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Improving accessibility to hearing healthcare: only smartphones have the answer,

presented in partnership with Seminars in Hearing

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Dr David Maidment is a Lecturer in Psychology within the School of Sport, Exercise and Health Sciences at Loughborough University, UK. His current research interests focus on digital interventions to improve physical activity and reduce noncommunicable disease risk in older adults with hearing loss. David graduated in 2008 with a BSc in Applied Psychology from Cardiff University. He then went on to complete an MSc (2009) and PhD (2013) also at Cardiff, exploring how different modes of speech interact in verbal short-term memory. David subsequently worked as a Research Associate (2012-15) at the Nottingham-based Medical Research Council Institute of Hearing Research, and a Research Fellow (2015-18) at the National Institute for Health Research Nottingham Biomedical Research Centre. In this latter post, David undertook research in the development and evaluation of novel digital interventions for hearing loss.

Disclosures

- **Presenter Disclosure:** Financial: David Maidment is employed by Loughborough University, UK. He received an honorarium for this presentation. Non-financial: David Maidment has no relevant non-financial relationships to disclose.
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Learning Outcomes

After this course, participants will be able to:

- Summarize the evidence assessing different connected hearing devices.
- Explain how connected hearing devices compare to traditional hearing aids.
- Discuss whether connected hearing devices can improve accessibility to hearing healthcare.

CONTINUED

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What percentage of adults with hearing loss adopt hearings aids in the USA?

1. 8.5%
2. 17%
3. ✓ 34%
4. 68%

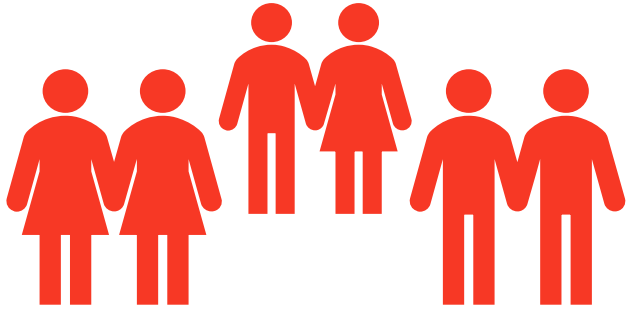
15

Valente & Amlani (2017) *JAMA*

Why is hearing aid adoption low?

No perceived difficulty

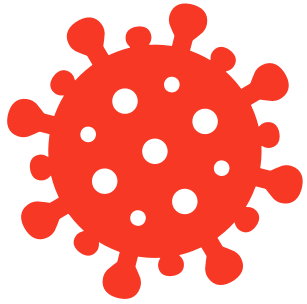
Limited benefit



Lack of support

Negative stigma

Discomfort



Reduced access

Addressing barriers to hearing healthcare

- Mobile health (mHealth)
  - Health services supported by mobile devices (e.g., mobile phones, tablets, patient monitoring devices)
- Smartphone-connected devices
  - Past decade seen a rise in available technologies
  - Connect wirelessly via Bluetooth

Image: https://pixabay.com/illustrations/smartphone-phone-call-iphone-4103051/

Smartphone ownership

- 55-65 year olds experiencing fastest rise

2012: **19%** owned a smartphone

2021: **83%** own a smartphone

Own a smartphone

Does **not** own a smartphone

Ofcom, UK (2021)

Smartphone-connected hearing aids*

User adjustment

Language translation

Automatic location adjustment

Fall detection

Audio streaming

Find misplaced devices

Remote microphone

Activity tracking

Remote delivery

*Or *made-for-iPhone/Android/All (MFI/A)*

Direct-to-consumer amplification products*

Low cost

Main alternative to hearing aids

Over-the-counter via (online) retailers

Non-FDA approved

Improve listening in specific environments

Not marketed for hearing loss

*Or *personal sound amplification products (PSAPS)*

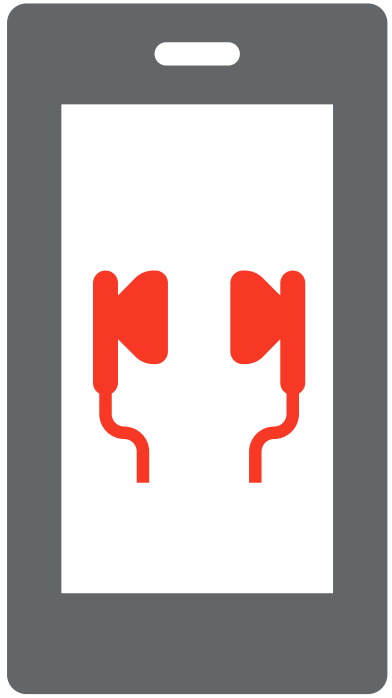
Smartphone hearing aid apps

Wired earphones

Wireless earphones (or hearable)

In-situ audiometry

User adjustment



What's the evidence?

- Review the current literature assessing the application and benefits of:
  1. Smartphone-connected hearing-aids
  2. Direct-to-consumer amplification products
  3. Smartphone hearing aid apps

A qualitative collective case study

- Method
  - Semi-structured interviews: clinicians (n= 8) and patients (n= 11)
  - Grey literature sources published in 2014-15 (e.g. news media, reports, professional magazines)
- Results
  - Aural rehabilitation practices were improved ✓
  - Potential to reduce stigma, 'normalised' ✓
  - Greater opportunities for patients to participate more fully in everyday life ✓
  - Technical issues related to Bluetooth connectivity ✗

Ng, et al. (2017) *JAAA*

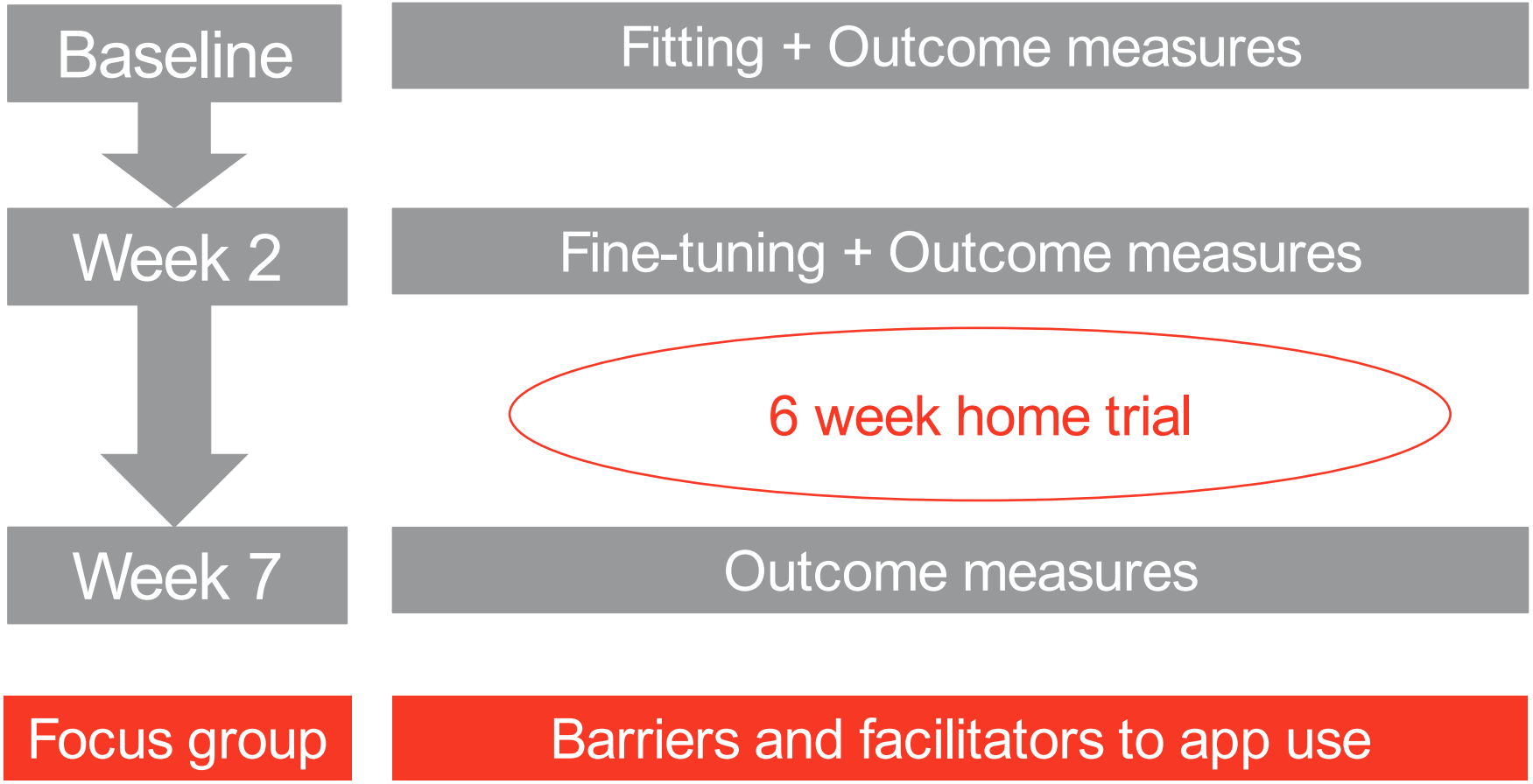
A mixed-methods study

- Aim
  - To assess the benefits of a smartphone app when used with smartphone-connected hearing aids
- Methods
  - Single centre, prospective, observational study
  - N=44 hearing aid users (*new*= 14; *existing*= 30)
  - Age= 68 years
  - PTA= 38 dB HL (i.e. *mild-to-moderate*)
  - Owned Apple iPhone ≥5.0 (iOS 10+)

Image: https://pixabay.com/photos/iphone-hand-screen-smartphone-apps-410311/

Gomez, et al. (2021) *Ear Hear*

Design



Gomez, et al. (2021) *Ear Hear*

Patient-reported outcomes

- All measures revealed several benefits of smartphone-connected hearing aids
  - social participation
  - hearing-related fatigue
  - quality of listening through hearing aids
  - hearing aid benefit and satisfaction

- All outcomes better for the smartphone-connected hearing aids in comparison to conventional hearing aids

Feedback survey (app)

- Star rating was high ★★★★☆

App met users' needs
- Extremely well = 68.5%
- Somewhat well = 26.3%

Best feature
- Ability to adjust = 42.1%
- Use anywhere = 26.3%

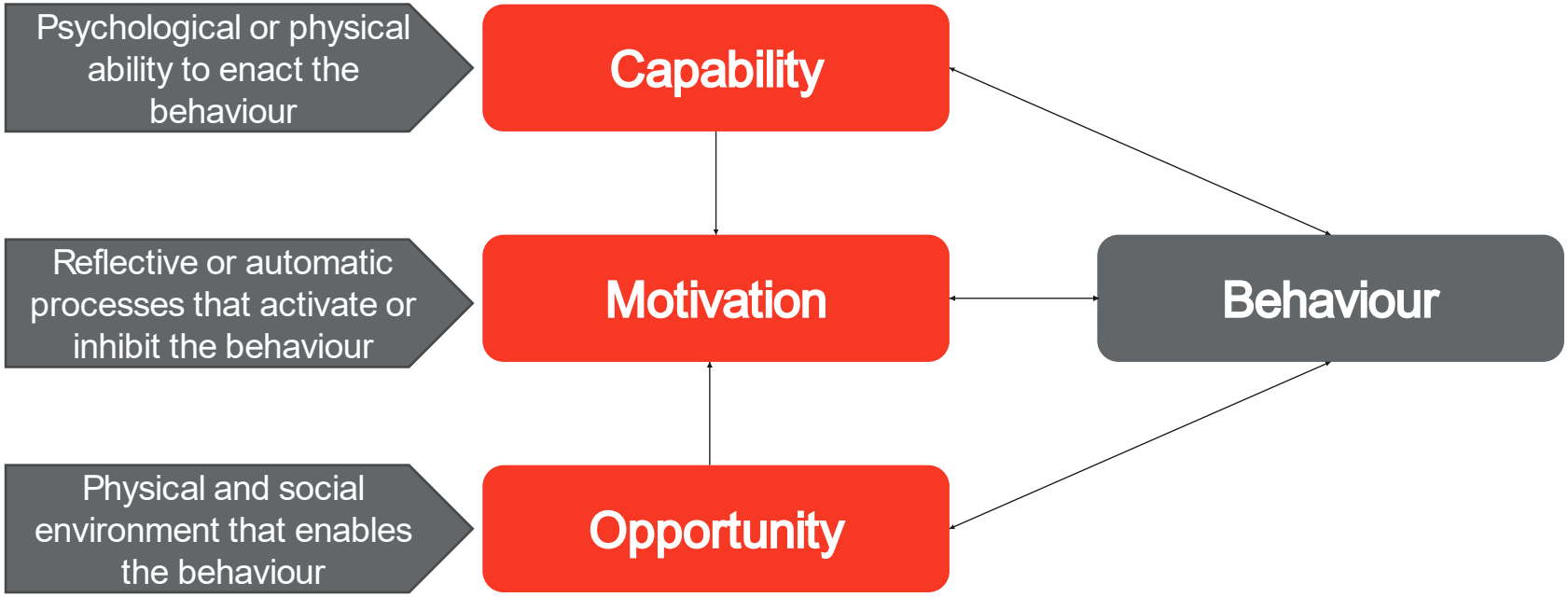
Preferred settings
- Noise reduction = 31.6%
- Volume = 31.6%

Experience tiredness?
- No = 86.8%
- Yes, only once = 7.9%

What would you change?
- Nothing = 21.1%
- Bluetooth, ⬆ personalisation

Patient focus groups (n = 8)

- Assessing barriers and facilitators to app use underpinned by the Behaviour Change Wheel



Michie, et al. (2011) *Implement Sci*

What patients said…

Capability

- Initial limited knowledge, ⬇ over time
- Burden from self-tuning
- Smartphone literacy

Opportunity

- Reduced hearing aid related stigma
- ⬆ participation
- Benefit in group conversation
- Societal norms

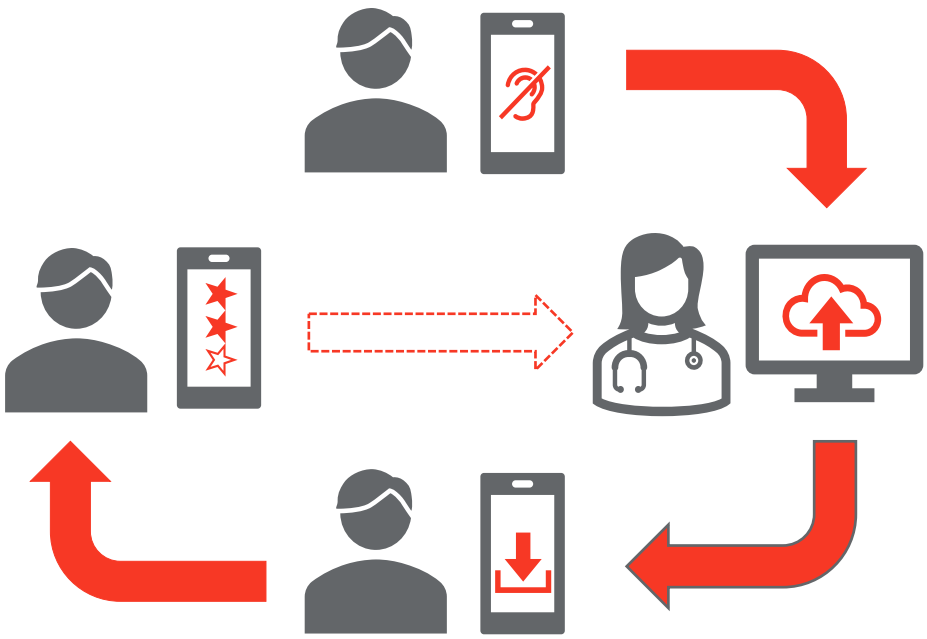
Motivation

- Empowerment led to ⬆ use and participation
- Suited to a younger demographic

"I think it's great to be able to control these things, it's nice to feel you're in control."

Gomez, et al. (2021) *Ear Hear*

Remote adjustment



- Compare quality of fine-tuning:
  1. In-person
  2. Remote adjustment
- Speech-in-noise performance did no differ
- Hearing aid outcomes did not differ
  - Use, benefit, and satisfaction

Groth, et al. (2019) *Canadian Audiologist*;
Convery, et al. (2020) *Telemed J E Health*

What's the evidence?

- Smartphone-connected hearing aids

Pros	Cons
▪ Improved rehabilitation practices ▪ Greater social participation ▪ Reduced stigma ▪ Greater hearing aid use, benefit and satisfaction ▪ Improved speech-in-noise perception ▪ Empowerment	▪ Require sufficient digital literacy ▪ Frustration due to connectivity issues ▪ Additional burden resulting from self-adjustment ▪ Suited to a more younger demographic ▪ Insufficient personalization

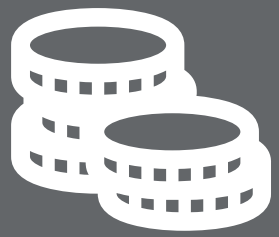
Join: **vevox.app** ID: **190-783-015**

Based on the evidence, would you recommend smartphone-connected hearing aids?

1. 
2. 
3. 
4. 
5. 

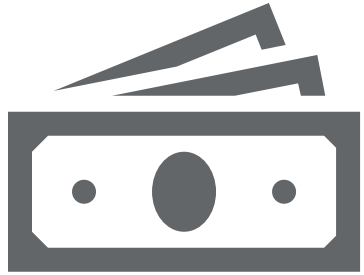
DTC products – price matters!

- Fail to meet prescribed target gains for age-related, sloping hearing losses
- Speech understanding in noise poorer than hearing aids



"Premium" >£200

- Allow for target gains to be met for most mild/moderate hearing losses
- Speech understanding in noise similar to hearing aids



Reed, et al. (2017) *JAMA*

DTC versus hearing aids

- 28 DTC products purchased online for <£400
- Compared to hearing aid
  - Electroacoustic performance
  - Match gain and slope targets
  - Cosmetic appearance
  - Willingness to wear
- Higher priced DTC products resulted in better outcomes
  - Produced uncomfortably loud sounds
  - Low cosmetic appeal ratings

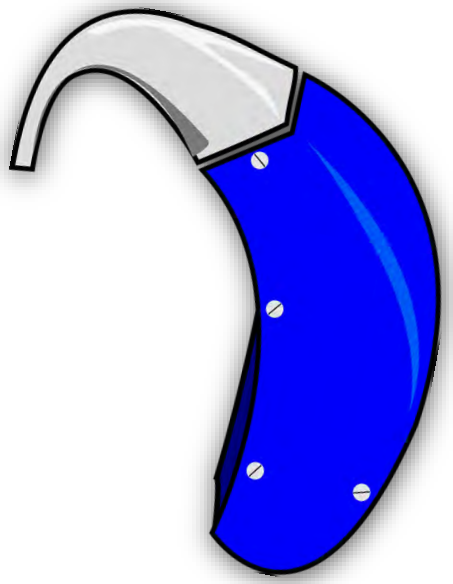


Image: https://pixabay.com/vectors/deaf-hearing-hearing-aid-blue-158604/

Almufarrij, et al. (2019) *Trends Hear*

What's the evidence?

- DTC amplification products
  - Performance of associated with purchase price
  - User-adjusted controls via a smartphone Improve frequency-gain and overall speech intelligibility
  - Serve as an accessible, lower-cost alternative?

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Based on the evidence, would you recommend DTC amplification products?

1. 
2. 
3. 
4. 
5. 

Smartphone apps in the lab

- Aim
  - Compare the electroacoustic and speech-in-noise performance of conventional hearing aids with hearing aid app
- Method
  - 18 adults (50-90 years) with mild/moderate hearing loss
  - Hard-wired, in-ear earphone with inline microphone (iPod Touch)
- Results
  - MPO higher and full-on gain lower for smartphone app relative to hearing aids
  - Speech-in-noise perception, benefit and satisfaction were all comparable across devices

Image: https://pixabay.com/photos/samsung-phone-music-play-earphones-605439/

Amlani, et al. (2013) *Hear Rev*

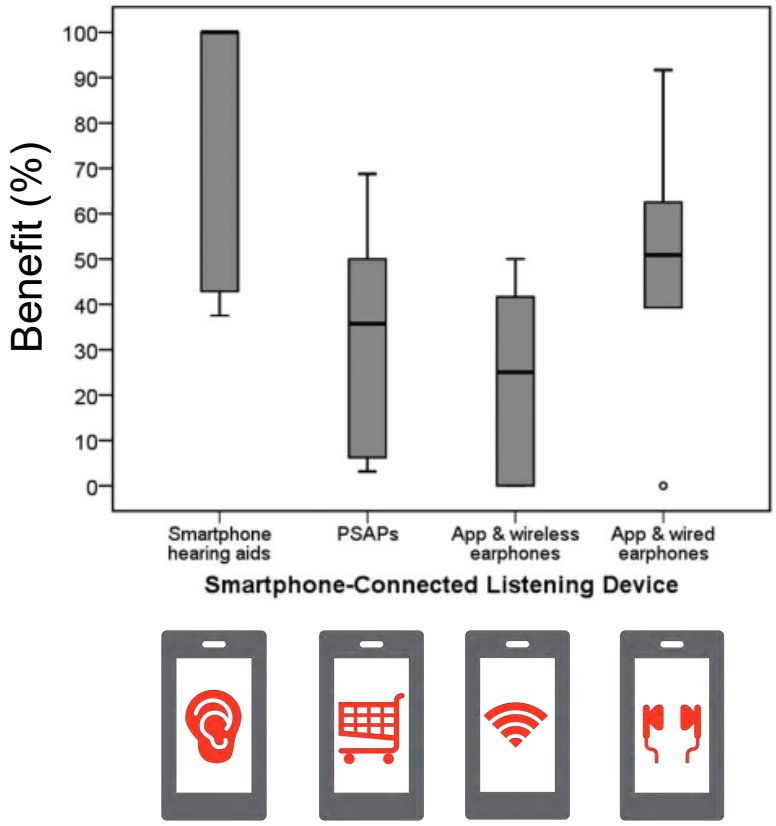
Smartphone apps in the real-world

- Aim
  - Assess the everyday experiences of existing hearing aid users toward a range of smartphone-connected hearing devices
- Method
  - 20 adults (21-81 years) with mild/moderate hearing loss
  - Trialled one device for two-weeks
  - Self-reported use, benefit and satisfaction (quantitative)
  - Individual semi-structured interviews (qualitative)

Maidment, et al. (2018) *AJA;* (2019) *JAAA*

Self-reported measures – quantitative

- Use, benefit and satisfaction best for smartphone-connected hearing aids
- Hearing aid app coupled to wired earphones was also rated highly
  - Attributed to user's ability to adjust the volume and frequency response in any listening situation
- Hearing aid app coupled to wireless earphones rated poorly
  - Significant sound delay



Maidment, et al. (2018) *AJA*

Semi-structured interviews – qualitative

Capability

- Limited knowledge, ⬇ over time
- Simplicity *plug and play*
- Smartphone literacy

Opportunity

- Reduced hearing aid related stigma
- ⬆ participation
- Benefit in group conversation
- Affordability

Motivation

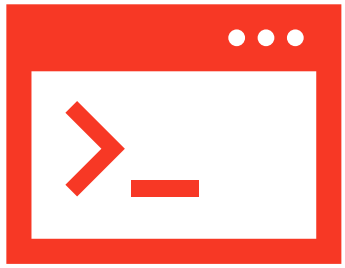
- Empowerment led to ⬆ use and participation
- Suited to a younger demographic

"It gives me that bit of control, and it's not other people running my life, it's me. It's not quality of life, it's just having a life."

Maidment, et al. (2019) *JAAA*

Software and hardware

- Android vs. Apple
  - Shortest delay found across all apps when used on an iPhone compared to an Android smartphone

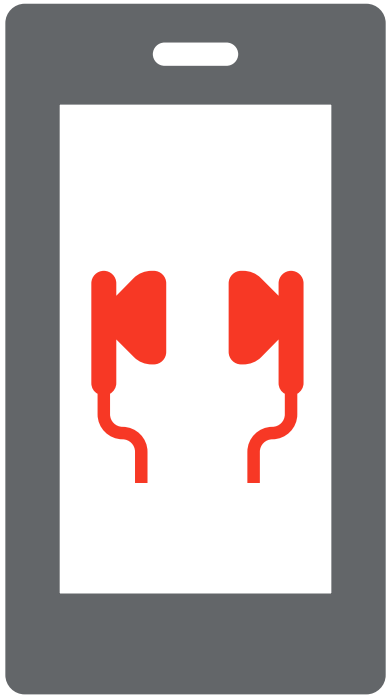


- Wired vs. Wireless earphones
  - Shortest delay found across all apps when used with wired compared to wireless earphones

De Sousa, et al. (2019) *Hear J*

What's the evidence?

- Smartphone hearing aid apps
  - Hearing aid apps may be a suitable, accessible alternative to hearing aids
  - Variation in performance across apps, operating systems (iPhone or Android) and earphones used



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Based on the evidence, would you recommend smartphone hearing aid apps?

1. 
2. 
3. 
4. 
5. 

Professional position

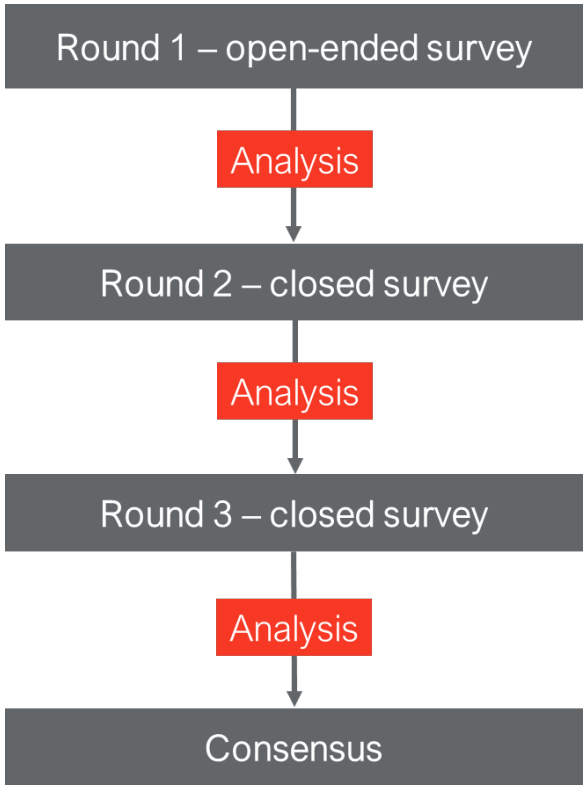
- What are the views of hearing healthcare professionals toward implementation?

- Survey of 258 audiologists working in the United States
- High willingness to integrate smartphone technology so patients can make adjustments and personalise their hearing aids
- Less supportive of allowing patients to make permanent changes
- Clinicians with less experience had more negative attitudes

Kimball, et al. (2018) *Hear Res*

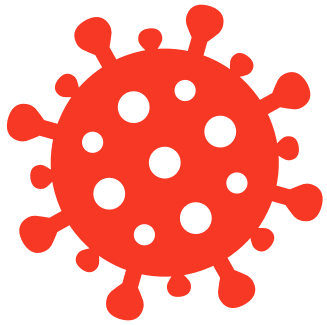
UK Delphi survey

- Expert panel of audiologists from the NHS (n= 22) and independent sector (n= 12)
- Appropriate candidates for connected devices:
  - Adults (≥18 years)
  - Communication difficulties
  - Sufficient digital literacy
  - No medical contraindications
- Concerns included:
  - Ability to assess hearing loss
  - Delayed treatment



Olson, et al. (2021) *IJA*

Impact of COVID-19

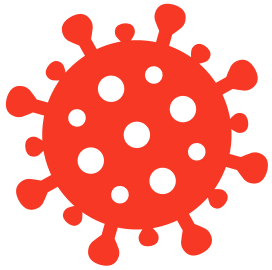


- Attitudes toward teleaudiology in 323 NHS and independent sector audiologists
- Changes in work status
  - Offering remote services; Redeployed; Furloughed; Unchanged; Unemployed; Other
- Most (92%) *moderately/ very comfortable* conducting remote consultations
  - Mostly telephone-based
  - Video conferencing and remote fitting/adjustments under utilised
- Key barriers include:
  - Limited equipment (NHS)
  - Patients' access and confidence toward technology (independent)

Parmer, et al. (2021) IJA

Are smartphones the answer?

- Connected hearing devices
  - Improve access to hearing healthcare
  - Each has their own pros and cons
- Patients perspective
  - Greater autonomy and control
  - Reduced stigma
- Clinicians perspective
  - High willingness to implement
  - Some ambivalence how this can best be achieved
- Advances in technology + global pandemic
  - Compelled to continually reassess practices



Maidment & Amlani, (2020) *Semin Hear*

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Thank you!

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