Phonak Field Study News.

Facial expression analysis indicates reduced listening effort with Spheric Speech Clarity

Pioneering research in a peer-reviewed study (Bhamborae et al., 2026) conducted at the University of Saarland, Germany, found that the facial muscle activity associated with increased concentration and listening effort was reduced by the activation of Spheric Speech Clarity.

Bhamborae, M. J, & Latzel, M., October 2026

Introduction

In 2024, Phonak introduced Spheric Speech Clarity (SSC) on the Infinio platform to improve speech understanding and reduce listening effort (LE) in noisy environments. LE is a key outcome measure for evaluating hearing aid (HA) performance and user experience, as it reflects the cognitive resources required to understand speech in everyday listening situations. Conventional approaches to assessing LE rely largely on subjective questionnaires, complemented in some cases by behavioral and physiological measures. Tian et al. (2025), Wright et al. (2024), and Latzel et al. (2025) measured subjective listening effort via use of the Adaptive Categorical Listening Effort Scaling (ACALES; Krueger et al., 2017) method. Participants listened to speech in noise and rated the effort required to follow the speaker at the current SNR using a 14-point categorical rating scale from "effortless" to "extreme effort". These methods could successfully show the positive effects of Spheric Speech Clarity on listening effort. Furthermore, Vaisberg et al., 2025 used functional Near-Infrared Spectroscopy (fNIRS), a neuroimaging technique to measure changes in prefrontal cortical oxygenation with different hearing aid features. The Spheric Speech in Loud Noise program was found to be linked to reduced activity in the brain areas related to cognitive effort, lessening cognitive demands for listening in noise compared to use of the Calm Situation program. Expanding on these methods, a pioneering study from Saarland University demonstrated the potential of using facial kinematics as indicators of LE in a real-world, out-of-lab setting.

Recent work has further established the feasibility of contactless, camera-based techniques for estimating sympathetic arousal linked to psychophysiological and affective states (Bhamborae *et al.*, 2025). Related studies

have shown that facial expressions extracted from video recordings (Venkitakrishnan and Wu, 2023) and auricular muscle activity recorded using electromyography (Schroeer *et al.*, 2024) are associated with perceived LE.

Building on this line of research, a recent study conducted at a commercial audiology center in Germany investigated the use of contactless, video-based methods to identify markers of effortful listening in experienced hearing aid users. Facial videos were recorded while participants performed a Speech-in-Noise (SiN) task, with Spheric Speech Clarity (SSC) systematically toggled ON and OFF. The following sections describe the methodology employed to capture, process, and analyze these video-derived measures of effortful listening.

Methodology

Participants

28 experienced HA users with mild-to-severe hearing loss.

Equipment

Participants wore the Phonak Audéo I90-Sphere hearing instruments. During the experiment, SSC was toggled on and off using Phonak Target 10.0 fitting software. Facial videos were recorded using a standard off-the-shelf machine vision RGB camera.

Setup

As shown in figure 1, the setup consisted of a total of 8 speakers arranged in a circle, 45 degrees apart. The speaker placed at 0 degrees azimuth relative to the participant presented speech material at a level of 58 dBA. All speakers, including that at 0 degrees, presented speech-shaped babble noise at 51 dBA per loudspeaker, resulting in a total background noise of 60 dBA and signal-to-noise ratio of -2 dB. Flicker-free videography LED panels were used to illuminate the participants' faces for the video recording.

Task

Participants listened to a podcast within a speech-in-noise paradigm while the SSC was toggled ON and OFF in ~30 s intervals.

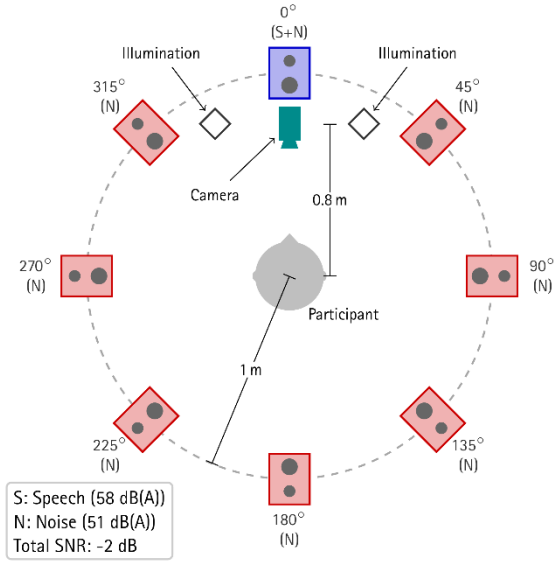

Figure 1 Overview of the speaker arrangement and camera position. S = speech, N = noise

Video-Based Metrics

Remote Autonomic Arousal Index (rAAI) was extracted using blood volume pulse (BVP) directly from the RGB facial video by analyzing minute changes in skin color, without requiring physical contact. The rAAI was computed from the frequency analysis of the variability of the BVP signal. The lower frequencies are generally associated with higher stress and greater sympathetic associated with parasympathetic activity (nervous system promoting recovery and calmness) (Shaffer and Ginsberg, 2017) and lead to lower amplitudes of rAAI.

Eyebrow movements were tracked using facial landmarks and optical flow. activity (nervous system preparing the body for stress or action) and lead to higher amplitudes of rAAI. Higher frequencies are These movements are primarily modulated by the facial muscles: corrugator supercilii, depressor supercilii, and procerus muscles. Activity of the corrugator supercilii has been associated with increased cognitive effort and negative affect (Larsen, Norris and Cacioppo, 2003; Heller *et al.*, 2014; Venkitakrishnan and Wu, 2023).

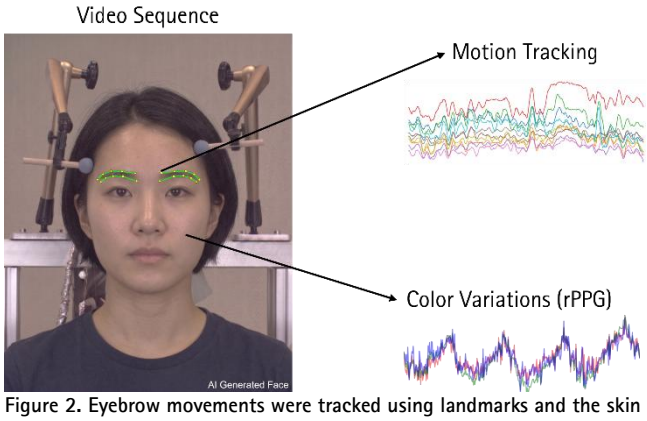

Figure 2. Eyebrow movements were tracked using landmarks and the skin color changes were used to extract the remote Autonomic Arousal Index (rAAI).

Results

SSC significantly reduced rAAI

rAAI amplitude significantly decreased when the SSC was ON, indicating a reduction in autonomic arousal relative to the levels under when SSC was OFF (see Figure 3).

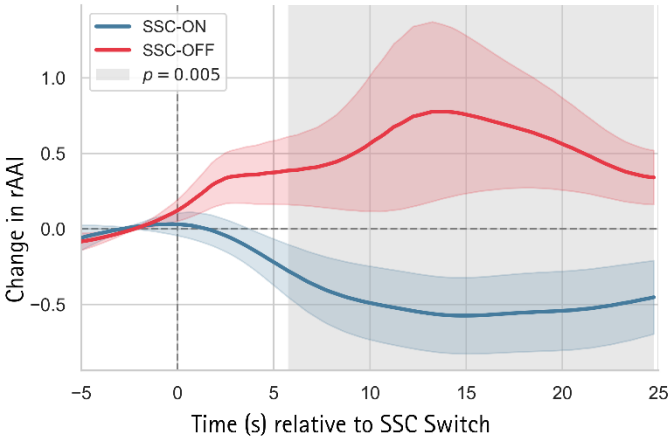

Figure 3. Time-resolved analysis of the contactless video-based rAAI signal.

Lower eyebrow frowning under SSC

Under noisy conditions, participants exhibited heightened eyebrow frowning (see Figure 4), a marker of intense concentration and cognitive strain. Activating SSC provided measurable relief from this tension. Analyses also showed increased eyebrow motility when SSC was ON signaling a kind of "relief" from the frowning observed when SSC was off (See Figure 5).

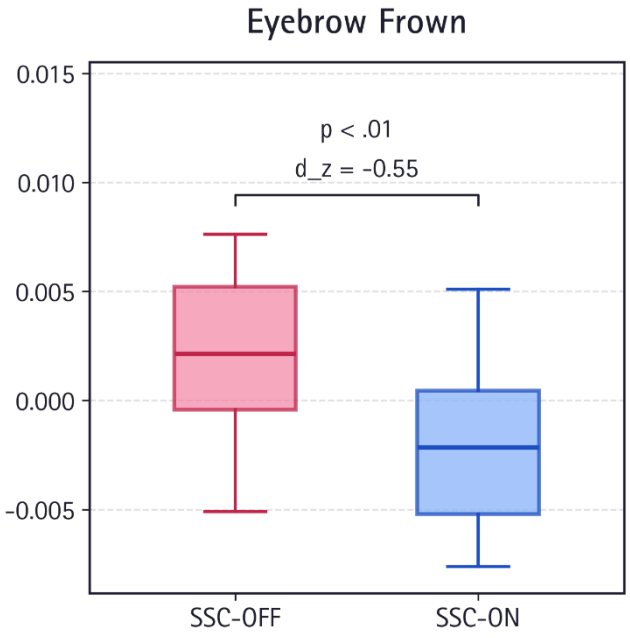

Figure 4. Eyebrow frown computed using the blendshapes showed that participants frowned less when SSC was ON opposed to OFF. Lower frowning implies lower muscle tension around the eyebrows.

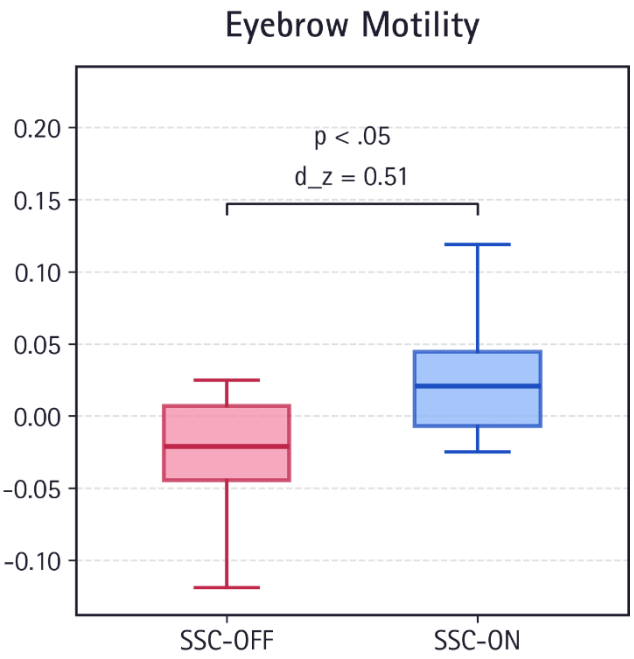

Figure 5. Overall eyebrow motility extracted from the landmark timelines increased when SSC was ON versus OFF showing a measurable relief from sustained eyebrow frowning.

Conclusion

This study shows that contactless, camera-based physiological signals can provide additional insight into LE in real-world conditions. Activation of SSC consistently reduced markers of autonomic arousal and facial muscle activity associated with cognitive strain.

These results align with other objective measures of LE such as fNIRS (Vaisberg et al., 2025) which found that the Spheric Speech in Loud Noise program was linked to reduced activity in the brain areas related to cognitive effort, lessening cognitive demands for listening in noise compared to use of the Calm Situation program.

The results of these two studies support the benefit of SSC with regards to listening effort, beyond subjective reports.

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Authors and investigators

External investigator

Mayur J. Bhamborae received his Master of Science in Visual Computing from Saarland University and is currently a research associate with the Systems Neuroscience and Neurotechnology Unit where he is also pursuing a Ph.D. His research is focused on the applications of visual computing to neuromonitoring and non-invasive psychophysiological sensing.

Internal investigator

Dr. Matthias Latzel studied electrical engineering in Bochum and Vienna in 1995. After completing his Ph.D. in 2001, he carried out his Postdoc from 2002 to 2004 in the Department of Audiology at Giessen University. He was the head of the Audiology department at Phonak Germany from 2011. From 2012 to 2022 he has been working as the Clinical Research Manager for Phonak AG, Switzerland. Since 2022 he is senior expert clinical studies for Sonova AG.

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One-page summary

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Key highlights

- An innovative methodology at the University of Saarland, Germany, aimed to assess listening effort differences by observing facial expression activity via video recordings.
- Results from this study, showed that listening with Phonak's most advanced technology (e.g. Spheric Speech Clarity) reduced markers of stressful listening.

Considerations for practice

- SSC addresses the number one listening need of speech understanding in loud noise. This innovative study aligns with subjective findings e.g. Tian et al., (2025) and objective findings (Vaisberg et al., 2025), all of which provide supportive evidence to the benefit of SSC with regards to listening effort.
- Reducing listening effort may free up cognitive resources for purposes other than listening (Pichora-Fuller et al., 2006) and may reduce feelings of fatigue (Hornsby et al., 2013).

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