Supplemental Digital Content 1: Methods

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TABLE SM1. *Overview of the Study's Measurements and Research Questions$^\lozenge$*

Constructs and measures	T0	T1	T2	T3	Data collection method	RQ$^\lozenge$
<u>Descriptive sample characteristics</u>	X				Online questionnaire	-
<u>App acceptability</u> App usage and compliance - Added and evaluated listening situations		X	X	X	The app*	1.1
- Influence of COVID lockdown on number of listening situations				X	Online questionnaire	
- Viewed snippets		X	X	X	The app*	
<u>App acceptability</u> Overall app usability: - SUS				X	Online questionnaire	1.2
Overall app usefulness: - IMI				X	Online questionnaire	
Overall app satisfaction: - IOI-AI item 4				X	Online questionnaire	
- Recommendation item				X	Online questionnaire	

<u>App acceptability</u>
Specific app usability:
  EMA survey usefulness:
  - Item in the T3 questionnaire
				X	Online questionnaire	1.3

Snippet usefulness: - Snippet review indicator 'useful'		X	X	X	The app*	1.3
- EMA evaluation survey item on snippet usefulness		X	X	X	The app*	
Snippet satisfaction: - All 6 review indicators		X	X	X	The app*	1.3
<u>Psychometric properties of SoC measures</u> - Staging Algorithm Generic	X	X			Online questionnaire	2.1 - 2.3
- Staging Algorithm TB-specific	X	X			Online questionnaire	
- The Line Generic	X	X			Online questionnaire	
- The Line TB-specific	X	X			Online questionnaire	

- Self-reported hearing disability	X				Online questionnaire	
- Item asking about the TBs that the participant thought about when reading generic SoC measures	X				Online questionnaire	
SoC tailoring of snippets						3
- Staging Algorithm TB-specific (for SoC_{person})		X	X		Online questionnaire	
- Staging Algorithm Generic (for SoC_{person})		X	X		Online questionnaire	
- Main SoC and main TB per snippet (for $SoC_{snippet}$)		X	X	X	The app*	
- Snippet review indicators 'useful' and 'interesting'		X	X	X	The app*	

EMA, Ecological Momentary Assessment; IOI-AI, International Outcome Inventory- Alternative Intervention; IMI, Intrinsic Motivation Inventory; RQ, research question; TB, target behavior; SoC, Stage of Change; SUS, System Usability Scale; -, not applicable.

*Data of 'The app' were collected throughout the 4-week intervention period, which started at T1 and ended at T3 (indicated in the table with an 'X' at T1, T2, and T3).

◊ The RQs were:

1. App acceptability

RQ1.1 Was the participants' compliance to app usage as intended?

RQ1.2 What is the app's overall usability, usefulness, and satisfaction?

RQ1.3 What is the specific usefulness of the EMA surveys and the specific usefulness and satisfaction of the snippets?

2. Psychometric properties of SoC measures

RQ2.1 What is the test-retest reliability of the 10 new TB-specific SoC measures?

RQ2.2.1 What are the correlations between the new TB-specific SoC measures, and between the new TB-specific SoC measures and their generic SoC versions (construct validity)?

RQ2.2.2 How do TB-specific SoC constructs relate to generic SoC (construct validity)?

RQ2.3 What are the correlations between the TB-specific SoC measures and self-reported hearing disability (construct validity)?

3. SoC tailoring of snippets

RQ3: What is the relationship between SoC-difference and the participant's satisfaction with the snippet?

TABLE SM2. *The Types of Listening Situations that Users Could Add via the EMA Identification Survey of the HEAR-aware App*

1. (Video)calling
2. 1-on-1 conversation
3. Group conversation, small (with 2-3 other persons)
4. Group conversation, big (with 4 or more other persons)
5. Lecture/ presentation
6. Sports instruction
7. Watching TV – On TV/PC/laptop
8. Watching clips – On smartphone
9. Radio interview / podcast / audiobook
10. Music
11. Cycling *(e.g., hearing other traffic approaching, hearing bicycle bells ringing/ cars honking)*
12. Driving the car *(e.g., hearing other cars honking, emergency vehicles sirens)*
13. Using public transport *(e.g., hearing check-in/check-out signals, public address systems)*
14. Walking *(e.g., hearing other traffic approaching, hearing bicycle bells ringing/ cars honking)*
15. Nature sounds *(e.g., hearing birds singing, leafs rustling, sounds of the sea)*
16. Other, namely…

EMA: Ecological Momentary Assessment

TABLE SM3. *Number of Snippets with the Main Stages of Change and Main Target Behaviors they Tapped into*

	Main Stage of Change			
	Precontemplation	Contemplation	Preparation	Total
Main target behavior				
Communication Strategies	0	1	8	9
Emotional Coping	1	4	0	5
Social Support	0	2	1	5
ALDs without hearing aids	0	0	3	3
ALDs with hearing aids	0	3	1	4
Hearing Aids	3	20	6	29
No target behavior	28	36	1	65
Total	32	66	30	118

ALDs, Assistive listening devices.

Explanation: Two Snippets with Two Different Main Stages of Change

The snippet shown in pane 7 of Figure 1 (see end of document) concerned main TB communication strategies and main SoC preparation. It contained two videos. The first one showed a female trainer who demonstrated the added value of using hand gestures. The second one showed a role model (person with hearing problems) demonstrating subsequently ineffective and effective communication strategies in a daily life situation. Hands-on tips and instructions were provided via the female trainer and accompanying text. Thus, these snippet elements aimed to underline important pros of applying effective communication strategies and promote self-efficacy, respectively. Thereby, it was deemed to especially serve persons in preparation, already planning to apply strategies in the near future. An example of a communication strategy snippet assigned to the adjacent, lower, contemplation SoC was the text-based snippet 'The effects of hand gestures' (not shown). It concerned an article written in a popular-scientific style, discussing the pros of communication partners using hand gestures when speaking to persons in general, but also when speaking to a person with hearing problems. The article suggested the reader to consider sharing the article and/or discussing the topic with a loved one. These snippet elements were assumed to mainly suit persons who had contemplating thoughts about asking significant others to adjust their communication style somewhat. The snippet meant

5

move the person towards taking a first step, which would move them to the adjacent SoC, i.e., preparation.

Stages of Change Measures

Below, the generic and target-behavior specific Stage-of-Change measures (adapted versions of the Staging Algorithm and The Line) that were used in the HEAR-aware study are provided. They were freely translated into English, from the Dutch version used in HEAR-aware. The original, Dutch versions can be obtained via the authors.

See Table SM1 above. All SoC measures below were administered via online questionnaires, on both T0 and T1. These data were used in RQs 2.1-2.3 (to examine the measures' psychometric properties). In addition, all Staging Algorithm scales were also administered on T2. The Staging Algorithm data on T1 and T2 were used for the analyses of RQ3 (to determine SoC_{person}, to be able to examine the potential of SoC-tailoring of the snippets).

Staging Algorithm- Generic

Which of the following statements best describes your view of your current hearing status? Tick this statement.

- ❑ I do not think I have any problems involving my hearing, and therefore I do not have to do anything about it.
- ❑ I think I have problems involving my hearing. However, I am not yet ready to take any action to address them now, but I might do so in the future.
- ❑ I know I have problems involving my hearing, and I intend to take action to address them soon.
- ❑ I know I have problems involving my hearing, and I am taking action to address them now.

The Line - Generic

How ready are you to work on your diminished hearing?

Please choose a number between 0 and 10 by moving the slider.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Not

ready

at all

Highly

ready
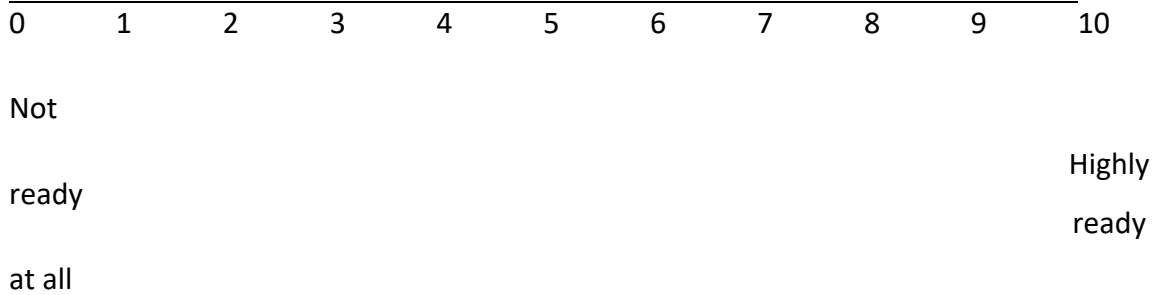
Staging Algorithm- Target-behavior specific measures (i.e., consecutively: Communication Strategies, Emotional Coping, Social Support, Hearing Aids, Assistive Listening Devices)

For the following 5 questions, we would like to know how you currently feel about taking **specific actions** for your diminished hearing. Please tick the statement that fits best.

1. Which of the following statements best describes your current view on **communication strategies***?

   Think of: consciously applying speech reading (lip reading, reading facial expressions), purposefully choosing a location in the room to sit or stand so that you can understand your communication partners well, asking others to articulate well or speak more slowly.

   ❑ I don't think my hearing problem is such that communication strategies would be of any help

   ❑ I think I have a hearing problem where communication strategies may be helpful. I am just not ready yet to put them into practice now, but I might be in the future.

   ❑ I know I have a hearing problem where communication strategies could be helpful and I intend to put them into practice soon.

❑ I know I have a hearing problem where communication strategies can be helpful, and therefore I am already putting them into practice.

2. Which of the following statements best describes your current view on **working on your feelings about your diminished hearing***?

*Think of learning to cope with the challenges or problems around your diminished hearing (learning to accept, to decrease any negative feelings)

❑ I don't think my hearing problem is such that working on my feelings would be of any help.

❑ I think I have a hearing problem where working on my feelings may be helpful. I am just not ready yet to put them into practice now, but I might be in the future.

❑ I know I have a hearing problem where working on my feelings could be helpful, and I intend to do this soon.

❑ I know I have a hearing problem where working on my feelings is helpful, and therefore I am already working on this.

3. Which of the following statements best describes your current view on **involving others in your diminished hearing***?

* Think of sharing any challenges and problems around your hearing with others. This can, but doesn't necessarily need, to be about sharing feelings.

❑ I don't think my hearing problem is such that involving others would be of any help.

❑ I think I have a hearing problem where involving others may be helpful. I am just not ready yet to put them into practice now, but I might be in the future.

❑ I know I have a hearing problem where involving others could be helpful, and I intend to do this soon.

❑ I know I have a hearing problem where involving others can be helpful, and therefore I am already working on this.

4. Which of the following statements best describes your current view on **hearing aids**?

   - ❑ I don't think my hearing problem is such that hearing aids would be of any help.

   - ❑ I think I have a hearing problem where hearing aids may be helpful. I am just not ready yet to try them now, but I might be in the future.

   - ❑ I know I have a hearing problem where hearing aids could be helpful, and I intend to do try them soon.

   - ❑ I know I have a hearing problem where hearing aids can be helpful, and I have already scheduled or had a hearing aid trial / am already using hearing aids.

5. Which of the following statements best describes your current view on **assistive listening devices***?

   * For example, think of amplified headphones for the TV, a doorbell amplifier, or a vibrating alarm clock.

   - ❑ I don't think my hearing problem is such that assistive listening devices would be of any help.

   - ❑ I think I have a hearing problem where assistive listening devices may be helpful. I am just not ready yet to try them now, but I might be in the future.

   - ❑ I know I have a hearing problem where assistive listening devices could be helpful, and I intend to do try them soon.

   - ❑ I know I have a hearing problem where assistive listening devices can be helpful, and I have already scheduled or had a trial period / am already using an assistive listening device.

The Line - Target-behavior specific measures (i.e., consecutively: Communication Strategies, Emotional Coping, Social Support, Hearing Aids, Assistive Listening Devices)

For the following 5 questions, we would like to know *how ready you are* to take specific actions for your diminished hearing. Please note that it again concerns how you feel *at the moment*.

For each question, choose a number between 0 and 10 by moving the slider. 0 indicates: 'Not ready at all' and 10 indicates: 'Highly ready'.

1. How ready are you to apply **communication strategies*** in your daily life?

   * For example, think of: consciously applying speech reading (lip reading, reading facial expressions), purposefully choosing a location in the room to sit or stand so that you can understand your communication partners well, asking others to articulate well or speak more slowly.

   If you are already consciously and actively applying multiple communication strategies, please choose '10'.

0	1	2	3	4	5	6	7	8	9	10

Not

ready   Highly

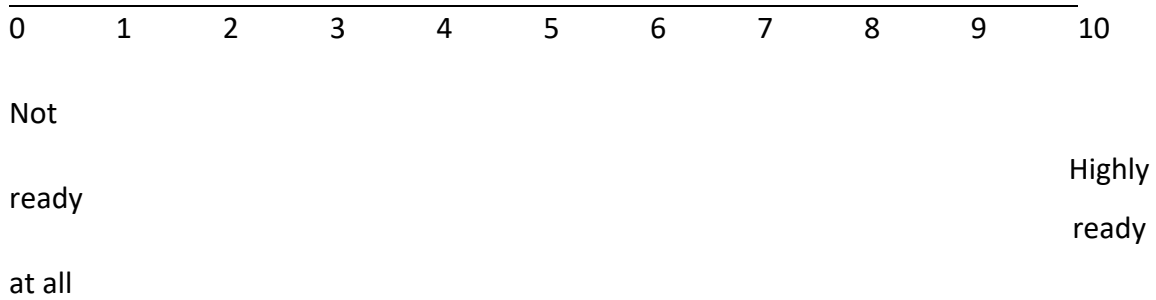at all   ready

2. How ready are you to **work on your feelings about your diminished hearing***?

   * Think of learning to cope with the challenges or problems around your diminished hearing (learning to accept, to decrease any negative feelings).

   If you are already working on your feelings intensively, please choose '10'.

0	1	2	3	4	5	6	7	8	9	10

Not

ready
                                                                                   Highly

                                                                                   ready

at all

3. How ready are you to **involve others in your diminished hearing***?
   * Think of sharing any challenges and problems around your hearing with others. This can, but doesn't necessarily need to be about sharing feelings.
   If you are already intensively involving others, please choose '10'.

0	1	2	3	4	5	6	7	8	9	10

Not

ready
                                                                                   Highly
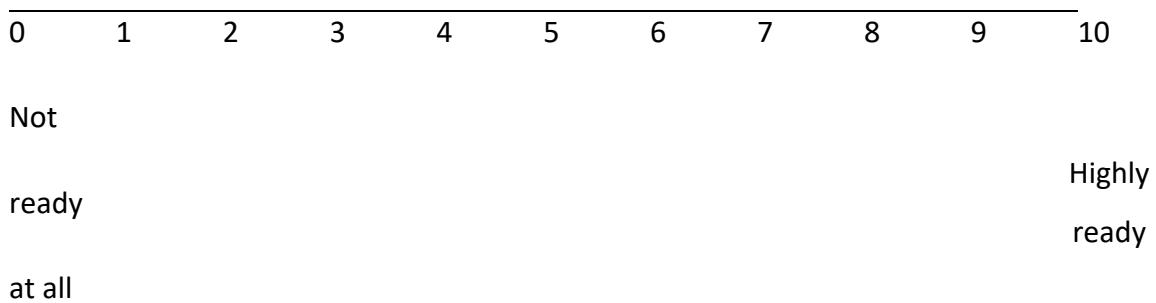
                                                                                   ready

at all

4. How ready are you to **try hearing aids**?

   If you have already scheduled or had a hearing aid trial, or already purchased them, please choose '10'.

0	1	2	3	4	5	6	7	8	9	10

Not

ready

at all

Highly

ready

5. How ready are you to **try assistive listening devices**?

   For example, think of amplified headphones for the TV, a doorbell amplifier, or a vibrating alarm clock.

   If you have already scheduled or had a trial period for an assistive listening device, or already purchased one, please choose '10'.

0	1	2	3	4	5	6	7	8	9	10

Not

ready

at all

Highly

ready

Fig. 1. *Screenshots of the App's Main Pages. The app was offered in Dutch only, but the screenshots were translated to English for this publication.*

Pane 1 - Home screen: Help and navigation to entering new listening situations (via the plus—icon) or viewing entered situations (total and per day), and their snippets. The pie-chart showed the total number of listening situations specified by type.

Pane 2 – EMA survey: Example of a question of the evaluation survey. The 'i'-icon held a short informative text explaining why it generally is more difficult to understand someone in certain types of background noise (e.g., background speech vs. steady noise from an electronic device).

Pane 3 - My listening situations: Help for this view and overview of all entered listening situations, organized by date. New listening situations can be entered here as well (via the plus-icon).

Pane 4 - My most difficult listening situations: A ranked list of the listening situations that were rated on level of difficulty by the user.

Pane 5 - My answers to the short surveys: Per selected listening situation (or for all types of listening situations lumped together), the user's individual and the whole user group's answers to a particular survey question are shown.

Pane 6 - My library: Per theme of the app (e.g., Communication strategies), the user can view, review, and share the snippets available to them.

Pane 7 - Snippet: Example of a snippet, on the value of speech reading. Its main target behavior was *Communication Strategies*, and main Stage of Change was *Preparation* (for the analysis of RQ 3)*.

Pane 8 – Snippets review screen: When closing a snippet, users were asked to review the snippet on six indicators.

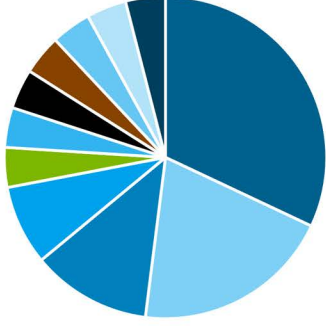# HEAR-AWARE APP: ACCEPTABILITY AND STAGES OF CHANGE

1

Vodafone NL Wifi 23:47

Home +

From here, navigate to the listening situations you entered today, and to their accompanying HEAR-snippets. Or, add new listening situations and receive a new snippet!

How does it work here? ?

Total listening situations (25) ⓘ

Friday 2 April 2021

(Video)Call

🏠 ≡① ılıl 📰 HELP

2

← ⓘ

What kind of sound(s) did the background noise consist of?

You can tick multiple answers.

Other conversation(s)

Street / traffic noise

Home appliances (vacuum cleaner, extractor hood, etc.)

Music or sound of TV

Air conditioning / home ventilation system

Beamer / computer / other electronic device

I don't know (any more)

Other, namely…

← →

3

Vodafone NL Wifi 23:46

My listening situations +

Oversee all your entered listening situations here. Evaluate your past listening situations (if still necessary). Or, take another look at the accompanying HEAR-snippet.

How does it work here? ?

Friday 2 April 2021 ⤓

(Video)Calling

Group conversation, big (with 4 or more other persons) ❗

Tuesday 30 March 2021 ⤓

Watching TV- On TV/PC/laptop

Thursday 25 March 2021 ⤓

Watching TV- On TV/PC/laptop

🏠 ≡① ılıl 📰 HELP

4

Vodafone NL Wifi 23:40

← **My most difficult listening situations**

A helpful overview.
Please find below the types of listening situations you found most difficult so far. The higher up the list, the harder the situation was for you. (Based on your answers to the question: "How much effort did it take you to understand/hear?")

1. Group conversation, big (with 4 or more other persons)
2. Nature sounds (e.g., hearing birds singing, leafs rustling, sounds of the sea)
3. Music
4. Cycling (e.g., hearing other traffic approaching, hearing bicycle bells ringing/ cars honking)
5. Lecture/ presentation
6. Group conversation, small (with 2-3 other persons)
7. 1-on-1 conversation

HEAR-AWARE APP: ACCEPTABILITY AND STAGES OF CHANGE

5

Vodafone NL Wifi 23:40

← **My answers to the short surveys**

All

Type of listening situation

All

Survey question

Importance of understanding speech

How important was it for you to be able to understand what was said?

Your data ■ Data other app users ■

- Very important
- Quite important
- Moderately important
- A little bit important
- Not important at all

0% 10% 20% 30% 40% 50%

6

Vodafone NL Wifi 23:41

My library

View all HEAR-snippets that were offered to you here. View and review them, or share them with others!

How does it work here? (?)

(i) **Background knowledge hearing** (↑)

(i) **Communication strategies** (↓)

The added value of hand gestures
👤 3 ★   👥 3.6 ★

The added value of speech reading
👤 3 ★   👥 3.5 ★

A difficult one – Should or shouldn't I tell others about my hearing?
👤 3 ★   👥 3.9 ★

FAQ50: Support - When can I

🏠 ☰ 📊 📰 HELP

7

Vodafone NL Wifi 23:41

←   ⤴ ★

The added value of speech reading

☰ 🎥

Learning objectives 💡

So-called communication strategies can support you in following a conversation. Several strategies are discussed in this HEAR-snippet. The first two are: using hand gestures and lip reading (or: speech reading).

With or without hand gestures- Notice the difference

This video shows how hand gestures can help to understand speech more effectively. Take a look and notice the difference!

▶

0:00 / 0:40

8

←   **Review**

Useful?
★ ★ ★ ★ ☆

Interesting?
★ ★ ★ ★ ★

Fun / Entertaining?
★ ★ ☆ ☆ ☆

Understandable?
★ ★ ★ ★ ★

Right extent / duration?
★ ★ ☆ ☆ ☆

Pleasant tone of voice?
★ ★ ★ ★ ☆

Other comments:

hhh

Send