Field Study News

June 2015

AutoSense OS

Benefit of the next generation of technology automation

The next generation of technology automation, AutoSense OS, makes life easy for the end user by selecting the best suited hearing aid settings for the listening situation. In this study, conducted in 2015 by E. Übelacker and J. Tchorz from the University of Lübeck, it has been proven to choose the listening program which elicits the best speech understanding for that environment. By selecting the best listening program, it can improve speech understanding by 20%.

Objective

The aim of this study was to investigate the end user benefit of AutoSense OS. The first task was to find out whether AutoSense OS selects the same programs which are preferred by experienced hearing aid users in several typical acoustical situations.

If this was found not to be the case, then:
(1) Does the automatic system select those programs which are favorable in terms of speech understanding?
(2) How is the automatic program subjectively rated in comparison to the program manually selected by an experienced hearing aid user?

Introduction

Hearing aid wearers are typically exposed to a variety of listening situations, such as speech, music or noisy environments. The diverse range of acoustic environments the typical person encounters requires different types of signal processing, in order to deliver the desired hearing experience (Büchler 2004, Büchler et al. 2005). For instance, this may involve activation of a directional microphone, or adaption of the compression/expansion parameters. The ability of the hearing aid to adapt these settings automatically is crucial for getting people to adopt and use hearing aids (Kochkin 2010). This therefore indicates the need for sound classification algorithms, functioning as a front end to the rest of the signal processing scheme, housed in the instruments (Kates 1995).

In 1990, a classification system, AutoSelect, was commercially introduced in Phonak Claro hearing aids. It was based on the general thinking of Bregman (1990) and the idea to transfer this to hearing aids (Kates 1995). Since then, this classification system has been revised and significantly improved. A study in 2008 (Hessefort) on a newer approach, called SoundFlow, revealed that comfort and spontaneous acceptance could be improved. Since the launch of the Phonak Quest platform in 2012, SoundFlow is capable of distinguishing between five different sound classes: Calm Situation, Speech in Noise, Comfort in Noise, Speech in Loud Noise and Music. There is, however, a need for more specific situations to be classified and to activate strong features, which need a precise classification. The new system, AutoSense OS, introduced with the Phonak Venture platform, is now able to distinguish between seven sound classes (Latzel 2015). This study aimed to investigate the end user benefit of AutoSense OS.

Study design

The subjects who took part in the study were 14 experienced hearing aid users (seven female and seven male). The average age of the subjects was 72 years old. All subjects had a symmetrical, moderate, sensorineural hearing loss. For the study, subjects were all fitted with Audéo V90-312 hearing aids, using the Phonak Adaptive Digital prescription formula. The hearing aids were programmed with either AutoSense OS (default settings), or five manual programs; Speech in Car (CAR), Calm Situation (Calm), Speech in Noise (SiN), Speech in Loud Noise (SiLN), Comfort in Noise (ComIN). The speech material used throughout the investigation was the Göttinger Sentence Test (Kollmeier and Wesselkamp 1997).

Subjects attended the clinic for two appointments. The aim of the first appointment was to find out which manual program the subjects chose, in each of four different listening environments, and to see whether this matched the program which was automatically selected by AutoSense OS. The four different listening environments were simulated by placing the subject in the center of a circle of loudspeakers (figure 1). Before subjects came in the room, an artificial head, sitting in the center of the circle wore the hearing aids with AutoSense OS active. The program chosen by AutoSense OS was then read out of the hearing aids by means of a special logging software. Subjects then sat in the same position as the artificial head and were instructed to switch through the five manual programs as much as they liked, in order to choose which program they preferred for each of the four sound scenarios.

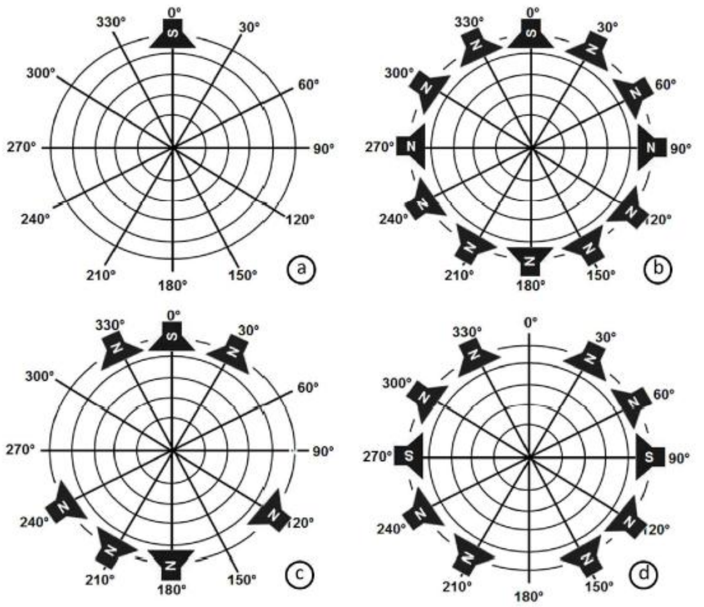


Figure 1: Set-up for the manual program selection and the subjective comparison. The subject sat in the middle of the circle (distance of approximately 1 meter when facing the speaker at 0° azimuth).

a. **Speech in Quiet : the speech material was presented from the front (0°), at a level of 60 dB (A). No noise was presented from the other loudspeakers.**
b. **Speech in Noise: the speech material was presented from the front (0°), at a level of 75 dB (A) and noise (cafeteria) was presented from all other loudspeakers at an overall level of 70 dB (A).**
c. **Speech in Loud Noise: the speech material was presented from the front (0°), at a level of 75 dB (A) and noise (cafeteria) was presented from the loudspeakers indicated in the diagram to produce an overall noise level of 73 dB (A).**
d. **Speech in Car: the speech material was presented at angles 90° and 270°, at a level of 60 dB (A). Noise (car noise: engine, rolling, wind) was presented from the other loudspeakers indicated in the diagram at a level of 58 dB (A).**

At the second appointment, subjects were seated again in the four test set-ups described in figure 1. This time, speech understanding was assessed by varying the level of the speech material according to an adaptive speech test. This test aimed to find the speech-to-noise level ratio which resulted in a speech understanding score of 50%. The noise levels remained constant and corresponded to those described in figure 1. This test was carried out using the hearing aid program/s (automatically selected by AutoSense OS and manually selected by subject) which were chosen at the first appointment as being the preferred one for each test set-up.
After the speech understanding test, subjects were asked to fill out a questionnaire which asked them about how they judged the two programs, which they had just used and which one they preferred, in each test set-up. Neither the test subject, nor the investigator knew which program (automatically selected or manually selected) had been activated at which point, as this had been done by another tester (double blinded test design). By asking the subject which program they preferred, it was possible to ascertain whether the manually chosen program at the first appointment was chosen again (test-retest procedure).

Results

Table 1 shows which program AutoSense OS selected for each of the four test set-ups.

Set-up	Program selected by AutoSense OS
a	Calm Situation (Calm)
b	Speech in Noise (SiN)
c	Speech in Loud Noise (SiLN)
d	Speech in Car (CAR)

Table 1: The programs selected by AutoSense OS for each test set-up.

Figure 2 shows which programs the test subjects selected as the best program, for each of the four test set-ups, at the first appointment. The green boxes indicate where subjects chose the same program as the program selected by AutoSense OS.

Program selected by AutoSense OS

Program selected by individual subject	Calm	SiN	SiLN	CAR
	Calm	SiLN	SiN	SiLN
	SiN	SiLN	SiN	SiLN
	Calm	SiLN	SiLN	SiN
	CAR	ComIN	ComIN	SiN
	Calm	ComIN	ComIN	Calm
	CAR	ComIN	ComIN	Calm
	SiN	SiLN	ComIN	ComIN
	SiN	SiN	ComIN	ComIN
	SiN	ComIN	ComIN	SiN
	SiN	SiLN	SiN	ComIN
	SiLN	SiN	SiLN	CAR
	SiLN	ComIN	SiN	SiN
	Calm	SiN	SiLN	CAR
	CAR	SiN	ComIN	ComIN

automatic selection # manual selection
automatic selection = manual selection

Figure 2: The first row indicates the program which was selected by AutoSense OS. The other fourteen rows indicate the program choices which each subject made, for each of the four test set-ups. Gray indicates that the subject's choice differed from that of AutoSense OS. Green indicates that the subject selected the same program as AutoSense OS.

Figure 3 shows the results of the speech understanding test (Göttinger speech test). It shows the calculated difference in speech understanding between the program selected by AutoSense OS and the program selected by the subject. A positive value means that speech understanding was better with the program chosen by AutoSense OS than with the program chosen by the subject.

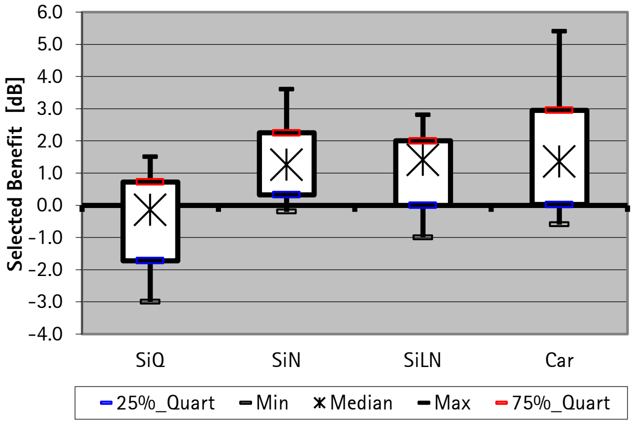
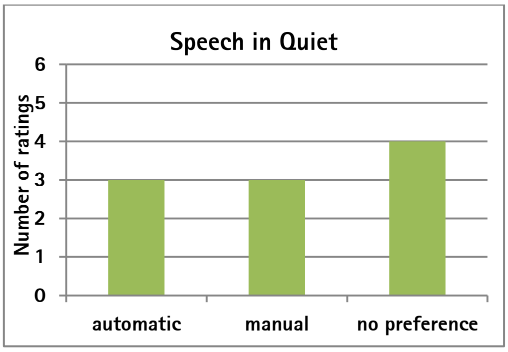


Figure 3: The difference in speech understanding between the automatically selected program and the manually chosen program. A positive value indicates better speech understanding with the automatically selected program. The boxplots show the minimum, maximum, median values as well as the 25th and 75th quartiles.

In the listening situations; Speech in Noise, Speech in Loud Noise and Speech in Car, the subjects achieved a better speech understanding score when using the automatically selected program as opposed to using the manually selected program ($p<0.05$). The median value is approximately up to 1.3 dB. The Göttinger Sentence Test has a gradient of about 20 percent per dB. Therefore, the measured effect corresponds to an improvement in speech understanding of approximately 20%. In the Speech in Quiet situation, there is no significant difference which implies a manual selection of an alternative program to the automatically selected one would have no negative effect.

The results of which program subjects preferred when asked can be seen in figure 4. In many cases, the manual program which subjects had chosen as their preferred program at the first appointment, was not preferred at the second appointment. This suggests that hearing aid users have difficulty, in selecting the best hearing aid program for various situations. Many subjects preferred their manually selected program, although it has been shown that speech intelligibility was better with the automatically selected one. This indicates that subjects may focus on other aspects to what we may think when choosing a hearing aid program.



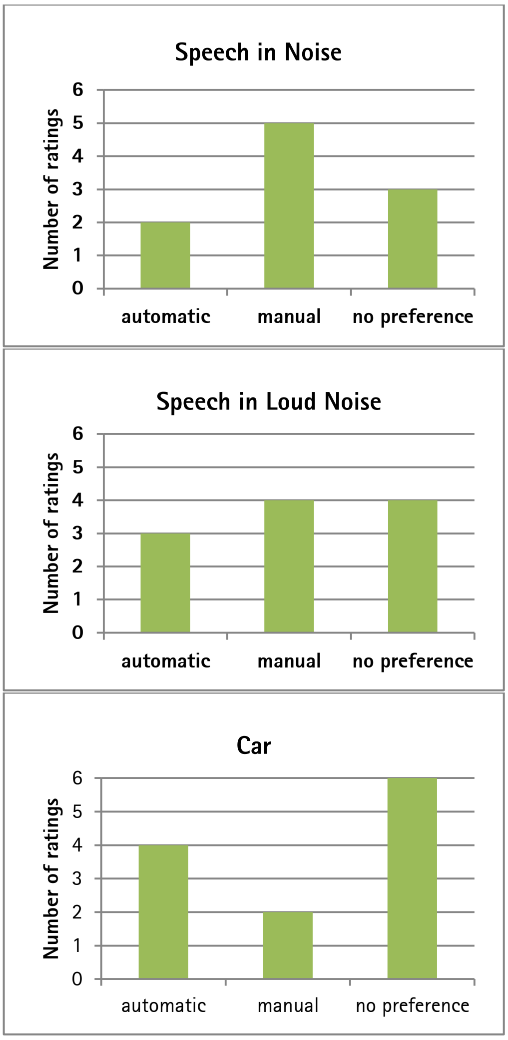


Figure 4: Results of which program subjects preferred after the speech test, for each listening situation.

Conclusion

It is very important that hearing aid wearers are happy with their ability to be able to hear well in as many different listening environments as possible. Kochkin concluded in his MarkeTrak (2010): the overall satisfaction with hearing aids is dependent on the number of listening situations in which the hearing aids are found beneficial. Therefore hearing aids are equipped with several programs which have different settings for different environments. As choosing the correct program can be difficult and impractical for the end user, an automatic classification system is an ideal solution. This study shows that end users have difficulty in selecting the most appropriate hearing aid program for an environment. Therefore, a system which takes over this task for the end user is highly beneficial. The automatic classification system, AutoSense OS, makes life easier for the hearing aid wearer by, first of all, choosing the listening program for the user. Secondly and most importantly, it has been proven to choose the program which delivers the best speech understanding.

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Authors and investigators

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