



# Innovations in Hearing Health Technology

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FTC Workshop “Now Hear This”  
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# Innovation

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**What:**

Generating value from creativity

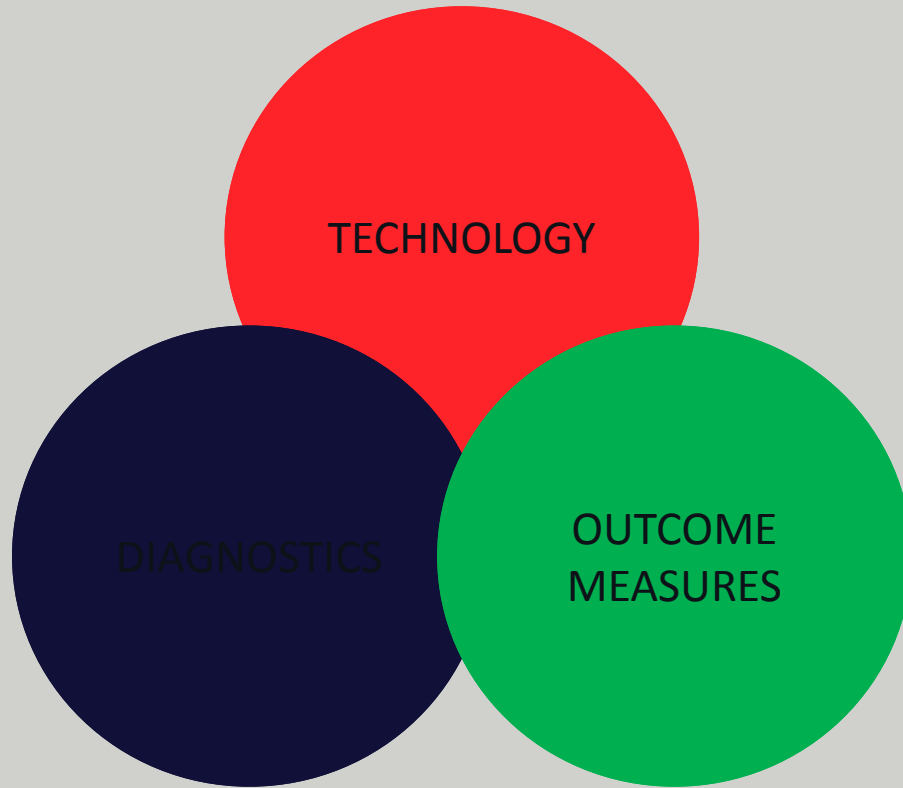
**How:**

Identify unmet needs

# Unmet Needs of People With Hearing Loss

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- **Improvements to:**
  - Audibility
  - Loudness growth
  - Sound quality
  - Naturalness
  - Speech understanding
  - Feedback
  - Localization ability
  - Distortion
  - Listening effort
  - Ease of use
  - Reduced stigma
  - Reduced occlusion
  - Comfort
  - Source segregation
  - Auditory focus
  - Musical timbre



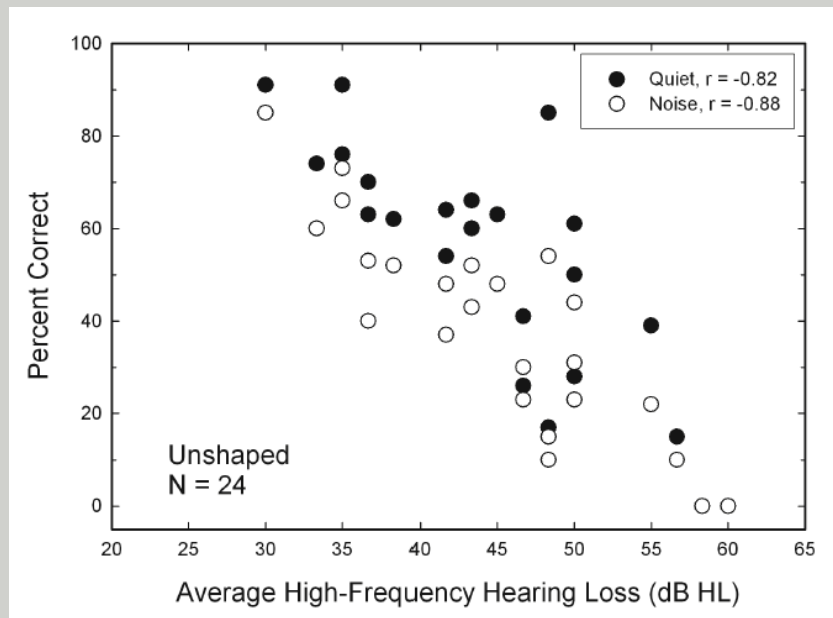
TECHNOLOGY

DIAGNOSTICS

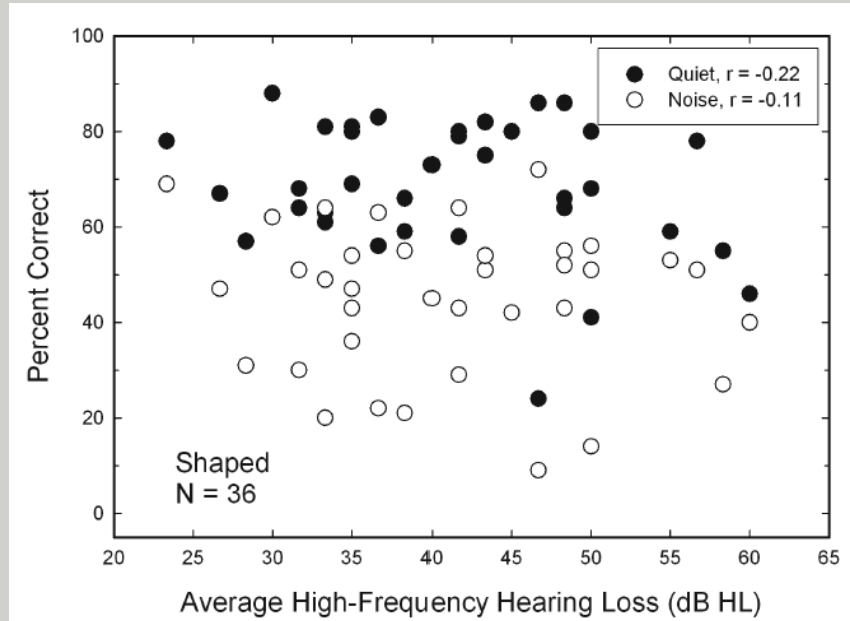
OUTCOME  
MEASURES

# Restoring Audibility is Insufficient

## Unaided



## Aided



# Hearing Aid Industry Has Developed Innovations to Address the Unmet Needs of Those With Hearing Loss

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- Multiband compression
- Noise reduction
- Feedback Cancellation
- Wind reduction
- Fitting Algorithms
- Directionality
- Frequency Lowering
- Decision-making intelligence
- Datalogging
- Music-specific processing
- Patient self-fine-tuning
- Improved fidelity transducers
- More powerful DSPs
- Wireless Ear-to-Ear: beamforming, MVDR
- Rechargeable batteries
- Improved cosmetics
- Made for iPhone wireless
- Remote microphones and other accessories
- Tele-audiology

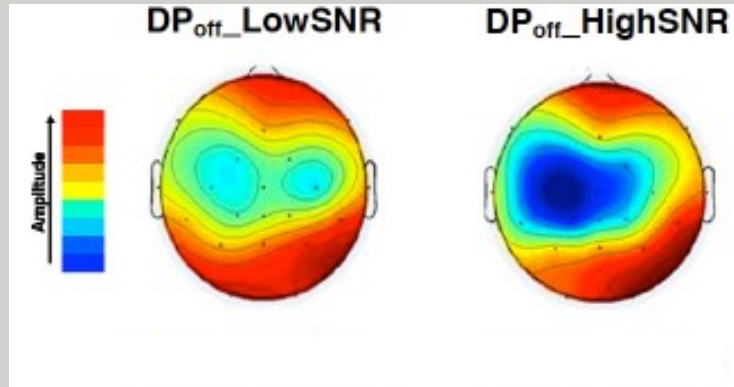
# Hearing Aid Industry Has Developed Innovations to Address the Unmet Needs of Those With Hearing Loss

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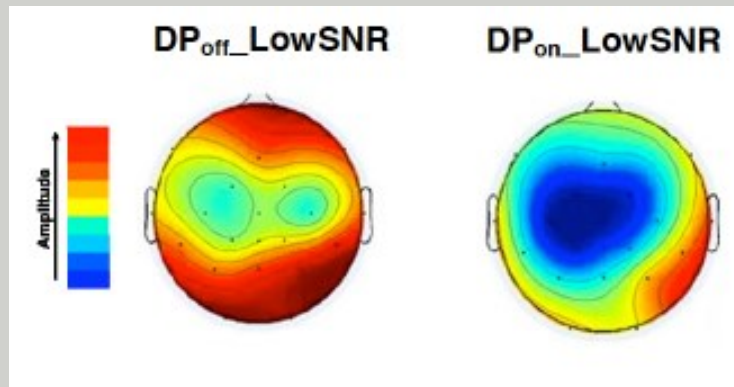
- Multiband compression
- Noise reduction
- **Feedback Cancellation**
- Wind reduction
- Fitting Algorithms
- Directionality
- **Frequency Lowering**
- Decision-making intelligence
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# EEG Measures of Change in Activation for Binaural Algorithm

Effect of improving  
Speech-to-noise ratio

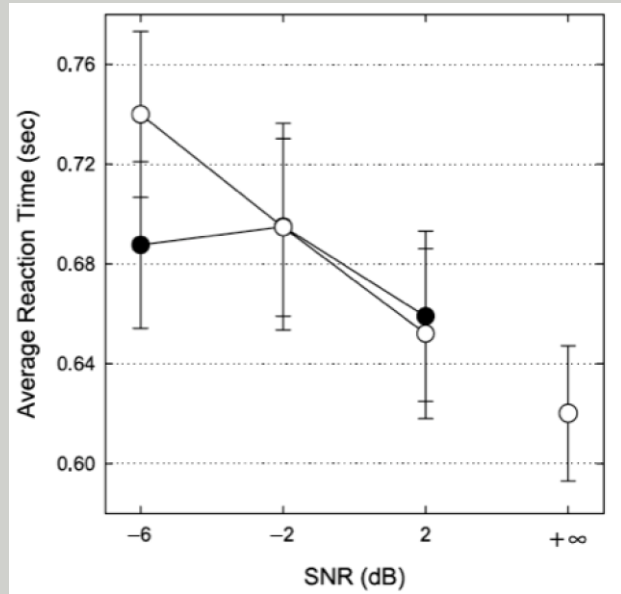


Effect of binaural algorithm

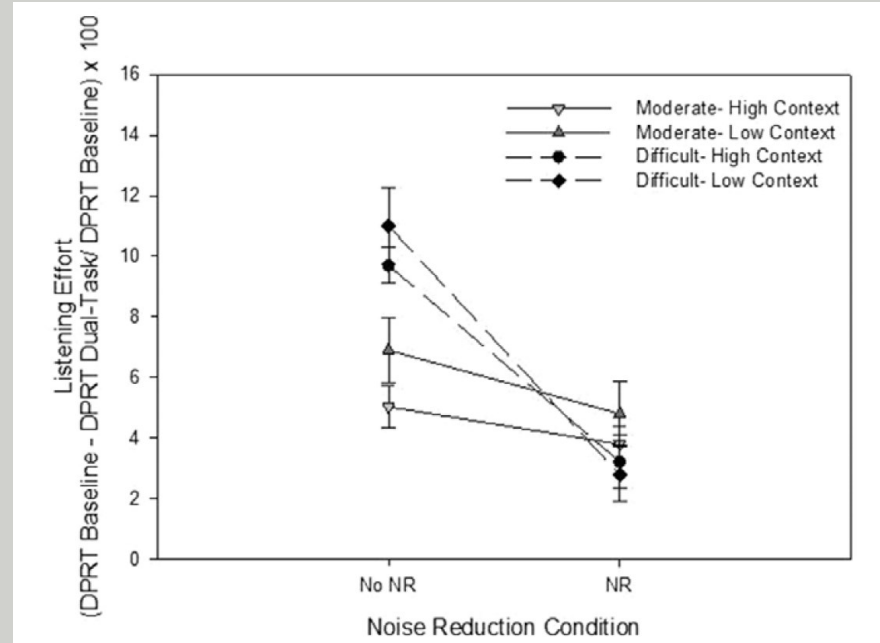




# Technology Reduces Cognitive Load

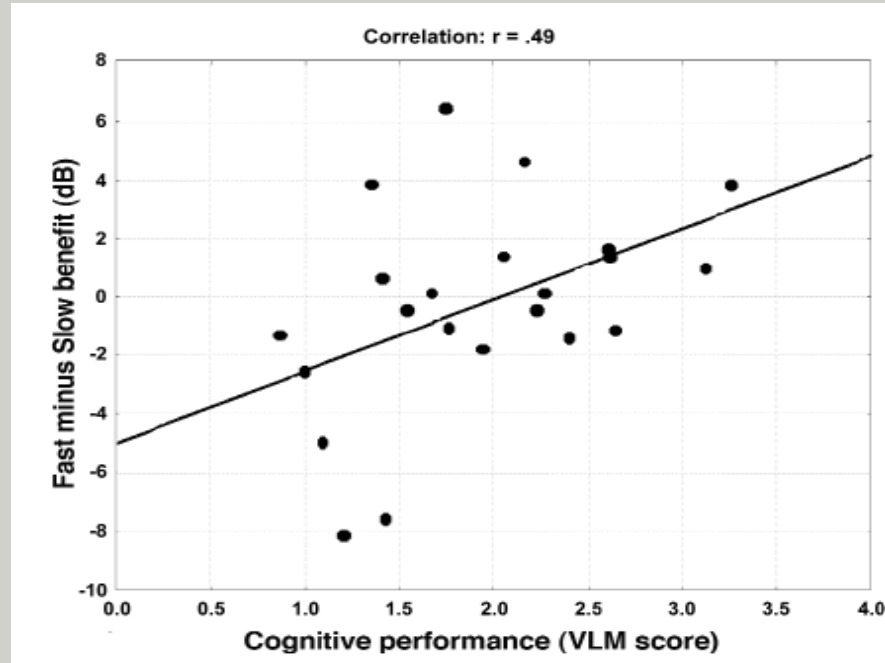


Sarampalis et al., 2009



Desjardins and Doherty, 2014

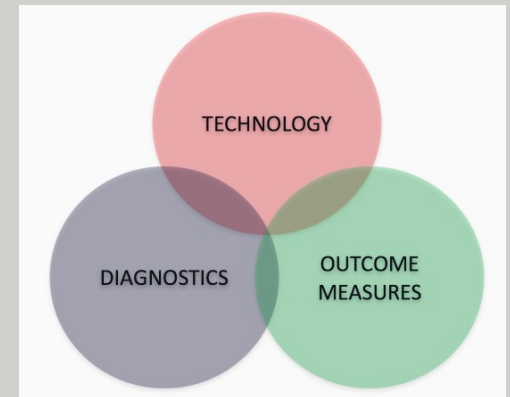
# Cognitive Ability Affects Hearing Aid Benefit



# Hearing Industry Research Consortium

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- Has provided \$300,000 to academic researchers in each of the following areas:
  - Cognition and hearing aid interaction
  - Dynamic spatial listening
  - Neurodegeneration
  - Big data analysis of treatment and outcome
  - Auditory ecology and quality of life



# Silicon Valley Innovation

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- An ecosystem exists to support ideas that address unmet needs



# Silicon Valley Innovation

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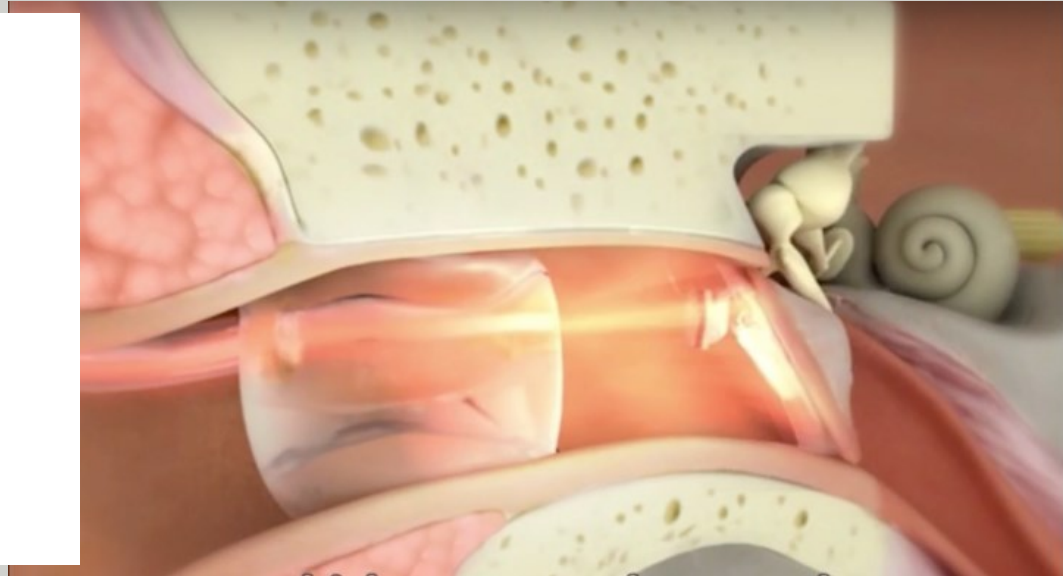
- An ecosystem exists to support ideas that address patient unmet needs



# Earlens

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- 140 employees
- Over \$120m invested to-date



# FDA Hearing Aid Regulations

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- **Good Manufacturing Practices and Design Control are of little burden for a well-run company**
  - **Certainly does not impede the development of innovation**

# Summary

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- **Significant innovation by the hearing aid industry**
  - Technology
  - Diagnostics
  - Outcome measures
- **Innovation is alive and well for startups**
- **FDA is not a burden on innovation**



# References

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- Humes, L. E. (2007). "The contributions of audibility and cognitive factors to the benefit provided by amplified speech to older adults." *J Am Acad Audiol* 18(7): 590-603.
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