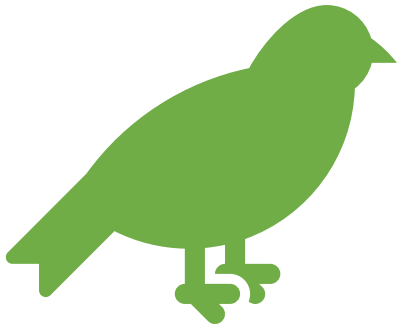
“The Garden Snail”

High & Low Activities



Infants or Early Listeners:

“What’s in the Box”



Toddlers or Experienced Listeners:

“Little Cockatiel”

Soft & Loud Activities



Infants or Early Listeners:

“Baby Sleeping”



Toddlers or Experienced Listeners:

“Drip Drop”

Thank you!



References

Corrigall, K.A. & Schellenberg, G.E. (2016). Music Cognition in Childhood. In G.E. McPherson (Eds.), *The Child Musician: A Handbook of Musical Development* (pp. 81-101). Oxford University Press.

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Resources

- MED-EL's Spotify Playlists for CI users
- ExpertsOnline Clinical Topics in Music
- MED-EL's US Professionals Blog
- Speech, Spatial and Qualities of Hearing Scale (SSQ)
- Munich Music Questionnaire



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Music Whitepaper

- MED-EL introduced the Fine Structure Processing (FSP) coding strategy, which was the first coding strategy to incorporate the intricate fine structure details of pitch.
- As a result, listeners reported that music sounded pleasant and more natural, and they were able to distinguish instruments, voices, complex musical pieces and more bass frequencies.

Additional Resources

Carnegie Hall's Big Note, Little Note

Free early childhood music program for families with infants and young toddlers (3-18 months)

Bionic Ear Lab at the University of Southern California

Studies speech comprehension, pitch perception, music appreciation, and the way sound signals are processed in cochlear implants

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