Navigating The Latest Hearing Technology Options Available To Consumers

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Sharing Some Initial Thoughts

- The advent of the digital age, Bluetooth transmission/pairing, WIFI, miniaturization of computer chips, cellphone apps, has led to greater access and ease of participation in listening settings that used to be so problematic for those with hearing loss
- But purchasing technology alone without guidance can result in frustration, disappointment, and possibly a waste of money

Ascertaining Listening Needs

- To avoid such issues, Gallaudet has developed a "Communication Needs Assessment" tool that allows the audiologist to determine the specific listening situations in which an individual is struggling
- Even more than one's degree of hearing loss, one's **lifestyle** will determine one's listening needs
- This assessment allows for a client-centered approach, whereby the client guides and helps direct the intervention process
- Having this knowledge, an audiologist can focus their recommendations on what best meet the client's stated needs

Listening Environment Factors

Client Factors

- Type/ Degree Hearing Loss
- Age
- Health Issues
- Cognitive Function
- Cosmetics
- Budget

Home

Face to Face:
1-1; Group

Media:
TV, Computer, Movie Theater

Phone:
Landline, Cellphone

Alerting:
Alarm, Door, Phone, etc.

Work/School/ Community

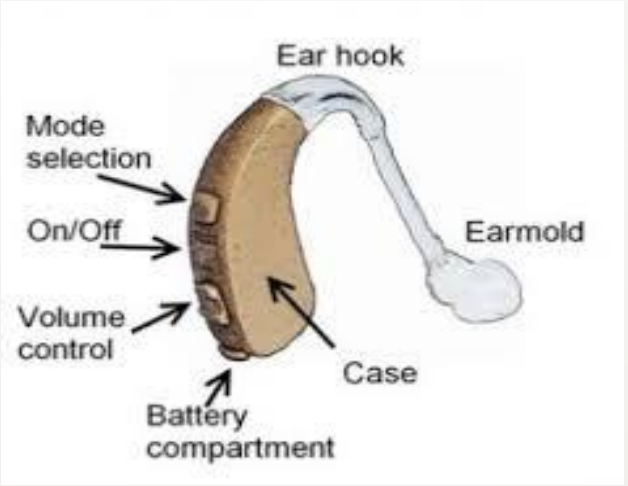
- Face to Face
- Media
- Phone
- Alerting

Recreational Activities

- Face to Face
- Media
- Phone
- Alerting

Advances in Hearing Aid Technology

- The advances that will I discuss may make a difference/impact for an individual, but it does depend greatly on the degree of hearing loss present
- I will mention various developments but not all of these will have equal benefit in relation to one's hearing loss
  - But with increased concern for accessibility/access for all consumers, there are other options that can meet everyone's needs to some degree
  - For example, even though I won't discuss Cochlear Implants in this talk, the advances that have occurred since the early 1980s when I was involved in their initial research, is unbelievable; I know many individuals who are able to communicate with me via Zoom without even looking at me and no captions on at the time, and I have been amazed by their ability to follow me


Ear hook
Mode selection
On/Off
Volume control
Earmold
Case
Battery compartment


photos courtesy of Phonak


PHONAK
PHONAK


THE BENEFITS OF
BLUETOOTH HEARING AIDS

Hearing Aid "Feedback" Management

- A number of you who have worn hearing aids for many years may remember when hearing aids might whistle- such as when wearing a hat over one's ears, hearing aid mold becoming loose over time
- For those who needed much gain, once a certain level was reached, one could not make the hearing aid louder as it would begin to feedback (i.e., whistle)
- In the 2000s, hearing aid manufacturers via digital algorithms, were able to detect when the whistling might just be beginning, and cancel it out
- ✓ This allowed for (a) increased gain; (b) elimination of ear molds (use of tubing/domes) for those with less than a moderately-serve hearing loss; and physically more comfortable and (d) a more enjoyable listening experience (no occlusion effect- that is, feeling as if one is talking in a barrel)

Adaptive Directional Microphone Technology

I need to first differentiate omni-microphone from directional microphone technology.

Omni Microphones:

Advantages: Sensitive to sound in all directions (360^0)

Limitations: May transmit more noise, especially in large crowds, making it hard to hear desired talker

Directional Microphones:

Advantages: Narrower beam, focuses more on one signal minimizing amplification of surrounding noise outside of the beam

Limitations: Need to face person (until recently, directional microphones amplified signals primarily from in front, relying on listener to turn to that direction when listening to talker

- Problem when talker is sitting to your side, walking next to you, or sitting in front of car, while you are sitting in the back (must turn to hear person)

Adaptive Directional Microphone Technology

- In the past few years, manufacturers have developed algorithms that enable the hearing aid to determine what is speech versus what is noise
- These algorithms will "direct" the microphones to focus on the speech signal, regardless of where the speech may be originating from (front, back, side) and decrease gain from other directions (i.e., where noise is deemed to be present)
- This enhances the audibility of the speech signal, making it easier to focus/listen to the talker
- The software can also switch from omni to directional and vice versa, depending if there is speech/noise in the environment (directional) or if it is quiet (omni, allowing one to hear talkers from all around you)

Automatic Adaptive Directionality

Siemens miFocus

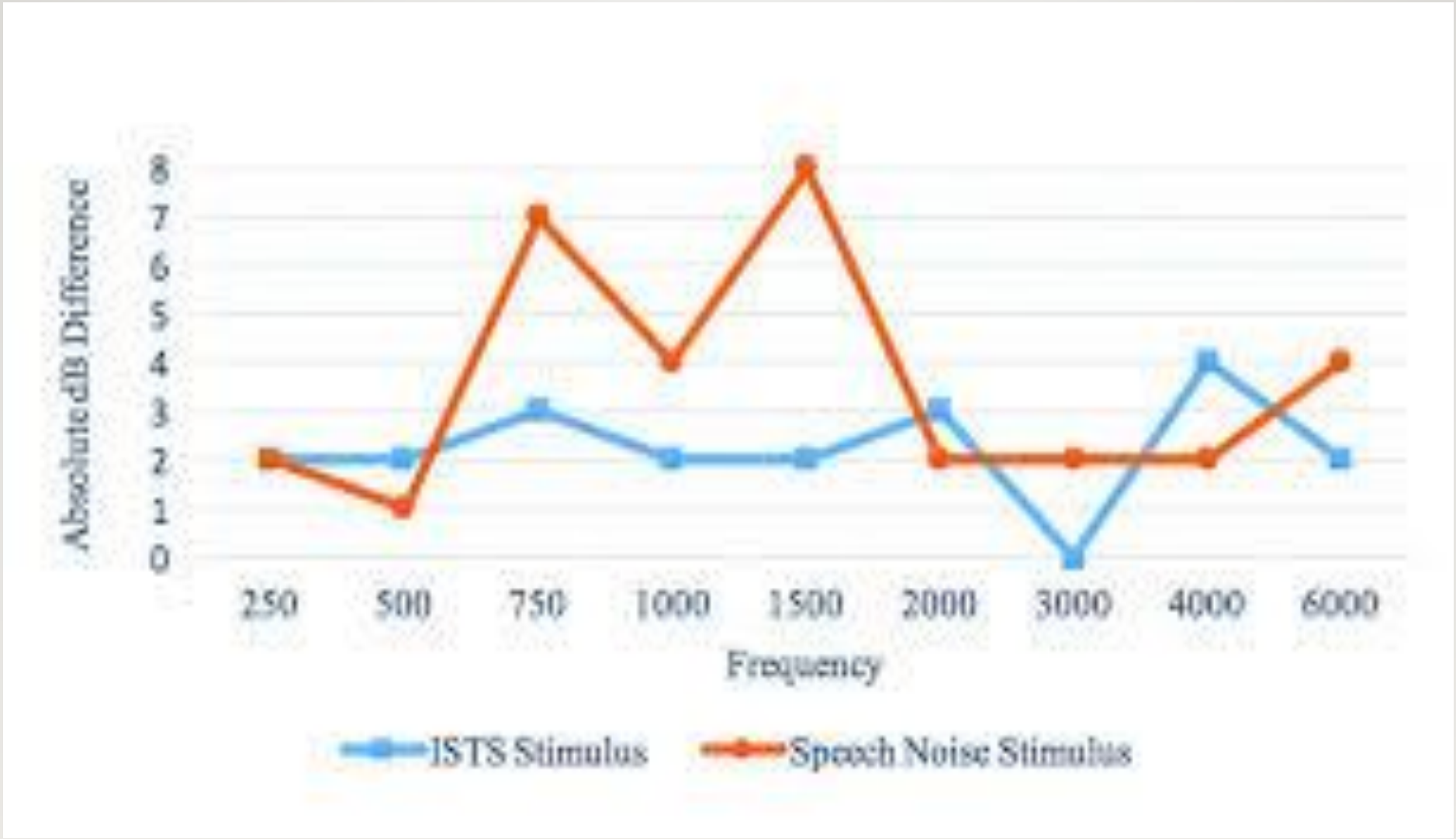
Vision

Speaker

Noise Comfort

- Sometimes, individuals find themselves in settings where it is very noisy but they are not talking with anyone; imagine sitting alone at Starbucks and trying to read a book, or grocery shopping by oneself and is a noisy location

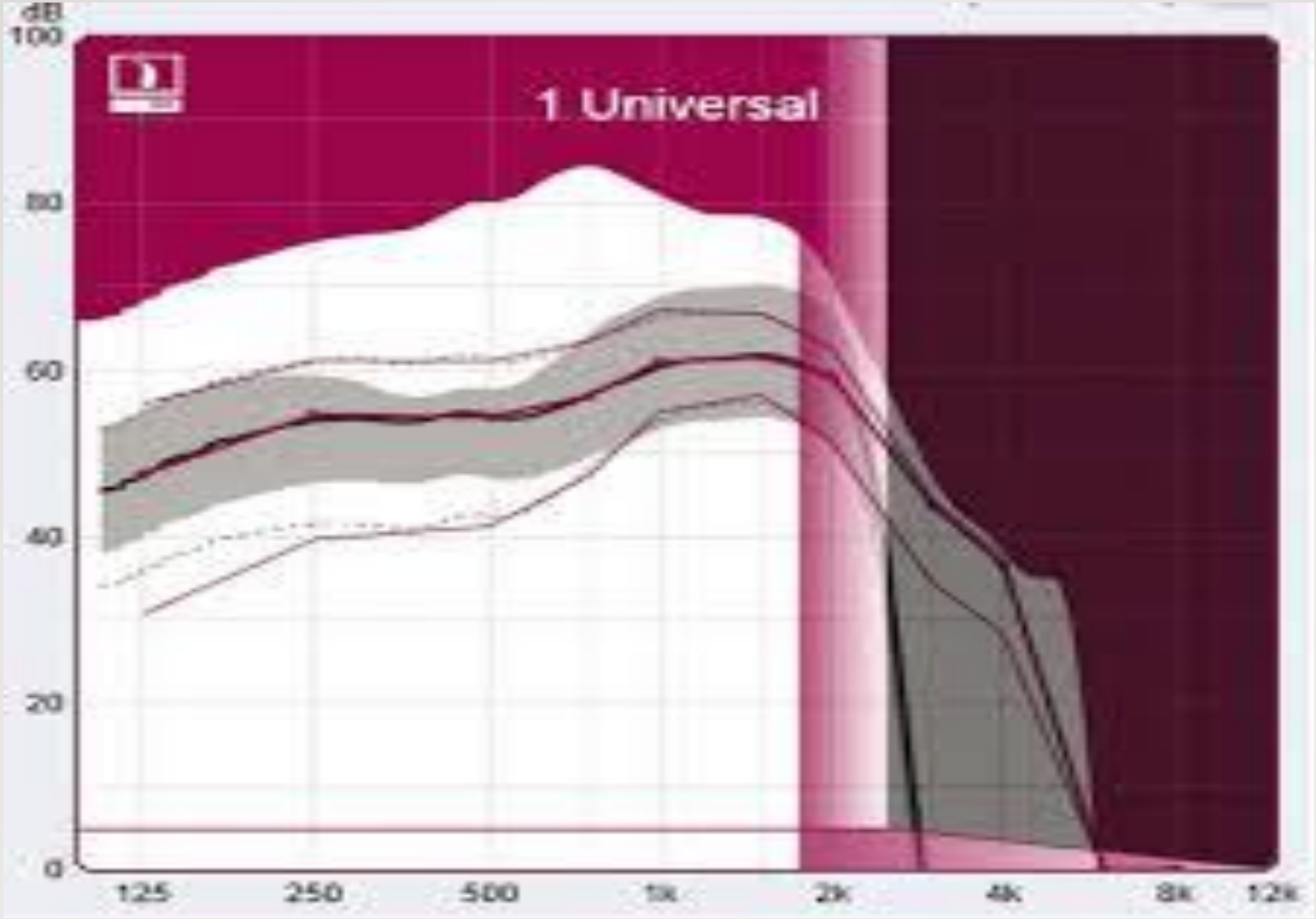
- If hearing aid recognizes that there is much noise but no speech, it will automatically reduce the overall volume, the goal to provide increased listening comfort and reduced listening fatigue


Absolute dB Difference
8
7
6
5
4
3
2
1
0
250
500
750
1000
1500
2000
3000
4000
6000
Frequency
ISTS Stimulus
Speech Noise Stimulus

Frequency Lowering

- Subset of population of individuals with hearing loss have much better hearing in the low frequencies and very poor hearing in the high frequencies; even if could amplify high frequency region, speech sounds likely not sound clear
- One technique that has been developed is to transpose the high frequency speech sounds to lower frequencies, where listener has much better clarity
- Caveat: Takes listener much time to adjust to the speech sounds; also, one is packing in more speech into a narrower region; early attempts were not very successful but new algorithms show promise and many are benefiting

❖ Note many of these individuals are now fit with hybrid cochlear implants (hearing aid portion for lower frequencies, and CI electrodes to process high frequencies)


dB
100
80
60
40
20
0
1 Universal
125
250
500
1k
2k
4k
8k
12k

Wireless Hearing Aid Connectivity

- Perhaps the greatest hearing aid advance has been wireless hearing aid connectivity
- Wireless connectivity refers to the streaming of acoustic signals from external sources, such as telephones, sound systems, and media devices without the use of hard-wired cables, to the hearing aid(s)
- I will discuss two of these modes of wireless transmission and the advantages/ disadvantages of both:
  - Near Field Magnetic Induction (often referred to near-field wireless communication)
  - Bluetooth wireless transmission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Logistics Officer

Near Field Magnetic Induction

- NFMI wireless signals have a much lower frequency transmission than Bluetooth and can easily pass through/around objects such as the human head, making it a favorable option for ear-to-ear signal processing (such as syncing the hearing aids, duo-phone, or streaming music in stereo to the hearing aids)
- Major limitation: range is @ 1 meter, thus there is a need for an intermediary streamer
- That is why a number of companies have used (many still continue to use) to use a streamer

Hearing Aid Streamers

- Hearing aid streamers are able to communicate with Bluetooth devices such as cellphones, BT transmitters that connect to TVs, computers, etc.
  - That is, on the input side of the streamer, they can pair with other BT devices via what is known as BT Classic
  - On the output side, they can emit NFMI transmission to hearing aids, thus, allowing hearing aids to be connected via this intermediary to BT devices
  - Note, that one device from ClearSounds (Quattro 4) is able to pair via bluetooth to BT devices, while transmitting the subsequent signal via a headset or neck loop (for use with hearing aids with T-coils and unable to connect via NFMI)
- Some streamers also function as a headset/remote mini-mic (Oticon Connect Clip) and connect to the hearing aid via BT 4.0 (low energy)


ClearSounds


oticon

2.4 GHz Transmission (Bluetooth is sub-category)

- Until recently, Bluetooth (i.e., the standard that BT devices use) resulted in significant battery drainage and could not be implemented in hearing aids
- In the 2010s, BT low energy was developed, which could be used in hearing aids
- Connectivity transmission distance of 30'-60'
- Traditionally, this signal could not propagate through/around obstacles with the effectiveness of lower frequency signals, thus, did not effectively transmit **acoustic** signals ear-to-ear (thus, one needed streamers with NFMI)
  - But with BT 4.0, music, speech can be transmitted to both hearing aids (e.g., from Connect Clip), such that one can hear in stereo
  - Because of connectivity distance from Connect Clip (and similar devices), one does not have to wear the device and can have hands free experience (such as doing aerobics, running on treadmill)

Phonak Marvel Hearing Aids

- Phonak engineers have developed technology (including antennae and chip) that have allowed them to overcome the deficiencies that were inherent with BT transmission, while allowing for such ear-to-ear communication (new Phonak Marvel hearing aids)
- In addition, the engineers have also been able to incorporate BT Classic into the Marvel hearing aids
- Thus, these hearing aids can communicate directly with BT devices- such as cellphones, BT computers, etc., while also allowing for music streaming and the hearing aids to work together
- Marvel also uses artificial intelligence to analyze acoustic environments and draws upon multiple features within the hearing aid. It then blends these features to optimize sound regardless of the listening environment

Rechargeable

Remote app

TV Connector

RogerDirect ready

Starkey Livio AI

- The world's first Healthable hearing aid
- Using integrated sensors and artificial intelligence
- Able to track body activity (steps, actual movement, heart rate), brain activity (social engagement, listening) and derive scores as to body and brain activity
- Integration of the physical activity data measured by inertial sensors of the hearing aids with Apple Health and Google Fit apps
- Fall detector and, in turn, can alert contacts to come help
- Able to communicate to Apple Phones directly, etc.


TELEHEALTH
ARTIFICIAL INTELLIGENCE
CLOUD
FALL DETECTION
MACHINE LEARNING
ACCESSORIES
Redefining hearing aid.

Phonak Roger Platform

- The Phonak Roger system replaced FM system technology, which is subject to interference from competing devices transmitting in the 72-76 KHz band
- The Phonak digital standard remote microphone (Roger) technology from Phonak uses 2.4GHz transmission to connect to compatible receivers
- No frequency interference (due to the frequency hopping), that is with the paired Roger receiver, the signal hops from one frequency to another until finds one free; does this many, many times a minute
- Roger technology uses adaptive algorithms that continuously analyzes noise levels to keep the Roger signal clearly audible above the background noise
- Multiple Roger microphones can link together in a multi-talker network
- And, unlike BT transmitters (maximum of 3 receivers), Roger can be connected to infinite # of receivers

Phonak Roger Technology

Adaptive behavior:

- When Roger mics are held in vertical position (lanyard mode), the mic enters a directional mode (so that can better pick up talker's voice)
- When placed on a table, the Roger mic enters an omnidirectional mode (to pick up speakers around the table)
- There are three types of Roger microphones:
  - Roger Pen
  - Roger Select
  - Roger Table Mic

Phonak Roger Systems

Roger Pen:

- Was the first of the Roger microphones introduced
- When the Roger Pen was introduced, a compatible Roger Receiver (MyLink) was introduced
- In addition, there is a Roger universal receiver that can be connected to many of the Phonak FM systems (as well as other company's FM systems)
- Roger Pen has **three** manual **microphone** modes: Omni, Directional; Zoom (most beamlike), as well as adaptive mic feature discussed in the last slide

Roger Pen

- With the introduction of the Marvel hearing aids, Roger microphones are able to stream directly to hearing aids, after a simple activation of a Roger receiver computer program into the hearing aid
- Recently the Roger Pen iN was introduced whereby with a docking station, it can be paired with various BT devices and, in turn, transmit the signal to Roger compatible hearing aids
- It can also be connected directly to BT devices via a USB cable

Roger Select

- Utilizes six microphones, beams created in six directions, covering 360°. In noisy settings, it calculates and compares the signal-to-noise ratio for all six directions and automatically selects the beam with the best clarity
- When placed on a table, it automatically selects the person who is talking and seamlessly switches from one talker to another.
- When multiple conversations take place, the listener can manually select whom to listen to

Roger Table Mic II

- Roger Table Mic II Microphone is dedicated for working situations when one participates in various meetings
- Similar to Roger Select, it consists of six microphones- each beaming within a 60^0 angle
- Roger Table Mics can be networked with each other to create a MultiTalker Network.; additional table microphones are placed so that one can hear the people seated around the table
- The Roger table mics selects the person who's talking and switches automatically between the meeting participants

Roger Table Mic II networked and in action

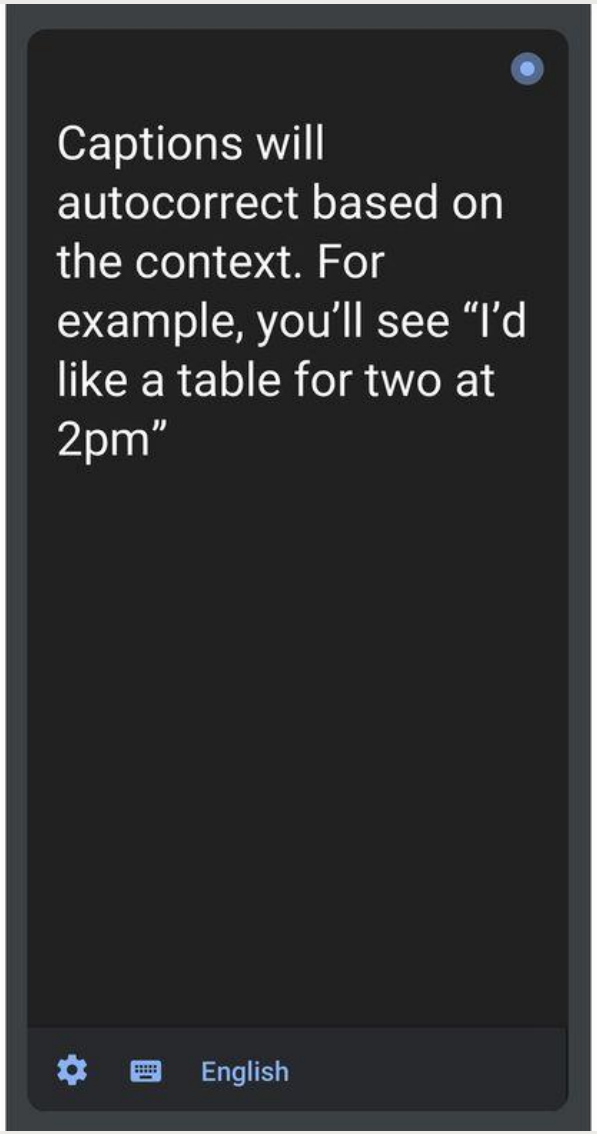

Roger Touchscreen Mic
Roger Select™
Roger Clip-On Mic
Roger Pen™

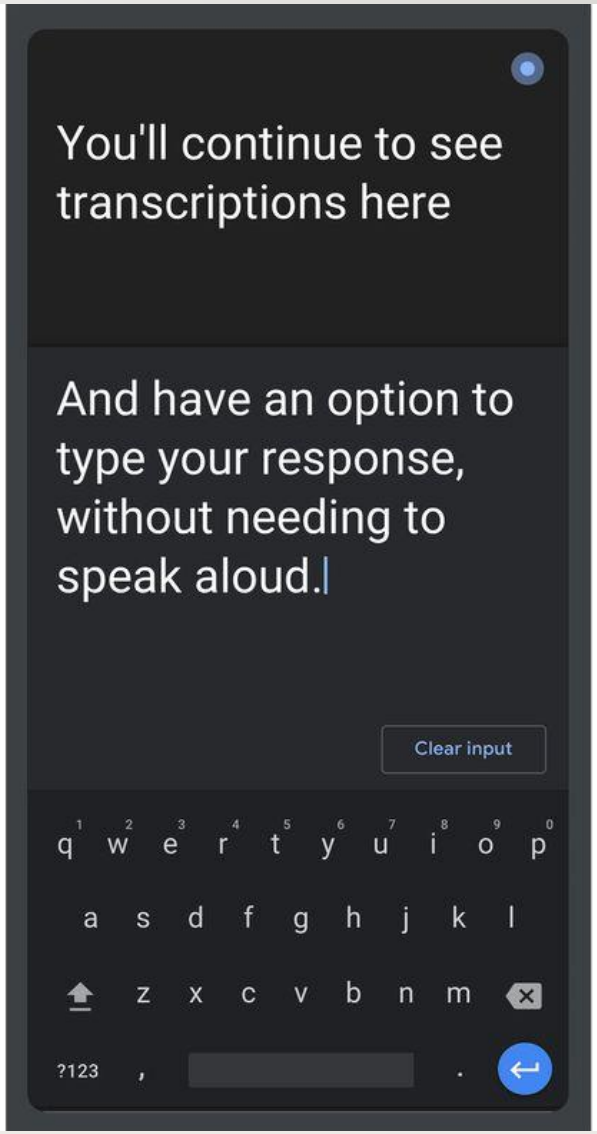
Innovative Cellphone Apps for Use as Hearing Assistive Technology

Voice to Text Software Apps for Use in Conversational Settings/ Presentations:

- Live Transcribe from Google (free download the app and go ahead/use)
  - This app can only be used on Android phones
  - Caveat: I have had some difficulty with Live Transcribe in noise, but this can possibly be overcome by attaching a highly directional mic to the phone
- Live Caption (for use with Android and iPhones); $2.99

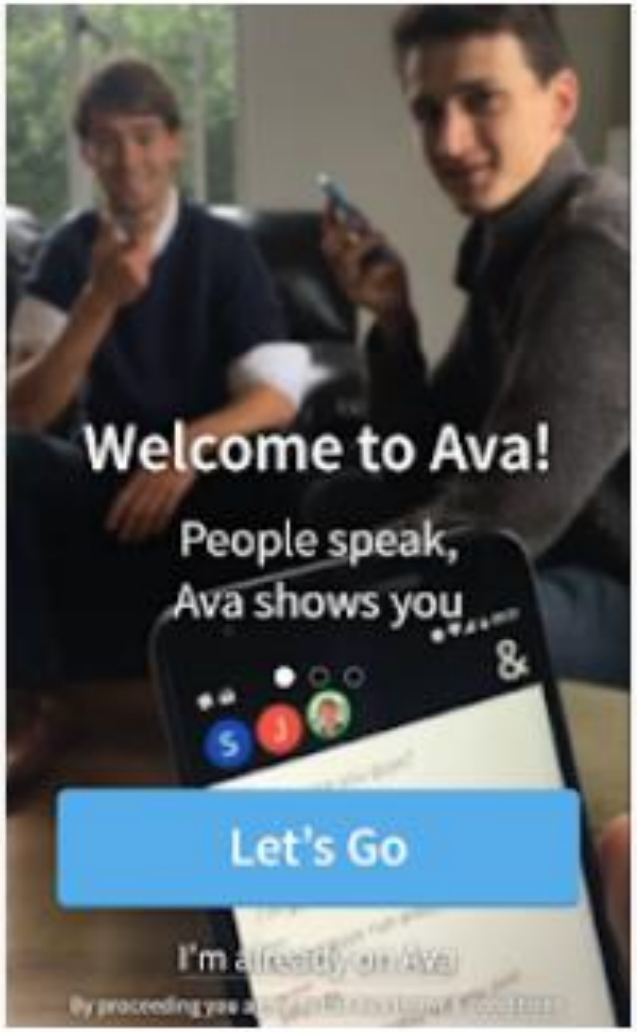

With Live Transcribe, you can see words appear on your phone as they're spoken.
English


Captions will autocorrect based on the context. For example, you'll see "I'd like a table for two at 2pm"
English

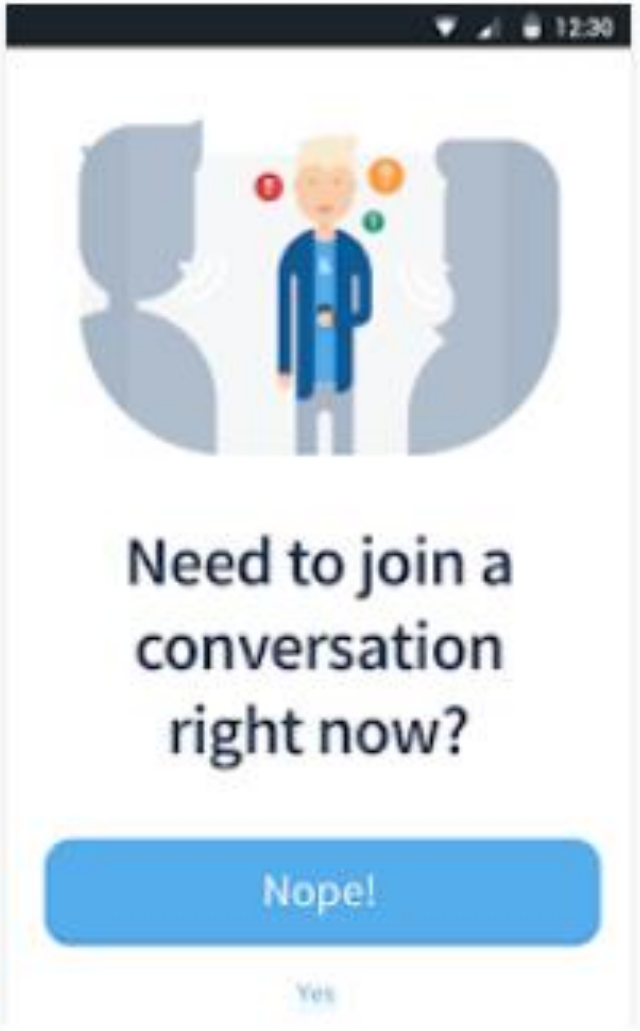

You'll continue to see transcriptions here
And have an option to type your response, without needing to speak aloud.
Clear input
q w e r t y u i o p
a s d f g h j k l
z x c v b n m
?123

Voice to Text Software Apps

- **Ava** is used for group conversations:
  - Each participant in a conversation downloads this app and sets up a profile (color coded)
  - Individuals talk normally near their phone's microphone and the speech to text translation is organized into a threaded message for everyone in the group to see (app identifies who spoke)
  - Use AVA in group meetings, restaurants and one-on- one and in church. Does quite well with moderate background noise, and one post indicated that was more accurate that Google Transcribe
  - Compatible for Android and iPhones; for **Ava** users that move past a 5 hour time frame, they can upgrade to a paid unlimited version of the **app** for $29 per month. ..


Welcome to Ava!
People speak,
Ava shows you
Let's Go


hello
I'd like a
double
Mocha


Need to join a
conversation
right now?
Nope!
Yes

Voice-to-Text Messaging

- Although not cellphone apps, I did want to mention Zoom and Google Meet
- These two software programs not only allow for **free** face-to-face conversations, but have incorporated what appears to be very good voice-to-text software, where without any training, captions are quite accurate (especially on Zoom)
- It appears that Zoom includes an auto-correct feature; I am not sure about Google Meet
- Zoom also incorporates an embedded closed captioning feature during recording, so that upon playback, one just has to hit CC, and one can see the captions
- Zoom also allows for three sized fonts for CC

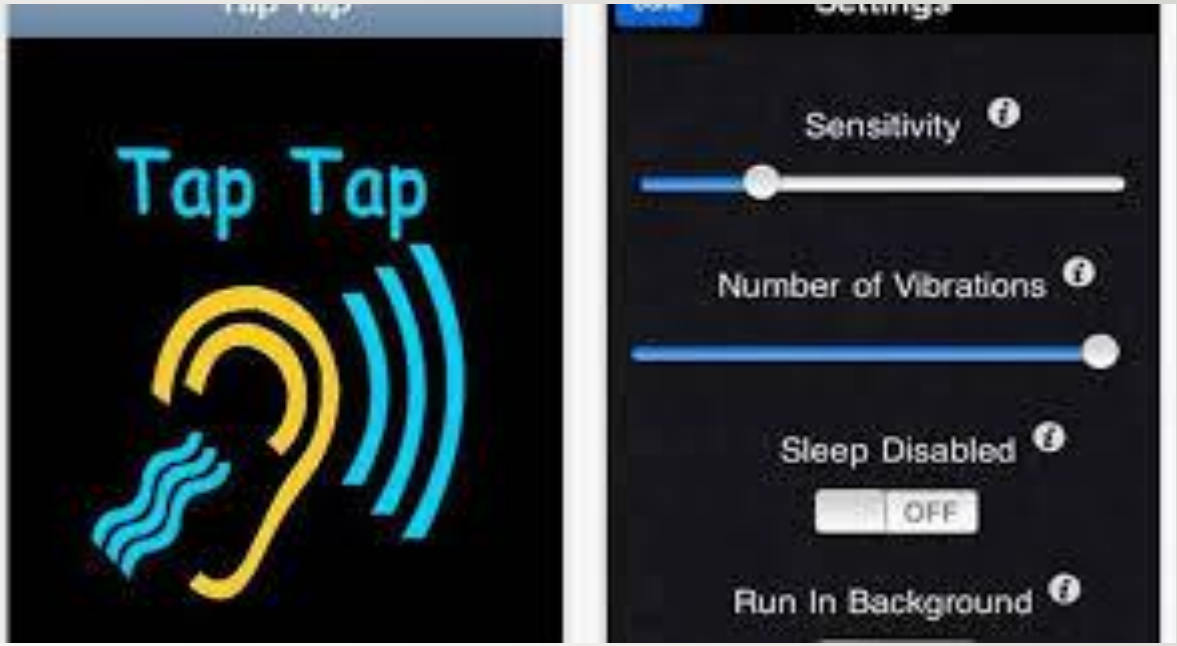
Mobile Device as an Remote Mic system

- Can attach a higher quality directional mic to smartphone (e.g., Mikey from Blue Microphones)
- Place the smartphone close to the talker
- Smartphone transmits signal to hearing aids directly (via BT 4.0) or to and then via a streamer up to a distance of up to 30– 45 feet away
- From what I can ascertain, the Mikey microphone can only be used on iPhones (have no idea why that would be the case); I am sure other mics can be attached to Android phones

Mobile Device as an Alerting Device

- There are apps that can be downloaded to alert user to important environmental sounds- such as door knocks, smoke alarm, telephone ring (even identify who may be calling you by different vibration pattern)
- Alerting mechanism includes vibrations, flashing lights
- These apps are subject to the same issues as dedicated alerting devices in that the device can be triggered via irrelevant, environmental sounds
- Sensitivity of the mic can be adjusted (to avoid triggering to extraneous sounds) and the app can run in the background


Listening...
SMOKE ALARM


Tap Tap
Sensitivity
Number of Vibrations
Sleep Disabled
OFF
Run In Background


FLASH ALERTS
CALLS & SMS


Smart Listening:
Smartphone Apps
to Assist with
Hearing Loss

VibroSaver

- VibroSaver in a strong vibration bed shaker Smart Wi-Fi alarm clock with multiple alarm & vibration Settings
- Used with a corresponding Android app, can set the day/times want alarm to go off, can use for self or even to wake family members or others in locations remote from cellphone location (i.e., access to VibroSaver from through the internet)
- Allows one to go on vacation, conferences without lugging an alarm clock


Monday, Aug 30
6:00 AM
Snooze
Stop
Vibrating Alarm
Strong Vibration
Immediate Vibration
Multiple Schedules
Wi-Fi Control
Voice Controls
Pillow Perfect
Simple Setup

Over-The-Counter Hearing Aids

- **OTC** hearing aids are supposed to become available in 2020, but are not yet on the market
- The FDA is still finalizing its guidelines for OTC hearing aids, which will be published by August 2020 at the latest before another round of input from the medical community and potential users.
- Until these guidelines are made official, consumers should be aware that any device marketed as an OTC hearing aid has not received FDA approval
- **OTC hearing aids** will be regulated as medical devices by the U.S. Food and Drug Administration

Over-The-Counter Hearing Aids

- OTC hearing aids will be able to be purchased without a medical prescription
- OTC will be hearing devices that are available for only adults with a **mild to moderate** hearing loss, that will be able to be purchased directly from a retailer or online
- They will obviously be cheaper than bundled cost hearing aids
  (the latter include the devices, fitting visits, and any service warranty; e.g., at Gallaudet, for private pay and 3rd Party co-purchase, we include a 3 year manufacturer and service warranty)

Questions/Caveats to OTC Devices

- As mentioned before, OTC devices will be only available to individuals with mild to moderate degrees of hearing loss; the maximum output will be limited to ensure that they do not damage hearing in these individuals, therefore, not of sufficient power for those with severe to profound hearing loss
- The primary hearing related issue confronting most individuals with mild to moderate hearing loss is difficulty hearing in noise, not in quiet
  - Thus, what important hardware/software features will be included in these devices that will allow them to address the noise issues (e.g., directional mics, nose cancellation, programming app flexibility)

Questions/Caveats to OTC Devices

- If there are any self-programming related issues (such as sound quality, comfort level, audibility in various listening settings), how will these be addressed?
- I have heard from some individuals who believe they will be able to purchase these hearing aids, then go to the audiologist to serve them; unless the audiologist somehow carries these OTC devices (and has access to the fitting/programming software), they will be unable to assist the client
- I have gone to some sites (such as Walmart) who appear to be selling FDA approved hearing aids and no information concerning the products are available

My Thought Re OTC Hearing Aids

- I believe that reliable OTC hearing aids will be very useful for individuals with mild to moderate hearing loss residing in nursing homes, assistive listening facilities, and those with sedentary lifestyles
- It appears that there are certain devices that may be able to address noise related issues, but will they be cosmetically appealing (such as BOSE Hearphones- not a hearing aid, so waiting to see what actually comes out), ?

My Thought Re OTC Hearing Aids

- No hearing tests required; will self-hearing testing or self-fitting be incorporated into all of these OTC hearing aids?
- How will fitting adjustment issues/repairs, etc. be addressed? Will there be trained staff available to meet with customers?
- Will there be individuals who purchase OTC hearing aids who have serious underlying medical issues (such as certain types of tumors) and have not seen an audiologist and do not seek treatment until very late in the process?

Doctoral Audiology (AuD) Training

- AuD students undergo a very intensive period of earning/training (3 or 4 year program)
- In addition to the academic aspects, they receive on-site training in the 1st (and possibly 2nd year), followed by internship placements (usually local to university setting) and one year externship placement with a licensed, qualified audiologist (who has received supervisory training)
- The focus of the training is client-centered care; that is, the audiologist seeks to ascertain the specific issues, listening needs, and client's hearing related goals

Doctoral Audiology (AuD) Training

Together, the client and the audiologist work together collaboratively to determine:

- the intervention(s) that will best meet the client's needs
- if the interventions have successfully met the client's listening needs, or, if the intervention plan needs to be changed or augmented:
  - hearing aids by themselves will not necessarily address all of the prioritized listening needs; hearing assistive technologies may be required (such as waking up to an alarm, or hearing a doorknock when in the shower)

Doctoral Audiology (AuD) Training

At Gallaudet, students are taught to demonstrate:

- Professional Integrity
- Respect
- Compassion
- Cultural Awareness

We are committed to serve the best interests of the clients. As Dr. Matthew Bakke stated at our White Coat ceremony yesterday for our Doctoral Audiology students (as they ready for their externship placements), "It is all about our clients, not you."

Summary

- I hope I have provided some information that was new to you, and possible avenues to explore going forward

- I hope you have questions that I may be able to answer for you!!!!