SWEEP™ TECHNOLOGY: INTERFACING WITH THE FUTURE OF HEARING AID DESIGN

Jason A. Galster, Ph.D., and Aaron Schroeder, M.A.

"I never perfected an invention that I did not think about in terms of the service it might give others." – Thomas Edison

Hearing instruments have always had controls — buttons, switches, wheels, dials — all predominately used for changing volume or switching programmed memories. Training patients on the use of the volume control and memory button is part of a hearing care professional's daily routine, and for some, may represent a significant challenge. Measurements taken from modern hearing aids show that the average hearing aid volume control wheel has an accessible surface area of 0.04 centimeters and the average push button has a surface area of 0.08 centimeters. As such, patients often experience difficulties locating these small controls. Many times, these difficulties are compounded by peripheral neuropathy, which may decrease manual dexterity and leave the fingers numb. Both the size of the hearing aid controls and the patient's manual dexterity may cause the patient to remove their hearing aids to make adjustments. Although small controls and the removal of the hearing aid to make adjustments have been accepted by many, Starkey Laboratories, Inc. set out to develop a switching mechanism that fits the needs of patients — even those that were previously unable to use hearing aid controls.

To develop a new and innovative switching mechanism that meets the needs of patients, it was necessary to think outside the box and look somewhere other than the typical supplier of hearing aid components. With the overwhelming success and acceptance of Apple's iPod Touch and iPhone, it was only natural to investigate the feasibility of applying touch technology to a hearing aid. After all, touch technologies have the ability to access countless features and applications eliminating the need for mechanical switches and dials that may be difficult to find.

In 1970, Patent US3662105: Electrical Sensor of Plane Coordinates was filed by Dr. George Hurst. At the time, few could have realized the applications that would come with this technology. What Dr. Hurst had introduced to the world was the first touch-screen technology. For the next 30 years, touch-screen technologies remained isolated to small tasks like information kiosks and personal computers. Some touch sensors use compression across multiple layers of material or a disruption of ultrasonic sound waves to track user contact. These systems are often too delicate and inaccurate to find wide acceptance as the primary technology for touch sensitive controls. One key to Apple's success is capacitive technology. This durable technology provides pinpoint accuracy and can be made from most any conductive material. This technology works by sending a slight, imperceptible voltage across the surface, establishing a minute electrical field. When a finger touches the surface, the body's natural capacitance disrupts the field, triggering the switch. This is all accomplished without any moving parts; it is a solid-state solution for touch control.

Sweep Technology

Three years of dedicated research focused on packaging advanced touch-surface technology into a hearing aid have resulted in Starkey's Sweep Technology. The buttons and wheels have become a single control with a surface area of .32 inches, ten times more surface area than a traditional volume control wheel. If your patients can find the back of their ears, they can adjust their hearing aids via a simple sweep or touch and release of the control surface on the hearing aid.

Figure 1. Two S Series behind-the-ear hearing aids are shown. The dark surface along the back of the hearing instrument is the Sweep Technology control surface.

Figure 1 shows the profile of an S Series™ behind-the-ear (BTE) hearing aid. The exact region of the Sweep Technology control surface is shown clearly through differences in paint and color on each hearing aid. The control surface is a single seamless surface that uses the same touch-screen technology as the Apple iPhone, giving patients full access to volume and memory controls. Again, notice that this surface is a part of the hearing aid, there is no mechanical movement required for activation; there are no longer push buttons that oxidize and fail with time, or openings around the volume control wheel that allow for moisture and dirt to enter the hearing aid.

Sweep Technology is designed to monitor the environment around the hearing aid. Because it reacts to human touch, the surface must be intelligent enough to understand the difference between a human finger or ear, a speck of dirt, or nail polish. The surface is constantly learning and adjusting. If a drop of nail polish dries on the sweep control, it will understand that this is a foreign substance and continue to function properly.

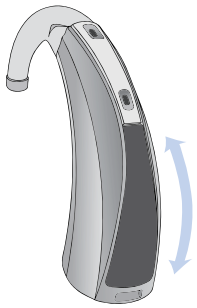

Figure 2a. An S Series hearing aid is shown. The arrows illustrate the sweep motion that, by default, triggers a change in volume.

Sweep Functionality

Figures 2a and 2b detail the intuitive functionality of Sweep Technology. The default volume adjustments are made by sliding a finger along the spine of the hearing aid. Completing an upward sweeping motion increases volume, whereas a downward sweeping motion decreases volume. Memory adjustments are made with a brief touch of the surface. The flexibility of Sweep Technology was designed to meet the needs of the patient. If a single function best suits the patient, various options are available. For instance, if a patient only needs access to volume adjustments, the hearing healthcare professional can allow volume adjustments via a sweep or touch. In contrast, if a patient only needs access to memory adjustments, the volume control can be disabled, leaving only the touch-based memory control. Finally for cases, such as pediatrics, where physical control of the hearing aid is not needed, the control can be deactivated. All of these settings are easily accessed in the Inspire® 2010 software.

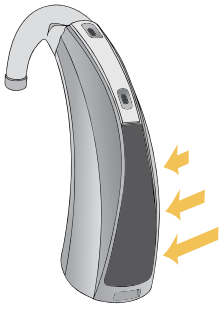

Figure 2b. An S Series hearing aid is shown. The arrows illustrate the touch motion that, by default, triggers a change in memory.

Patients Prefer a Larger, More Reliable Switch

As part of a clinical study, 15 hearing-impaired participants were asked to evaluate the usage of a behind-the-ear (BTE) hearing aid equipped with both a volume control wheel and a traditional memory button. Participants were then asked to evaluate the S Series BTE featuring Sweep Technology. After experiencing both instruments, each participant rated their preference for eight different aspects of the hearing aid controls. Figure 3 provides individual preference ratings for questions regarding volume control adjustments. Participants not only rated the large surface area of the sweep control as easier to find, they also preferred completing volume control adjustments using Sweep Technology when compared to the traditional volume control wheel. Figure 4 shows data related to memory adjustments. Again, participants rated the sweep control as easier to find, and preferred making memory adjustments with Sweep Technology when compared to the traditional memory button.

Figure 5 shows the individual judgments for quality, cosmetic appeal and overall preference. As with the previous comparisons, the research participants preferred Sweep Technology. When asked to explain their reasons for their cosmetic preference, some participants noted that Sweep Technology was "classy," "sleek," "more sophisticated" or that the "old hearing aids look obsolete and antique." Recent advancements in hearing aid design have shown that patients find value in hearing aids that appeal to them aesthetically and technologically. It's apparent from the preference data shown for Sweep Technology that patients find that this design complements the advanced technology provided by their hearing aids.

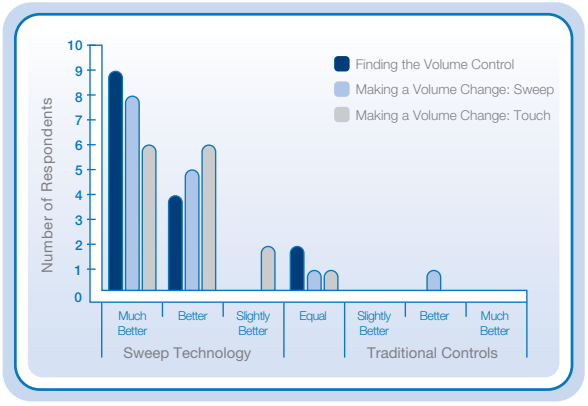

Figure 3. Individual preference ratings for finding the volume control and performing adjustments. Participants compared adjustments using the sweep control and a traditional volume wheel.

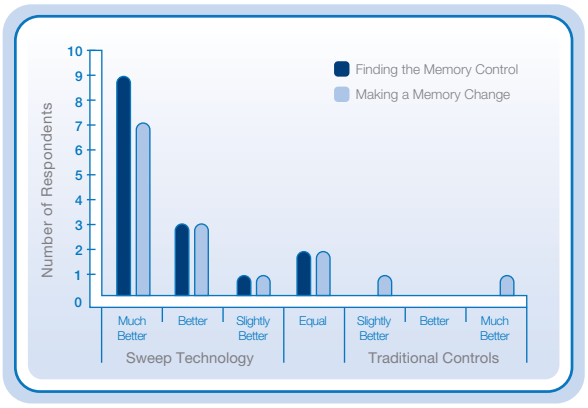

Figure 4. Individual preference ratings for finding the memory control and performing memory changes. Participants compared adjustments using the sweep control and a traditional memory button.

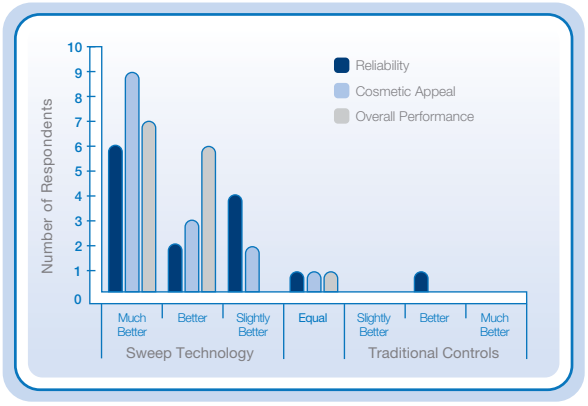

Figure 5. Individual participant ratings for reliability, cosmetic appeal, and overall preference. Sweep Technology and a traditional behind-the-ear hearing aid with both a volume wheel and memory button were compared.

Summary

For years patients have struggled with small hearing aid controls. Sweep Technology combines all of the traditional hearing aid controls into a single capacitive surface that is flexible enough to meet all your patients' needs. This control surface intelligently monitors the surrounding environment searching for contact with a patient's finger while ignoring eyeglasses or hats that may inadvertently trigger other switches. Through focused research, this advanced technology has been adapted for use in hearing aids, benefiting patients and hearing care professionals alike.

Starkey®

Experience more.™

A global hearing technology
company headquartered in
Eden Prairie, Minnesota, U.S.A.

Starkey Laboratories, Inc.
6700 Washington Avenue South
Eden Prairie, MN 55344-3476
800.328.8602

StarkeyPro.com