

Using Digital Therapeutics to Address Hearing Loss and Related Comorbidities

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Disclosure



- Dr. Tye- Murray is a professor at Washington University School of Medicine and...
- CEO and Founder of cLEAR (customized learning: Exercises for Aural Rehabilitation), which is the parent company of Amptify, a digital therapeutic for the management of hearing loss and...
- PI of NIH R01 DC014722 04

What we'll cover today

- Hearing - related comorbidities
- Digital therapeutics (DTx)
- Amptify
- The benefits of auditory brain training
- Example research study



The three pillars of hearing healthcare



DIAGNOSIS; The pt.:

- Suspects hearing loss
- Receives formal diagnosis



TREATMENT; The pt.:

- Receives appropriate amplification
- Receives appropriate assistive device technology.

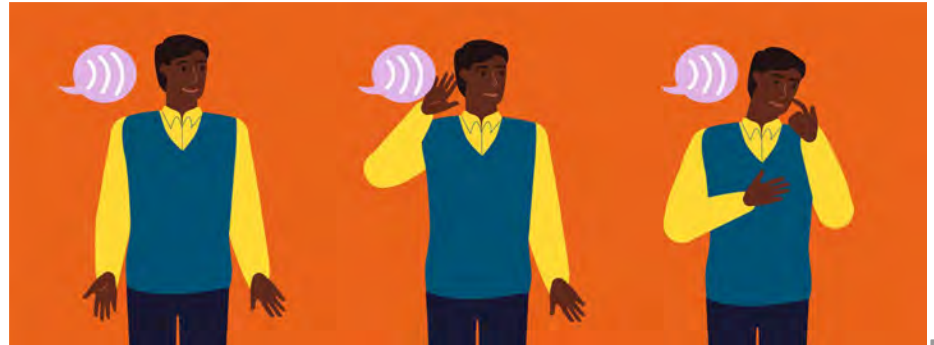


REHABILITATION; The pt.:

- Learns to manage the listening technology
- Engages in ongoing aural rehabilitation to manage listening challenges

Hearing loss challenges

- Impaired sound detection
- Reduced speech discrimination
- Poor sound localization
- Increased perceptual effort
- Stinted conversations
- Increased communication breakdowns



Hearing loss challenges don't stop at the ears



Hearing loss tied to increased risk for depression

PERSONAL HEALTH

Hearing Loss Threatens Mind, Life and Limb

Poor hearing is not just an annoying inconvenience.



LIFE KIT

Untreated Hearing Loss Linked To Loneliness And Isolation For Seniors

September 12, 2019 · 4:31 PM ET

ROCHELLE SHARPE



Medscape

Hearing Loss Tied to Cognitive Decline

Dementia warning: The hidden sign of Alzheimer's disease in your ears you shouldn't ignore

DEMENTIA symptoms can be difficult to spot in its early stages, and they vary from person to person. But, you may be missing one of the earliest warning signs of Alzheimer's in your ears. Should you speak to a doctor about dementia symptoms?

By MATT ATHERTON

PUBLISHED: 16:37, Thu, May 23, 2019 | UPDATED: 20:39, Thu, May 23, 2019

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Alzheimers Research UK explain 'what is dementia?'

THE HearingReview

Untreated Disabling Hearing Loss Costs Billions

DownToEarth

Early intervention crucial for children with hearing loss



Comorbidities of hearing loss

Healthcare costs are 46% higher for those with untreated hearing loss.

SOCIAL ISOLATION AND LONELINESS

- Reduced quality of life
- Increased communication difficulties
- Poorer emotional well-being, and mental health ¹

CARDIOVASCULAR DISEASE

- Higher risk of death from all-cause cardiovascular disease ¹⁰
- Higher risk of strokes ⁶

DEPRESSION

- Independent risk factor associated with depression ^{3,4}
- Incidence of depression increases with severity ⁴

DIABETES

- Higher prevalence of diabetes ⁸

FALLS

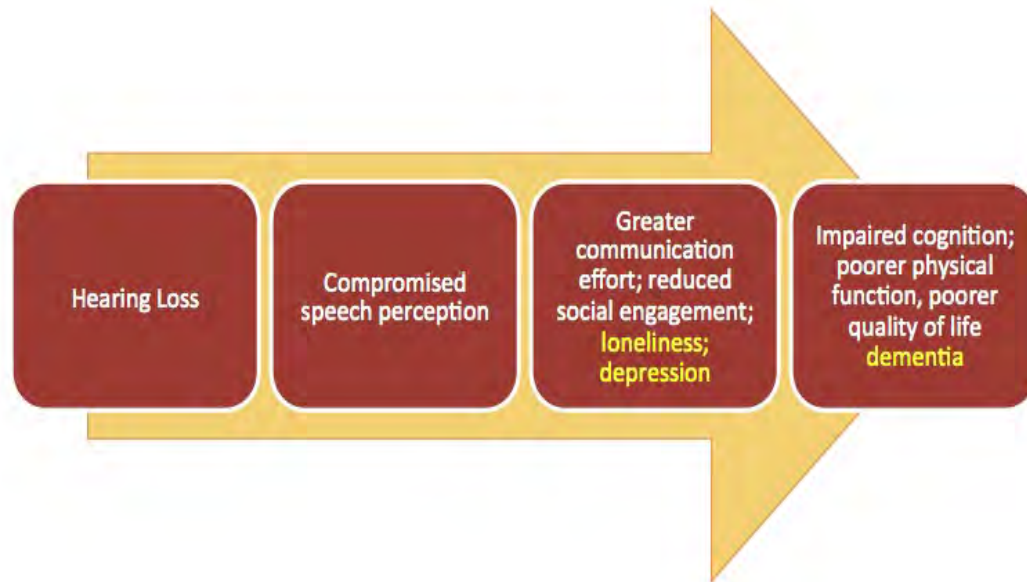
- 14-fold increased odds of reporting a fall in the previous year for every 10 dB of hearing loss ⁵

Comorbidities, cont.

DEMENTIAS

Compared with normal hearing, the hazard ratio for dementia was:

- 1.89 for mild hearing loss
- 3.00 for moderate hearing loss
- 4.94 for severe hearing loss.¹



What is a Digital Therapeutic (DTx)?

A Digital Therapeutic (DTx) is a software-based intervention for a disease and/or disorder that is clinically validated to drive a specific positive outcome.

Often used in combination with a drug intervention or a medical device (e.g., hearing aids).

Example existing DTx use cases



TYPE 1 & 2 DIABETES

Welldoc's BlueStar®



ASTHMA or COPD

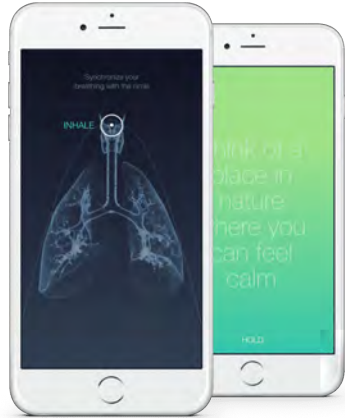
Propeller Health



DIABETES, HYPERTENSION, Etc.

Omada

Example existing DTx use cases



SMOKING CESSATION

Clickotine
By Click Therapeutics



ADHD

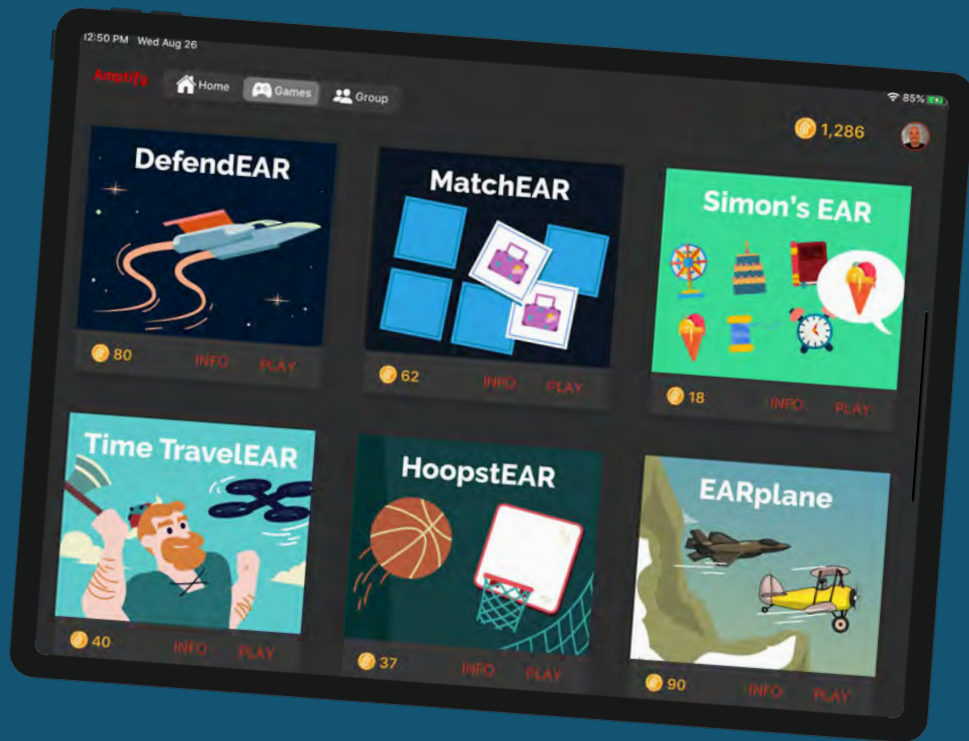
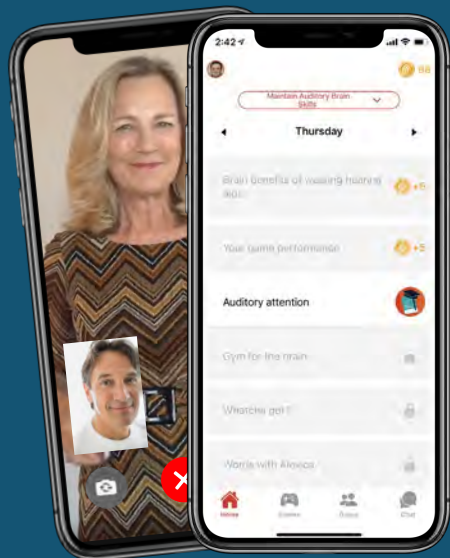
EndeavorRx
By Akili Interactive



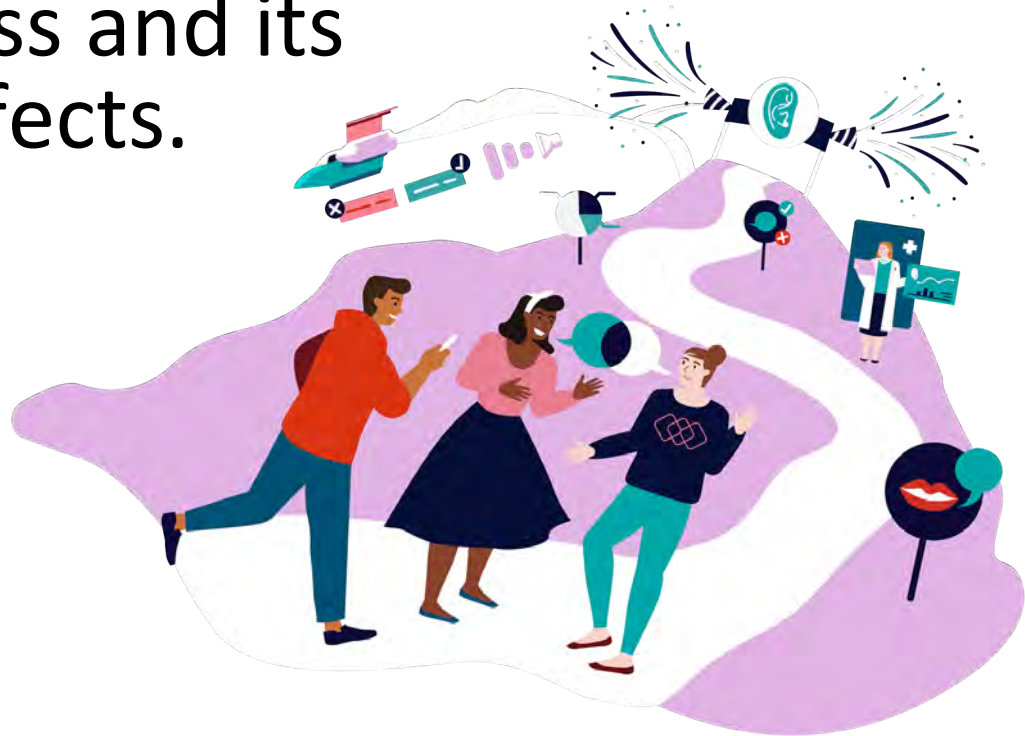
PANIC ATTACKS & PTSD

Freespira

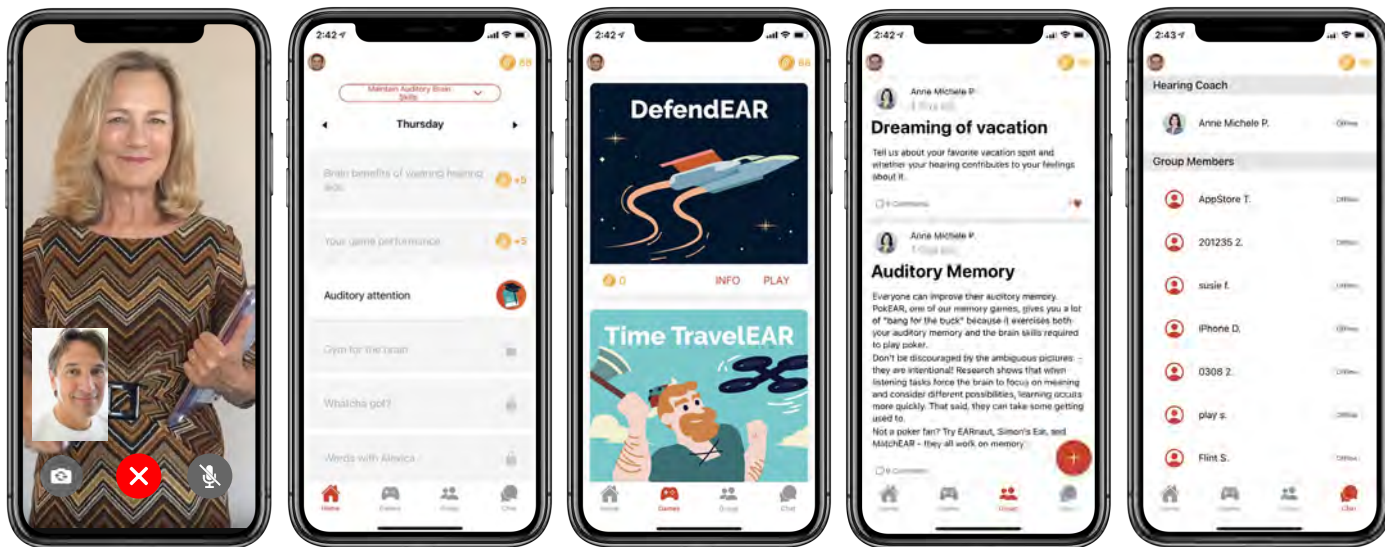
Amptify Hearing Health DTx



A comprehensive tech-enabled hearing health DTx designed to treat hearing loss and its downstream effects.



The Amptify journey



Personal Hearing
Health Coach

Interactive Hearing
Health Lessons

Auditory Brain
Training Games

Hearing Health
Community

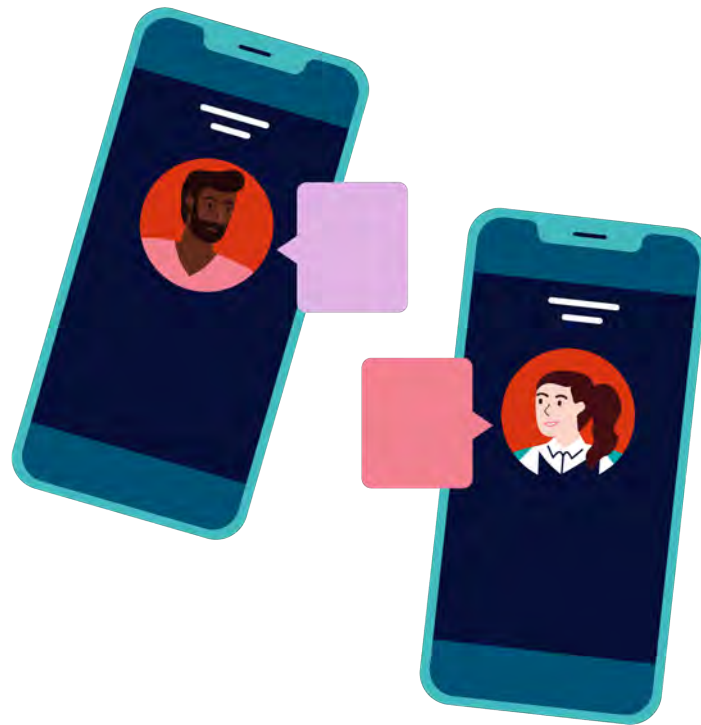
Hearing health coach

- Coaches are trained and certified to support participant care.
- Participants receive one-on-one support and encouragement.
- Coaches track weekly training progress to provide personalized assistance and guidance on how to improve and reach individual hearing goals.



One-on-one support

- Participants can message their Hearing Health Coach directly in the app and expect a response in 24 hours.



Daily content

- Six days a week, participants receive motivational, educational, and interactive content via their mobile devices.
- Participants are provided with tools that empower them to take charge of their communication difficulties.
- Quizzes help to enhance engagement and reinforce newly acquired hearing health knowledge.



Weekly topics: Examples

- **Discover effective listening:** Presenting listening strategies that enhance a participants ability to understand messages and remember what people say.



- **Control your listening experience:** Learning effective strategies to optimize listening and speechreading.



Weekly topics: Examples

- **Plan for reading lips:** Learning tips to lip and speechread provides a better understanding of what someone is saying.



- **Manage communication breakdowns:**
Gaining skills to help lessen and eliminate communication breakdowns, when one partner does not recognize another's message.



Weekly topics: Examples

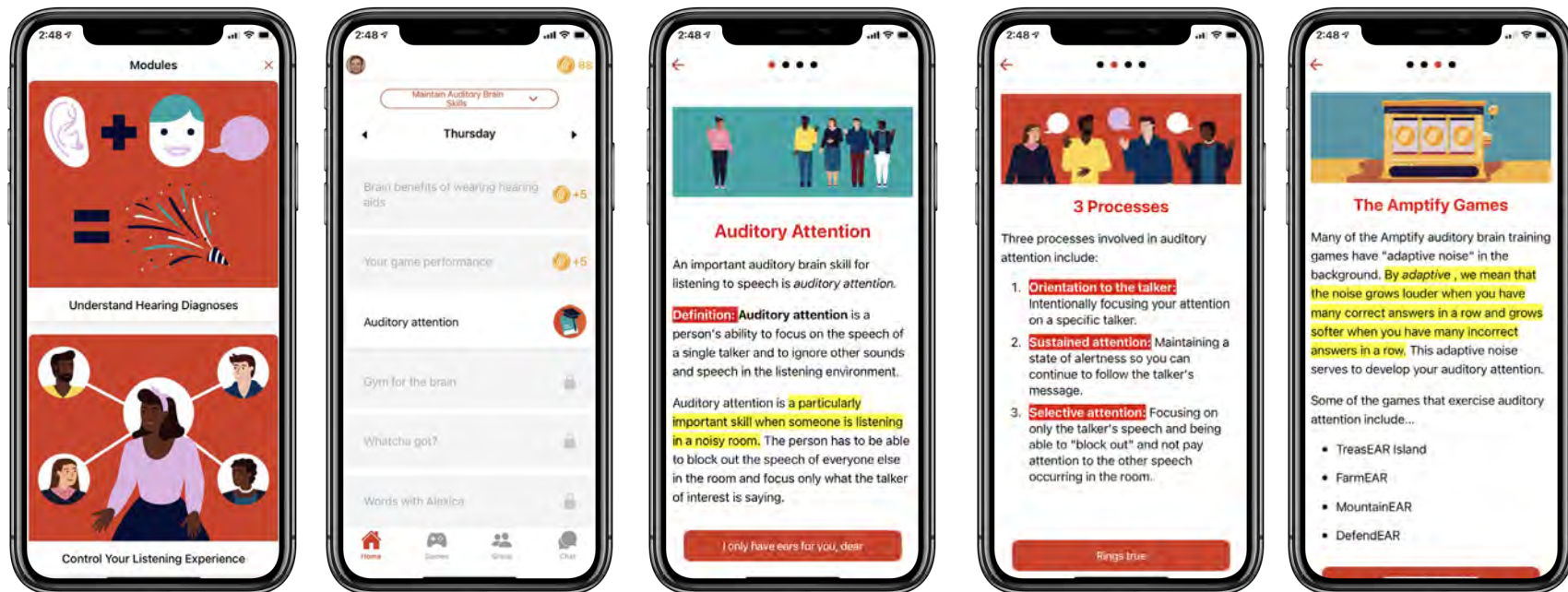
- **Your communication partners:**
Understanding how hearing loss affects our communication partners.



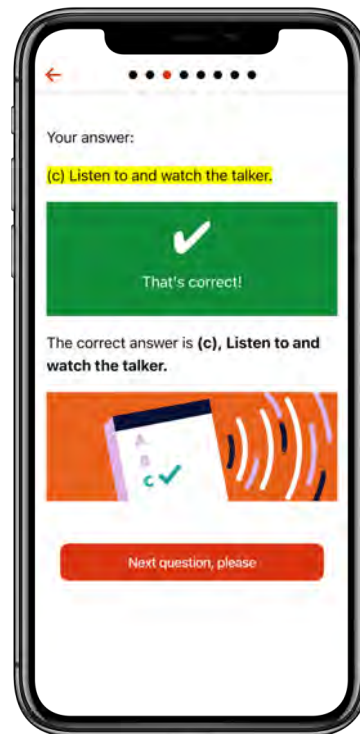
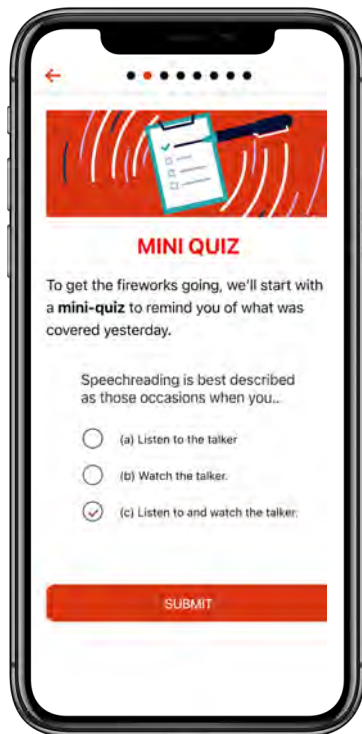
- **7+ more:** Amptify is continually expanding the curriculum and adding more modules



Screen shots: Modules, day, tab

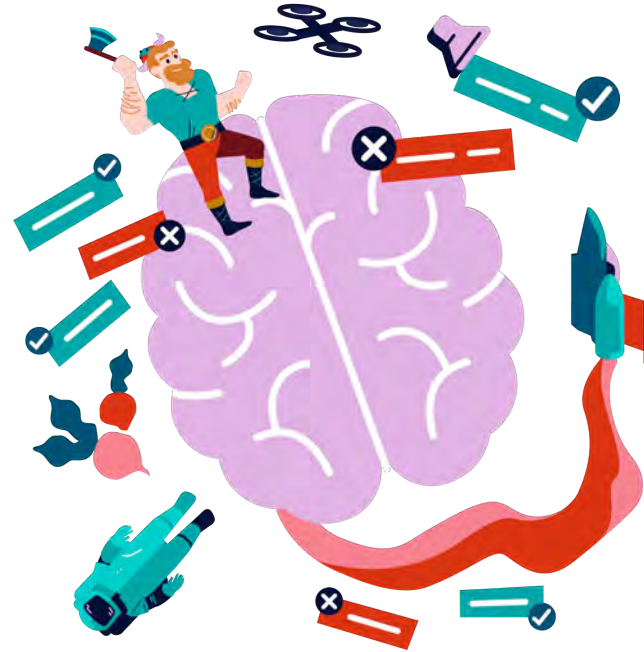


Mini quiz



Auditory training

- Video games designed to teach strong listening and cognitive skills through fun, interactive auditory training modules.
- Game play develops the brain skills necessary to understand what is being said, including auditory attention, word memory, and auditory processing speed.
- The daily Amptify curriculum includes auditory training assignments. Participants earn Amptify coins by playing and a leaderboard shows their standing within the community.



Example of a game

- Get ready to pilot your spaceship through an orbit filled with words and sounds to help increase your auditory processing speed and phoneme discrimination.
 - Auditory Skills Trained
 - Speech Perception
 - Noise Tolerance
 - Phoneme Discrimination
 - Word Identification



More examples: New games always coming



Screen shot: DefendEAR



Progress reports

- Participants can track listening progress, training performance, and more to identify areas of improvement and strengths.



Screen shot: Performance metrics



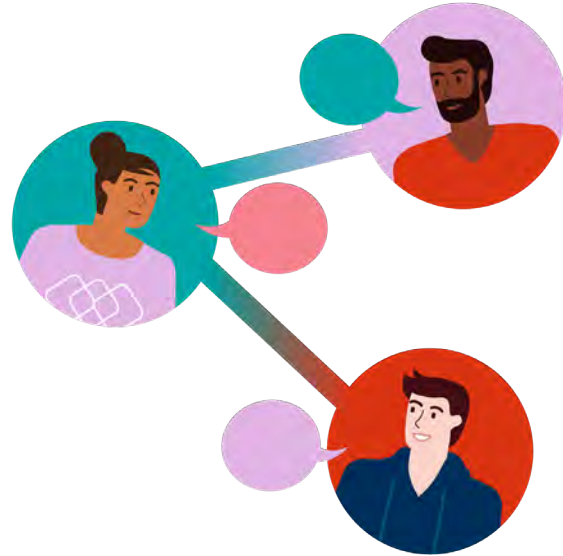
Peer support community

- Shared experiences build community. Share strategies for handling challenging listening situations, post questions, discuss frustrations, and celebrate progress.

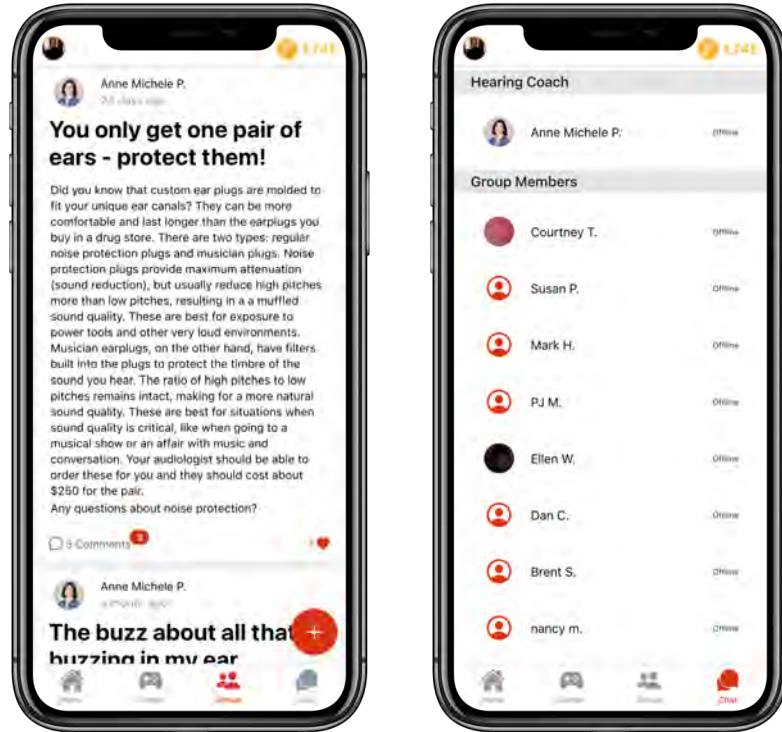


Counter-act social isolation

- Listening challenges can be isolating. The Amptify community seeks to help participants identify with others by tearing down the walls of isolation and creating a place of understanding and acceptance.



Screen shots: Guided conversations & group chats



Auditory training: Deep-dive

Auditory brain training

- Exercises auditory skills
- Helps patients maximally use their residual hearing



Auditory skills trained

- Word discrimination (e.g., car/far; chair/care; tree/bee)
- Everyday, familiar words (e.g., table, girl, street)
- Listening confidence
- Auditory cognitive skills
 - Auditory processing speed
 - Auditory word memory
 - Auditory attention

Auditory processing speed

- **Definition: Auditory processing speed** is how long it takes for you to understand and react to something that someone says.



Why is auditory processing speed important?

- Words come very quickly when someone is speaking.
- **For example:**
- Someone speaking slowly still says about 120-150 words every minute.
- Not only do your ears convey each word to your brain, but your brain must also recognize each word's meaning.



Auditory memory

Definition: The ability to understand what someone says and store it for later recall.

Examples:

- Recalling the details of a funny story
- Remembering spoken directions

Auditory memory entails...

- Paying attention
- **Listening**
- Processing what you hear--i.e., making sense of it
- Storing the information in your brain
- Recalling

If "listening" step is difficult, the subsequent steps will also be difficult.



Why listening with hearing loss may detract from understanding:

Brainpower goes toward identifying each word, therefore not leaving intellectual resources available for processing meaning or for storing the information into memory.

- A week later, someone might not remember the details of a conversation because the details never made it into the person's memory banks.



Auditory working memory

Definition: A subset of auditory memory; the work someone does as they listen in the moment; e.g., to get a punchline, the listener has to keep in mind the lead-in to a joke.

"My daughter is flying in from Chicago tonight, so I have to run home and get the oven preheated because she's expecting her favorite meatloaf..."

- It would be easy to forget the first part of this sentence by the end.
- Thanks to auditory working memory, most people can remember the beginning of a sentence even this long. Unless...



Unless they have hearing loss.

Because some people with hearing loss have to work so hard to recognize the words, for them, this super long sentence might come across like this

"My daughter

..... because she hasn't been home in so very long"

If someone were to ask, **"Where is she flying in from?"** they might not be able to answer, **"Chicago."**



Auditory Attention

Definition: A person's ability to focus on the speech of a single talker and to ignore other sounds and speech in the listening environment, especially when listening in a noisy room.



Three processes involved in auditory attention include:

1. Orientation to the talker
2. Sustained attention
3. Selective attention



Why is auditory brain training helpful?

- **When someone incurs hearing loss:**
- Some brain cells dedicated to processing sound get “co-opted” by other parts of the brain.
- Other brain cells shut down and stop working.
- Over time, they have fewer cognitive resources for processing speech.
- That’s where **auditory brain training** comes in.
- Because the brain has neural plasticity, it can reorganize.



Why gamify auditory brain training?

- Playing video games is entertaining.
- Entertaining activities cause the brain to release dopamine, a neurotransmitter that works as a messenger between brain cells.
- Game play causes more dopamine release.
- More dopamine promotes brain plasticity.
- More brain plasticity means more auditory learning and more development of auditory brain regions.



Auditory training is backed by clinical research and peer-reviewed publishing

- Enhances speech discrimination ^{1,2}
- Leads to reduced perceptual effort during listening. ³
- Enhances the hearing wellness experience. ⁴
- Increases listening confidence. ⁴
- Leads to improved communication and interactions between couples. ⁵
- Hearing aid use time, satisfaction, and acclimation. (In Progress)



Evidence from speech perception studies

- Burk and Humes (2008) found that auditory training led to improved word recognition for trained words.
- The inclusion of the most frequent words of the language led to the likelihood of a person recognizing a word in a sentence presented in noise (2009).

Example of one of our studies (Tye-Murray et al., 2017, JSHLR)

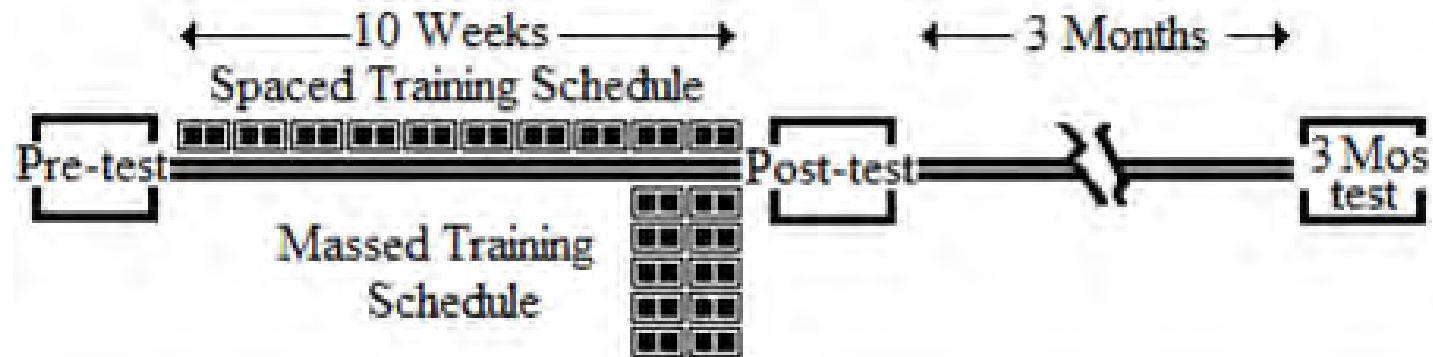
- What kind of training schedules should we recommend to patients?
 - Cognitive psychology literature suggests that “spaced” training leads to better learning than “massed” training on such tasks as word learning and game learning. Does this apply to perceptual learning?
- Are training gains maintained over time?

Optimum training schedule

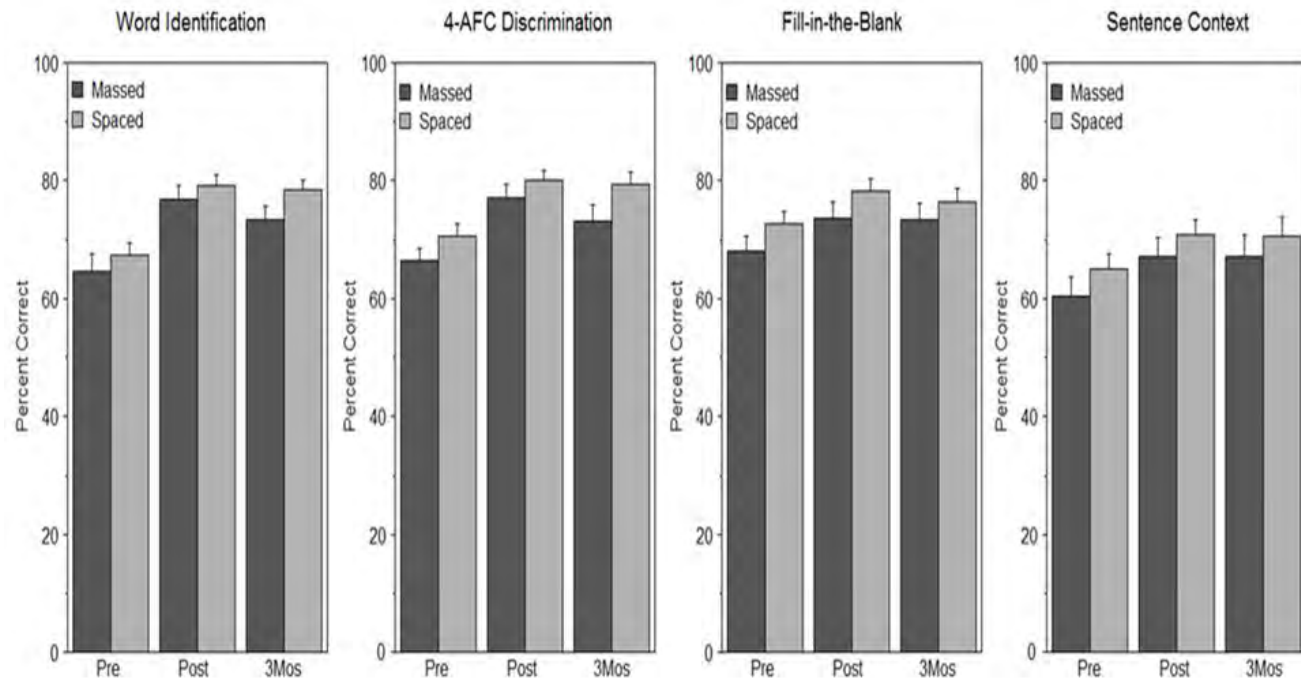
- 24 participants assigned to “spaced” training (41 dB HL)
- 23 participants assigned to “massed” training
- 20 training sessions
- Tests that tapped into the skills that were trained
 - Word recognition
 - 4-choice discrimination
 - Fill-in-the-blank
 - Using sentence context



Training Schedules



Results



Wrap up

Hearing healthcare digital therapeutics are coming

- Many will include auditory brain training
- Goals are to...
 - Help patients maximally utilize their residual hearing
 - Exercise auditory brain skills
 - Increase socialization
 - Educate patients about hearing loss and management techniques
 - Provide ongoing hearing healthcare from hearing professionals



Getting started with Amptify

- Available via iOS, Android and the web
- Following a 2 week introductory trial, it is subscription based, renewed monthly.
- Members can purchase it privately or their audiologist can sponsor them.
- www.Amptify.com

THANK YOU!

Amptify.com