# apps for audiology

BY JASON A. GALSTER, Ph.D.

Apps, apps, and more apps. Everyone is talking about apps. Most of us remember when computers ran programs and mobile phones were not particularly smart. It was only 2008 when Apple introduced the App Store and the iPhone 3G, two undeniable catalysts for change. Today, four short years later, the term app has become common vernacular for a program or application, whether it runs on a desktop or laptop computer, smartphone or tablet.

The statistics behind mobile apps are staggering. At present—and this figure changes by the day—there have been an estimated 31 billion app downloads[1]. By the close of 2013 this will have leapt to a projected 49 billion downloads. Alone there are no less than 11 different app stores, each featuring tens of thousands to hundreds of thousands of different apps. The largest stores include: Apple's App Store, Android Market, GetJar, Windows Phone Marketplace, and BlackBerry App World. Of these, Apple's App Store stands as the dominant resource with approximately 550,000 available apps[2]. This library of apps exceeds the offerings of the next closest option (Android Market) by a margin in the hundreds of thousands.

There are options, many options, when browsing any app store looking for new and interesting apps. For those of us in hearing healthcare, a quick search reveals an abundance of apps targeted at aspects of hearing. In fact, the extent of options for hearing-related apps is so broad that the remainder of this article will focus on those available in the iOS (Apple) App Store. A number of apps in two categories (defined for this article) will be described.

apps designed for acoustic measurement

One of the earliest options for a hearing-related app was the sound level meter, something perfectly suited for smart phones. The combination of a dedicated device that offered sufficient signal processing, a microphone, and display had not been previously been available in a convenient consumer product. A search of the iOS App Store will quickly show no less than 50 options for sound level meters, ranging from numerous free options to $74.99 for SignalScope Pro that offers similar functions to a far more expensive real-time analyzer. Most apps designed for sound level measurement will use the un-calibrated microphone built into the device itself, an inherent weak point for anyone expecting an accurate measurement. Several options exist that aim to overcome the limitations of the mobile device's integrated microphone: Tascam offers a stereo condenser microphone ($79.99) that plugs into Apple's proprietary multi-port, while smaller microphones similar in size to a pencil eraser(starting at $3.00) will plug into the device's headphone jack. For those wanting a more robust solution, Studio Six Digital offers the iAudioInterFace2 external adaptor ($399.99) capable of connecting to

Signal Scope

uHear

SoundCheck

Siemens' Hearing Test
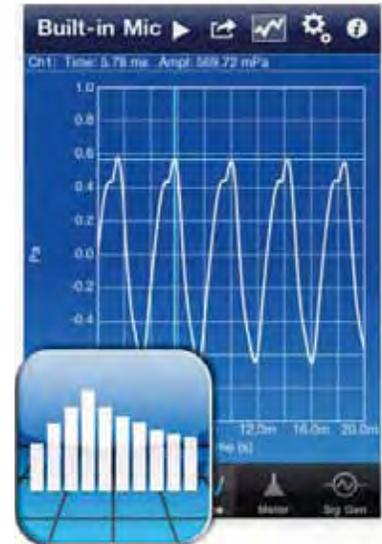
any calibrated third party microphone. Regarding the use of these measurement tools, the acoustic characteristics of the mobile device itself (e.g. a phone or tablet) remain an unknown factor; meaning that if one of these systems was to be used in a formal measurement, the entire recording system should be evaluated and benchmarked against a formally calibrated recording setup.

A second wave of acoustic measurement apps arrived to mobile devices in the form of options for hearing screening. Several developers of hearing aids have introduced apps for the screening of hearing. The first of these was Unitron's uHear. In this app the hearing screening is completed at up to six frequencies centered at 250, 500, 1000, 2000, 4000, and 6000 Hz. The listener is presented with a tone and prompted to respond when the test signal is heard. SoundCheck is an app developed by Starkey Hearing Technologies. In this screening app the listener is presented with four tones at 500, 1000, 2000, and 4000 Hz and the listener responds only when the tone is heard.

Finally, Siemens Hearing Instruments has introduced a screening app that uses a closed set of nonsense words (e.g. adda, atta) presented in a background of noise. Each of these apps reports an estimate of hearing ability that approximates a standard measure representing normal hearing as measured through that app. If a listener fails the screening or requires additional follow-up, each of these apps leverages the device's GPS to find the listeners current location, providing a referral to a local audiologist. As noted previously, these measures are not completed through a calibrated, standard test system. The outcomes of such screening should only be treated as valuable information when motivating referral for hearing care or general interest. Diagnostic evaluation must be completed during a formal appointment for the prescription of hearing aids.

apps designed for improved hearing

The title of this section may sound surprising, prompting the question "are people using their mobile devices to replace hearing aids?". Considering the cumbersome mechanical design of modern mobile phones and tablets, it seems unlikely that the average person with hearing loss would find these mobile devices an acceptable replacement to hearing aids; although they are similar in form and function to some assistive listening devices. These apps, designed to augment some aspect of listening, require the listener to wear headphones while pointing the microphone on the device toward the sound source they would like to hear. It is important that we pay attention to these novel technologies; implementations such as these may prove disruptive to our current perception of acceptable treatment options for hearing loss.

EarTrumpet is an app developed for *hearing enhancement*. The listener begins with a simple hearing screening, similar to those offered by other apps. In this example, EarTrumpet uses this information to build a filter that acoustically shapes any input to the mobile device's microphone to match the estimate of hearing obtained during screening. The effect is similar to the most rudimentary function of a hearing aid, frequency shaping and amplification of the shaped acoustic input. There are also options to introduce a high- or low-cut to the input signal and the listener has access to adjustments for volume and maximum output limiting.

There is, indeed, an app called Hearing Aid. Available both as an ad-supported free version or a version for $1.99, this app gives the listener a single slider that controls overall level and three band sliders that allow for broad control of gain applied at 'low, mid, and

high' frequencies. A third app, EARs ($3.99) promises that the iPhone, iPod Touch, or iPad can be used as a hearing aid. The listener is provided a slider for overall level and adjustments to frequency shaping by moving a small icon around a square space. The four corners of this space are labeled, warm, dark, bright and tinny. Casual analysis of these applications in a test box suggests that the accessible real-ear aided gain, from any of the three, could approach 30 dB. This value should be circumspect as it is highly dependent upon the quality and style of headphones being used.

An app that interacts directly with hearing aids has been introduced to the App Store. SoundPoint, developed by Starkey Hearing Technologies, allows the patient to adjust her hearing aid settings during a programming session in the clinic. In this example, the patient is prompted to move their finger around a graphical space; as they move their finger around this space the hearing aids' gain and compression parameters are changed in real-time. This interaction allows the patient to assist in the fine tuning of their hearing aids moving them toward their subjectively preferred sound quality.

A search for 'tinnitus' in the iOS App Store reveals 12 apps that—as described—are specifically designed for the treatment of tinnitus. A greater number of apps offer similar functions with more ambiguous descriptions. One such app with the name Tinnitus specifically states that its use should be based on prescription by an audiologist. This app presents a steady-state masking noise that can be adjusted in level by the patient; the listener is not able to apply any frequency shaping to the noise. Days and hours of use are logged and provided in a report that can be used by the listener or discussed with the audiologist.

Another app for tinnitus treatment is Tinnitus Pro Music Therapy. This app cites the 2010 work of Okamoto and colleagues who demonstrated efficacy in the treatment of tinnitus through the use of windowed sound therapy with music. In this treatment paradigm the listener is presented with music that has been filtered to remove information around their perceived tinnitus frequency. When using Tinnitus Pro, the listener completes a pitch-matching task and is asked about the perceived level of their tinnitus. The process of pitch-matching is used to establish the center frequency for the notch. The app then provides access to the listener's iTunes music catalog and all music played through the app is filtered in a manner similar to that described by both Okamoto et al (2010) and Lugli et al (2009). The duration of listening is logged by the app and the listener is occasionally queried about the perceived loudness of their tinnitus. The

duration of use and perceived loudness data are stored and provided in a report.

an app-arent future

The apps selected for this review are a representative sample of what exists today in one app store. The popularity of mobile apps and the fact that 87% of the global population has access to a mobile phone[5] point toward a future in which these technologies will only become more accessible and convenient. It is unlikely that apps and these mobile devices will soon replace hearing aids or any core competency of the audiologist. Rather, they will continue to evolve as complementary resources to our clinical regimen. In the near term, we will see applications that better connect patients to their audiologist, providing easy reporting of their listening experience, improved trouble shooting and universally increased continuity of care. Our best action is to learn about options and capabilities of these mobile apps, we will stay better informed and may discover new opportunities for improving the patient's experience. ∎

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