App-based Hearing Screenings: Are They Reliable?

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Background

With the constant growth and evolution of technology comes the accessibility to resources at our fingertips. Audiology, being a profession that is sometimes inaccessible in certain areas, could benefit from the access to this technology. This study compares the results of hearing screenings using clinical equipment and questionnaires to the results of multiple free and easily accessible phone-based applications.

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Methods

Participants

- 5 participants with reportedly-normal hearing (all female)
- Age 21-22 years old

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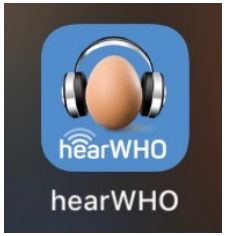
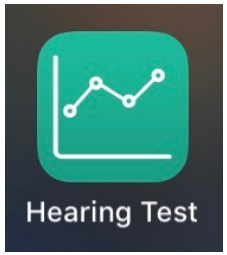
Methods

Materials used:

- iPhone with the HearWHO (World Health Organization) app
  - Digits-in-noise test
- Hearing Test & Ear Age Test app
  - Application that generates an automated audiogram
  - PortTownSoft, Inc.
  - Yuichi Sakashita, developer
- Earbuds
  - JVC brand (JVC Kenwood Corporation)
  - HA-FX7M “Gumy Plus Inner-Ear Headphones” with Mic/Remote





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Methods

Research Protocol:

- Adult case history form
- Hearing Handicap Inventory Questionnaire
- Hearing test app – two trials
  - If the results varied by more than 5 decibels (dB) at any frequency, a third trial was completed.
- HearWHO app – two trials
  - If the results varied by more than 5 points, a third trial was completed.

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Methods

Measurements/Calculations

- Results for the Hearing Test app were analyzed and compared to the results from the previously-validated HearWHO app and Hearing Handicap Inventory questionnaire
- Descriptive statistics included: mean of decibel hearing level (dB HL) values, standard deviation of dB HL values, and the range and average dB difference across trials within each participant to gauge reliability

Results of Hearing Test app

HAPP 1:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
HAPP1.1 right ear (dB HL)	10	5	15	10	10	5	-5
HAPP1.2 right ear (dB HL)	5	10	10	10	15	10	-5
HAPP1.1 left ear (dB HL)	5	10	10	0	15	5	0
HAPP1.2 left ear (dB HL)	-5	10	10	5	25	5	0
Means:							
Right ear	7.5	7.5	12.5	10	12.5	7.5	-5
Left ear	0	10	10	2.5	20	5	0
Standard Deviation:							
Right ear	2.5	2.5	2.5	0	2.5	2.5	0
Left ear	5	0	0	2.5	5	0	0
Greatest dB difference:							
Right ear	5	5	5	0	5	5	0
Left ear	10	0	0	5	10	0	0

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Results of Hearing Test app

HAPP 2:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
HAPP2.1 right ear (dB HL)	50	70	75	80	85	85	70
HAPP2.2 right ear (dB HL)	60	20	25	25	10	30	10
HAPP2.3 right ear (dB HL)	30	20	30	80	40	25	0
HAPP2.1 left ear (dB HL)	60	25	60	30	20	30	70
HAPP2.2 left ear (dB HL)	40	70	75	70	10	85	70
HAPP2.3 left ear (dB HL)	60	25	40	80	20	10	30
Means:							
Right ear	46.67	36.67	43.33	61.67	45	46.67	26.67
Left ear	53.33	40	58.33	60	16.67	41.67	56.67
Standard Deviation:							
Right ear	12.47	23.57	22.48	25.93	30.82	27.18	30.91
Left ear	5.44	21.21	14.34	21.6	4.71	31.71	18.86
Greatest dB difference:							
Right ear	30	50	50	55	75	60	70
Left ear	20	45	35	50	10	75	40
Average dB difference:							
Right ear	20	33.33	33.33	36.67	50	40	20
Left ear	13.33	30	23.33	33.33	6.67	50	26.67

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Results of Hearing Test app

HAPP 3:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
HAPP3.1 right ear (dB HL)	5	15	15	5	15	5	-5
HAPP3.2 right ear (dB HL)	5	20	20	5	15	5	-5
HAPP3.1 left ear (dB HL)	10	10	20	10	15	5	5
HAPP3.2 left ear (dB HL)	5	10	20	10	15	5	5
Means:							
Right ear	5	17.5	17.5	5	15	5	-5
Left ear	7.5	10	20	10	15	5	5
Standard Deviation:							
Right ear	0	2.5	2.5	0	0	0	0
Left ear	2.5	0	0	0	0	0	0
Greatest dB difference:							
Right ear	0	5	5	0	0	0	0
Left ear	5	0	0	0	0	0	0

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Results of Hearing Test app

HAPP 4:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
HAPP4.1 right ear (dB HL)	15	10	20	20	15	5	-5
HAPP4.2 right ear (dB HL)	20	20	20	10	10	0	-5
HAPP4.1 left ear (dB HL)	25	30	25	20	15	0	-5
HAPP4.2 left ear (dB HL)	20	25	30	10	10	0	-5
Means:							
Right ear	17.5	15	20	15	12.5	2.5	-5
Left ear	22.5	27.5	27.5	15	12.5	0	-5
Standard Deviation:							
Right ear	2.5	5	0	5	2.5	2.5	0
Left ear	2.5	2.5	2.5	5	2.5	0	0
Greatest dB difference:							
Right ear	5	10	0	10	5	5	0
Left ear	5	5	5	10	5	0	0

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Results of Hearing Test app

HAPP 5:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
HAPP5.1 right ear (dB HL)	15	20	30	10	10	0	-5
HAPP5.2 right ear (dB HL)	20	20	30	10	10	0	-5
HAPP5.1 left ear (dB HL)	20	15	20	5	5	0	-5
HAPP5.2 left ear (dB HL)	20	20	20	10	10	-5	0
Means:							
Right ear	17.5	20	30	10	10	0	-5
Left ear	20	17.5	20	10	7.5	-2.5	-2.5
Standard Deviation:							
Right ear	2.5	0	0	0	0	0	0
Left ear	0	2.5	0	0	2.5	2.5	2.5
Greatest dB difference:							
Right ear	5	0	0	0	0	0	0
Left ear	0	5	0	5	5	5	5

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Summary of Results

- The results of this study indicate that for 4 of the 5 individuals tested, the results of the Hearing Test app vary no more than 10 dB across trials.
- The results of the Hearing Test app also indicated normal hearing for 4 of the 5 individuals which was consistent with the results of the case history, Hearing Handicap Inventory questionnaire, and the HearWHO app.
- The participant (HAPP2), whose results on the Hearing Test app were unreliable, was found to have normal hearing ability with the HearWHO app and the questionnaire.

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Conclusion

- The results indicate that the Hearing Test app is generally reliable and provides information related to hearing ability that is consistent with results on previously-validated, clinic-oriented tests.

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