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## **Validation of a French translation of the Speech, Spatial, and Qualities of Hearing Scale (SSQ) and Comparison with other language versions.**

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## Validation of a French translation of the Speech, Spatial, and Qualities of Hearing Scale (SSQ) and Comparison with other language versions.

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### Abstract

**Objective:** To adapt and validate a French version of the Speech, Spatial and Qualities of Hearing Scale (SSQ), a subjective evaluation of patients' hearing disability in daily life and to assess SSQ reproducibility across different language versions.

**Design:** The SSQ was translated in accordance with the principles of the "Universalist approach" of cross-cultural adaptation of patient-reported outcome instruments. Scores from a normal-hearing and a hearing-impaired population were compiled and compared, whenever possible, with data, from the literature, collected using other language versions.

**Study sample:** One hundred normal-hearing subjects and 230 hearing-impaired subjects.

**Results:** Good reproducibility of scores and inter-subject variability were obtained between several language versions, even if scores found using the French version were slightly lower than those obtained using Dutch or English versions. A comparison of factor analysis outcomes between the English and French versions confirmed good conceptual equivalence across languages and robustness of the SSQ for use in international settings. The 3 main subscales (Speech, Spatial and Qualities) confirmed their usefulness in assessing different aspects of hearing disability.

**Conclusion:** This study validated a French-language version of the SSQ and assessed the reproducibility of the SSQ across subject groups, administration modes and different countries/languages, confirming its potential as an international standard for hearing disability evaluation.

**Key words:** Self-report Measure; Hearing Disability; Hearing Loss; Cross-cultural Adaptation; Spatial Hearing; Speech; Spatial and Qualities of Hearing Scale.

### Acronyms and abbreviations

**SSQ:** Speech Spatial and Qualities of Hearing Scale

**F-SSQ:** French version of the Speech Spatial and Qualities of Hearing Scale

**E-SSQ:** English version of the Speech Spatial and Qualities of Hearing Scale

**G-SSQ:** German version of the Speech Spatial and Qualities of Hearing Scale

**D-SSQ:** Dutch version of the Speech Spatial and Qualities of Hearing Scale

**Speech:** Speech subscale of the SSQ

**Spatial:** Spatial hearing subscale of the SSQ

**Qualities:** Qualities of hearing subscale of the SSQ

**HIS:** Hearing-impaired subjects.

**NHS:** Normal-hearing subjects.

**PTA:** Pure-tone average (0.5, 1, 2 and 4 kHz)

**SD:** Standard deviation

**NA:** Non Applicable answers

## Introduction

A patient's perception of hearing rehabilitation benefits in their daily life is of paramount importance when optimising their hearing rehabilitation. Hence, subjective self-report measures can be a very useful complement to more objective clinical evaluations (Noble, 2013). They are low-cost and fairly easily implemented but need to encompass the whole range of daily communication situations experienced by all hearing-disabled patients. The Speech, Spatial and Qualities of Hearing scale (SSQ), designed by Noble and Gatehouse (2004), is becoming one of the most widely used tools (e.g. Noble et al, 2008, 2009; House et al, 2010; Van Wieringen et al, 2011; Anderson et al, 2013; Firszt et al, 2012; Ahlstrom et al, 2014). The SSQ is a self-report measure of "auditory disability", a condition defined as the limitation resulting from hearing loss (WHO, 1980), in which the listener is asked to assess different scenarios through 49 items depicting various real-world hearing situations. The SSQ items are grouped into three main subscales: *Speech perception*, *Spatial hearing* and *Qualities of hearing* (Gatehouse & Noble, 2004), and 10 pragmatic subscales (Gatehouse & Akeroyd, 2006).

Initially created in the English language, the SSQ needs to be cross-culturally adapted and compared in several languages and countries to be used as a standard for international comparison studies (Bentler & Kramer, 2000; Arlinger, 2000). The aim of the present study was to adapt and validate a French version of the SSQ (F-SSQ) by following, as closely as possible, the principles of the Universalist model of the cross-cultural adaptation of patient-reported health outcome instruments as defined by Herdman et al (1998). Indeed, this model was proposed to define and explore issues related to the cross-cultural equivalence of patient-reported outcome instruments and has been largely used for the cross-cultural adaptation of various health-related questionnaires since its introduction (Regnault and Herdman, 2014). It defines 6 types of equivalence that need to be addressed for a tool to be considered to be cross-culturally valid: *Conceptual equivalence*, *Item equivalence* and *Semantic equivalence* refer to the way the questionnaire would be adapted with similar relevance and meaning between cultures; *Operational equivalence* refers to the ability to use a similar presentation format, instructions, and mode of administration across languages, and *Measurement equivalence* pertains to psychometric properties. The final level of equivalence is *Functional equivalence* and relates to an overall assessment of the quality of the cross-cultural adaptation of the instrument (Renault and Herdman, 2014).

Following an iterative process of cross-cultural adaption of the English SSQ (E-SSQ) to achieve the first 3 equivalences, the scores yielded by a final French version of the SSQ (F-SSQ) were collected in normal-hearing subjects (NHS) and hearing-impaired subjects (HIS) to achieve *Operational* and *Measurement* equivalence. Those results were compared to results published in the literature for other versions of the SSQ: German (G-SSQ, Kiessling et al, 2011), Dutch (D-SSQ; Demeester et al, 2012) and English (E-SSQ; Banh et al, 2012; Dwyer et al, 2014; Akeroyd et al, 2014). By performing a factor analysis similar to that of Akeroyd et al (2014), we determined the similarity with which the SSQ items load on the same factors in a different language version of the same instrument, hence

providing further evidence for the reliability and robustness of the SSQ (*Measurement equivalence*). Lastly, other aspects, often viewed as minor but still useful to the clinician, have been considered, such as the readability of the SSQ and the percentage of missing answers.

## **Methods**

### **1. Cross-cultural adaptation of the E-SSQ.**

#### ***1.1. Preliminary steps and translation procedures.***

A qualitative assessment by bicultural persons and French natives close to the target population helped to ensure *Conceptual equivalence*, which is concerned with the way different populations conceptualise hearing deficits and hearing disabilities and *Item equivalence*, which refers to a similarity in relevance of a particular item to the domain it is supposed to explore, was performed. To achieve *Semantic equivalence* (i.e., the transfer of precise meaning across languages), we chose a multistep approach (as advocated by the European Regulatory Issues on Quality of Life Assessment (ERIQA) group, Acquadro et al., 2008) involving two independent translations, a translation/expert committee (which is now considered superior to the well-known back-translation procedure (Douglas & Craig, 2007; Epstein et al, 2013), a focus group and a pilot study. Two translations of the English version (E-SSQ from Gatehouse & Noble, 2004) into French were obtained independently, one of which was kindly provided by Cochlear (CEL5277, June 2011 version). Our committee was composed of one professional native French translator, 3 balanced bilingual and bicultural people (French & British) and 4 French natives with a working knowledge of English and expertise in hearing aids (1), audiology (1) and ENT practice (2). Once a consensus was reached, the translation was tested using a focus group of 3 elderly French natives, representatives of the target population, whose input prompted minor changes in the wording of several items.

#### ***1.2. Material presentation: Operational equivalence.***

As one item in the E-SSQ dealt specifically with hearing aids, and therefore was not very relevant to most of our subjects (who did not wear hearing aids), the translated version was composed of 49 items [rather than the 50 items in the original version by Gatehouse & Noble (2004)] in three subscales: the Hearing for Speech subscale (*Speech*) included 14 questions regarding the subject's ability to understand Speech in the presence of different types of noises, the Spatial Hearing subscale (*Spatial*) included 17 questions concerning sound and source localisation and the *Qualities* subscale dealt with naturalness and clarity of sounds and included 18 items (instead of 19 items due to item 15 being deleted).

We used the presentation format of the E-SSQ as a template and modified it in minor ways, mostly to accommodate mild visual impairments (presbyopia), which are very common in aged populations. Subjects responded on a horizontal visual-analogue ten-point scale that was identical for each item. If the situations described in the questions were not relevant to the patient's experience, the subject could tick a "Not Applicable" (NA) box that was available for each item. At the end of the questionnaire, 2 items were added that asked subjects about their opinions regarding the relevance of the questions towards the situations they experience every day ("*Ecological validity*" item<sup>1</sup>), and the difficulty of the questions ("*Difficulty*" item<sup>2</sup>). Subjects were asked to include the time they needed to complete the questionnaire.

#### ***1.3. Pilot study in an ENT department***

To identify potential linguistic and understanding difficulties, the F-SSQ was given in an interview format to 26 HIS (mean age: 60.4 years old, SD = 12.6), 14 of them women, visiting an ENT department for hearing assessments (mean better ear PTA: 24 dB HL, SD = 15; mean worse ear PTA: 40 dB HL, SD = 26). The hesitations of the subjects, their difficulties in understanding the questions and

<sup>1</sup> Did the questions seem easy to answer? (not at all/ yes, no problem)

<sup>2</sup> How well do the questions reflect your hearing experiences in daily life? (very badly/ very well).

their remarks concerning the questions were noted.

This pilot study led to further adjustments in the wording of some items. Hence, the French SSQ version we used (presented in Appendix 1) is different from version 1.4 (22/11/2012) provided by Cochlear<sup>o</sup>. In addition, this pilot study allowed us to check that the first 4 types of equivalences in the Universalist model (*Conceptual, Item, Semantic and Operational* equivalences) were met.

## 2. Data collection

All participants underwent otoscopic and audiometric evaluations. Air and bone conduction hearing thresholds were obtained using an AC 33 clinical audiometer (Interacoustic<sup>o</sup>) in a sound-treated booth. Pure-tone audiometry was performed for octave frequencies between 250 and 8000 Hz in each ear for all subjects. Pure tone averages (PTAs) were calculated using the thresholds at 500, 1000, 2000 and 4000 Hz. General information was also gathered, including each subject's number of years of education and current professional activity.

The SSQ questionnaire was presented in a counterbalanced manner with another similar questionnaire [the Spatial Hearing Questionnaire by Tyler et al (2009)], the results of which are not the topic of the present paper. The questionnaires were given to the HIS in a pre-stamped and addressed envelope after receiving instructions from the clinician. The NHS completed the questionnaires on site. Written informed consent was obtained from all subjects within the framework of French laws regarding non-invasive biomedical research on humans (Agreement number A-11-385, "CPP Sud-Est IV").

## 3. Participants

### 3.1. Normal-hearing subjects (NHS)

The questionnaires were given to 100 NHS (first to third year university students), of whom 98 gave valid responses (mean age: 20.8, SD = 2.21, range: 18 to 27 years old); 69 of the responses

were from women. The mean PTA was 8.7 dB HL (SD = 3.6) in the worse ears and 1.1 dB HL (SD = 4.5) in the better ears. The mean number of educational years was 16.7 (SD=1.7).

### 3.2. Hearing-impaired subjects (HIS)

A total of 230 out of 280 HIS returned their questionnaires (rate of reply: 82.1%). For the analysis of the number of items completed, we took into account all of the HIS except for 4 HIS who had missed a page, leaving 226 HIS. As several HIS failed to answer several questions, we restricted the numerical analysis to the 216 questionnaires that contained fewer than 10 missing or not applicable responses on the SSQ. Of those 216 subjects (109 women), 20 wore a hearing aid in at least one ear. The average age was 54.2 years (SD = 17) and the average number of educational years was 12.4 (SD = 4.3). The mean better ear PTA was 26 dB HL (SD = 15), the mean worse ear PTA was 44 dB HL (SD = 26), and the mean hearing-loss asymmetry was 15.2 dB HL (SD = 23.3).

## 4. Data analysis

### 4.1. Readability analysis

One of the concerns when developing and translating questionnaires is ensuring that the questionnaire remains easily readable by the target population (Calderon et al, 2006; Paz et al, 2009; Atcherson et al, 2011). Several readability indices have been defined, most of them based on the number of words per sentence and the number of syllables per word (Reck & Reck, 2007). Although those indices are limited in reflecting all of the processes involved in reading comprehension and most of them have been developed mainly for the English language, they still represent a standard for measuring readability. We analysed the readability of both the E-SSQ and the F-SSQ using the Gunning-Fog Index (Gunning, 1952) and the Flesch Kincaid Index (Flesch, 1948; Kandel & Moles, 1958). Each index was calculated for the entire SSQ, by subscale and for each item, as in Calderon et al (2006) and Paz et al (2009).

#### 4.2. Comparison with international literature data

For each subject, the average score was calculated over all 49 SSQ items and for each of the main subscales (*Speech, Spatial and Qualities*).

The rates of response for each item were compared to Akeroyd et al (2014)'s data and the G-SSQ data (Kiessling et al, 2011). The comparison of scores was performed with data from the literature obtained from NHS, allowing for a comparison between the French (F-SSQ), Dutch (D-SSQ; Demeester et al, 2012) and English (E-SSQ; Banh et al, 2012) versions on very similar populations (NHS below 30 years of age). A comparison of scores between the F-SSQ and both the E-SSQ and the D-SSQ was performed for each item. To ensure comparability of our results with those of Demeester et al (2012), the last 5 questions of the *Qualities* subscale were omitted, as was done by them.

### 5. Statistical analysis

#### 5.1. General procedures

Although the data were non-Gaussian, as is typical for this type of data, we opted to use non-transformed data because we failed to obtain a unique transformation across HIS and NHS and across all items of the questionnaires. The average skewness across items was -0.68 for the HIS and -1.6 for the NHS (showing a build-up of high scores, as would be expected for NHS) with a kurtosis of -0.12 and 3.11, respectively. Non-parametric statistics were chosen, as in Dwyer et al (2014): the HIS and NHS were compared using Mann & Whitney and Wilcoxon rank sum tests. Differences between the different subscales were evaluated using Wilcoxon sign tests and Friedman's ANOVA (F-ANOVA), and correlations were performed using Spearman's rank correlation coefficient. However, we presented the data as the means and standard deviations of the means (SDs) for ease of comparison with literature. Differences between correlation coefficients were tested using Fisher's z score (Steiger, 1980).

A false discovery rate approach was chosen to address the problem of multicomparisons (Benjamini & Hochberg, 1995) to avoid the problem of inflated type II error rates than can occur with older multicomparison adjustments such as the Bonferroni correction (see for instance Asendorpf et al, 2013; Glickman et al, 2014). All of the exact p-values is specified, and the p-corrected value for significance is 0.01. Internal consistency was determined using item-to-total correlations and Cronbach's alpha coefficients for the NHS and HIS, both separately and together. All statistical analyses were performed using R statistical package version 3.1.0 (2014-04-10).

#### 5.2. Comparison with literature data

For comparisons with the literature data obtained in the NHS, we used the parametric Student's test because it is the only test that can be used when the available data are means and SDs. As there was no a-priori expectation of the French data scores being lower or higher than the literature data, the comparison between the French SSQ and literature data was performed using two-tailed Student's t-tests. The reproducibility between the different language versions of the questionnaires (i.e., Dutch, English and French) was evaluated using non-parametric Spearman's correlation coefficients for the 49 items and for each of the 3 main subscales.

As our aim was to analyse the underlying structure of the questionnaire to determine whether the same underlying structure of the original English version of the questionnaire could be obtained for the French version in a population sample including NHS, we performed a common factor analysis using the "psych" package for R software, with very similar options and steps as was described in Akeroyd et al (2014) (i.e., correlation matrix, maximum likelihood method for factors extraction, parallel analysis for number of factors extraction, oblique factor rotation). The results obtained in the total population (i.e., 314 subjects) were compared to those of Akeroyd et al (2014). For simplification, we kept the names of the different factors originally used by Akeroyd et al (2014). A similar factor analysis was performed on the group of HIS, which yielded results very similar

to the total population. The number of NHS was not large enough (<100) for NHS specific factor analysis. For more details about the method and meaning of the different elements of a factor analysis, please see Fabrigar et al (1999) and in the context of the SSQ, Akeroyd et al (2014).

## Results

### 1. SSQ general characteristics

#### 1.1. SSQ difficulty and ecological validity.

The difficulty of the F-SSQ was perceived as

difficulties than about the inherent difficulty of the questions themselves. However, no systematic relationship was observed between subjects' characteristics (HIS versus NHS, better ear PTA, number of educational years) and the F-SSQ "Ecological Validity" score.

#### 1.2. Readability analysis (details in appendix 2)

The number of words per item varied from 7 to 43 (mean = 22.7 words), with a total length of 1111 words. The readability analysis revealed a Gunning-Fog index of 7.7 and a Flesch-Kincaid index of 10.5, i.e., normal to fairly easy, with the *Qualities* subscale being the most difficult and

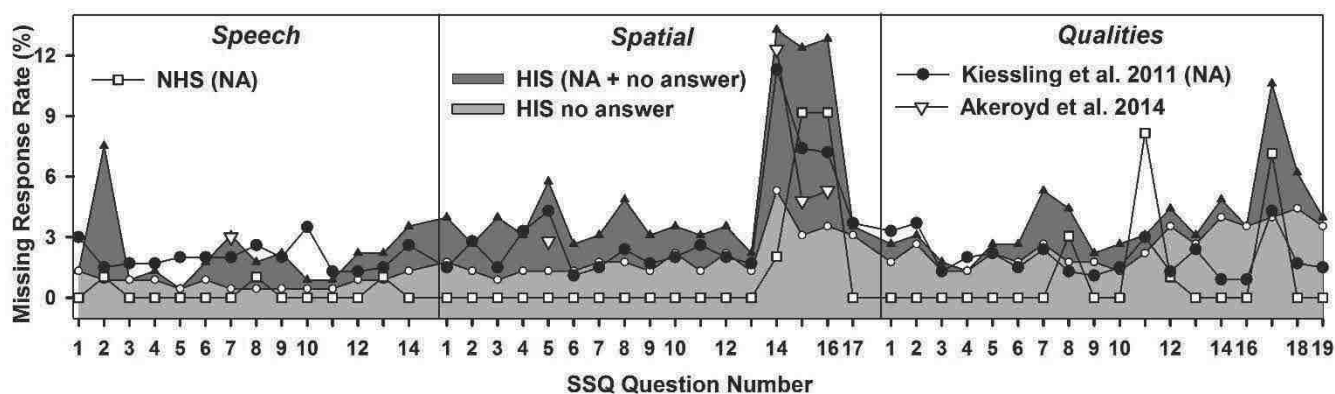


Fig. 1. Percentage of missing answers for each SSQ item, in normal hearing young subjects: NHS, white squares and in hearing impaired subjects (HIS): Black triangles- dark grey (total missing answers, including the "non applicable" answers) and white dots-light grey: Missing answers. For comparison, the rate of missing answers obtained by Akeroyd et al (2014) using the English SSQ is provided as white triangles (for question 16 of the *Qualities* subscale, this rate was 45%). The rate of "non applicable" (NA) answers from the German SSQ (Kiessling et al, 2011) is specified as black dots.

significantly lower for the NHS (7.9, SD = 2.1) than for the HIS (7.1, SD = 2.6) (Mann-Whitney  $z = 2.5$ ,  $p < 0.02$ ), but no significant difference between the HIS and NHS was obtained for "Ecological Validity" (8.6, SD = 1.6 for NHS versus 8.2, SD = 2.1). There was a systematic relationship between the F-SSQ "Difficulty" and the PTA, with a lower score (i.e., more difficult questions) for subjects with high PTAs, and no interaction with the number of educational years. This relationship is confirmed using Spearman's  $r$ , with  $r = -0.22$  ( $p < 0.002$ ) between the worse ear PTA and the F-SSQ "Difficulty" score and  $r = 0.39$   $p < 0.0001$  between the F-SSQ and the F-SSQ "Difficulty" scores, suggesting that the HIS' answers were more about their hearing

the *Spatial* subscale being the easiest. A per-item analysis revealed a large amount of inter-item variability, with readability ranging from 4.2 and 7.2 (very easy) to 15.6 and 19.4 (extremely difficult) for the Gunning-Fox and Flesch-Kincaid indices, respectively. A readability analysis of the E-SSQ showed a significant correlation with the F-SSQ analysis ( $r = 0.48$ ,  $p < 0.0005$ ) across the 49 items.

#### 1.3. Percentage of valid responses

##### - Per item analysis

In the NHS, a total of 42 "not applicable" answers out of 4 802 possibilities (98 subjects x 49 items) were obtained (<0.9%) (fig. 1). With the exception of #3.11, the HIS had a greater



SSQ Subscale	Language Version	Mean (per question)		SD (per question)	
		French	Dutch	French	Dutch
Total	Dutch	<b>0.86</b>	1	<b>0.71</b>	1
	English	<b>0.88</b>	<b>0.82</b>	<b>0.48</b>	<b>0.72</b>
Speech	Dutch	<b>0.94</b>	1	<b>0.85</b>	1
	English	<b>0.93</b>	<b>0.9</b>	<b>0.8</b>	<b>0.72</b>
Spatial	Dutch	<b>0.69</b>	1	<b>0.61</b>	1
	English	<b>0.69</b>	0.42	<b>0.51</b>	<b>0.78</b>
Qualities	Dutch	0.46	1	0.22	1
	English	0.6	<b>0.73</b>	0.17	0.48

Table 1. Correlations (Spearman correlation coefficients) between different language version Speech Spatial Questionnaires (SSQ) mean scores, (and standard deviations, SD) obtained in normal- hearing subjects (French SSQ obtained in 98 subjects; Dutch SSQ data on 103 subjects from Demeester et al (2012) and English-US SSQ data on 48 subjects from Banh et al (2012). Statistically Significant correlations with  $p < 0.01$  are specified in bold italics.

percentage of missing values than the NHS. There were significant correlations across the 49 items in the percentage of missing answers between the NHS and HIS ( $r = 0.68, p < 0.0001$ ). There was a significant correlation between the

F-SSQ and the G-SSQ across the 49 items in the HIS for both NA answers ( $r = 0.46, p < 0.001$ ) and missing answers ( $r = 0.59, p < 0.0001$ ).

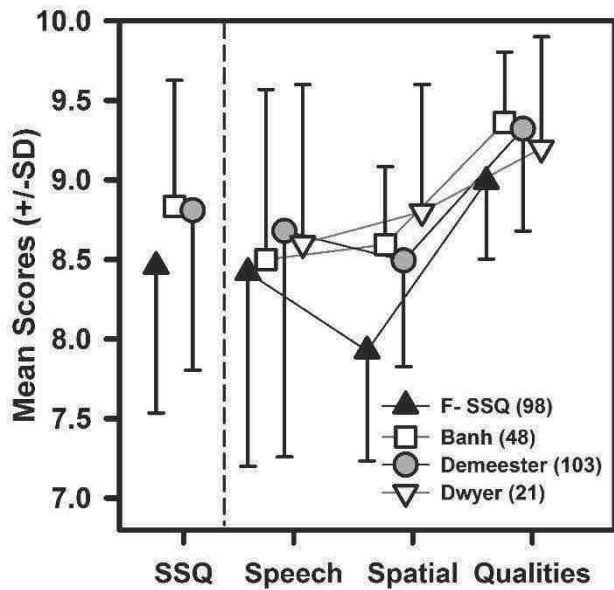


Fig. 2. Mean SSQ scores (+/- standard deviation) obtained for the 49 items of the SSQ (left panel), and for the 3 main subscales (right panel). The present data (black triangles) obtained with a French SSQ version, is compared to other versions in similar populations (young normal hearing subjects): Demeester et al (2013) Dutch version, Banh et al (2012) & Dwyer et al (2014) for English versions. The number of subjects is mentioned in parenthesis beside each data set.

There was no significant correlation between the percentage of missing answers per item and the average score per item, whether the score was calculated for the NHS or HIS ( $r < 0.2, p = ns$ ). The Spearman rank correlation across the 49 items showed a statistically significant increase in the percentage of NA responses, for both the NHS and HIS, as the readability indices increased in difficulty for both the Gunning-Fog ( $r = 0.32, p < 0.03$  for NHS & HIS) and Flesch Kincaid indices ( $r = 0.34$  (NHS) and  $r = 0.35$  (HIS),  $p < 0.02$ ). However, no correlation was observed for the percentage of missing answers and readability indices. Specifically, HIS tended to choose “NA” for more difficult questions (less readable according to readability indices) rather than give no response at all.

- Per subject analysis

The number of missing response increased significantly with age (Spearman  $r = 0.26, p < 0.0001$ ), worse ear PTA (Spearman  $r = 0.28, p < 0.0001$ ), and better ear PTA (Spearman  $r = 0.20, p < 0.005$ ) but not with the number of years of education or the time taken to complete the questionnaire.

As expected, the time needed to complete the questionnaire was significantly lower for the NHS (mean = 11.2 min, SD = 4.5, median = 10) than for the HIS (mean = 20.8 min, SD = 12,

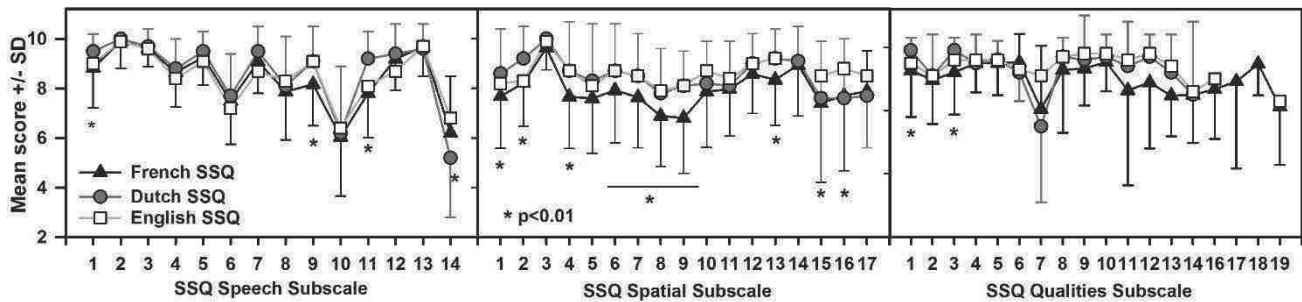


Fig. 3 Mean scores ( $\pm$  standard deviation (SD)) for each SSQ subscale, with the question number in the x-axis, for normally hearing subjects, tested with the French SSQ (Black triangles, present data,  $n = 98$ ), the Dutch SSQ (grey dots, Demeester et al, 2012;  $n = 103$ ) and the English-US SSQ (white squares; Banh et al, 2012;  $n = 48$ ). Several questions in the *Qualities* subscale were not available in Dutch and/or in US data, and results from one question were missing from the US data in the *Spatial* subscale. The presence of stars denote a significant difference between the French SSQ and either the Dutch SSQ or the English SSQ (Student t test), with false discovery rate correction ( $p < 0.01$ ).

median = 17) (Mann-Whitney  $z = 8.8$ ,  $p < 0.0001$ ).

## 2. Internal validity indices (details in appendix 2)

Cronbach's alpha results were all above 0.91 for both the NHS and HIS. The item-total correlations ranged from 0.38 (#1.2) to 0.84, with an average inter-item correlation of 0.41 for NH, and 0.54 for HI. The Spearman rank correlations between the SSQ scores and the different subscales ranged from 0.64 (*Speech X Spatial*) to 0.93.

In the NHS, the total F-SSQ score was 8.5 (SD = 1.0). An F-ANOVA showed significant differences between the 3 subscales (Chi-squared = 83,  $p < 0.0001$ ). Wilcoxon paired tests showed significant differences between each pair of subscales ( $z > 4.41$ ,  $p < 0.0001$ ), with the *Spatial* subscale lower than the other two subscales (fig. 2). Means and standard deviations obtained for the F-SSQ by item and subscale are provided in Appendix 2. As with Demeester et al (2012) and in accordance with international guidelines for the identification of diseases (WHO, 1980), the cut-off points lower than 2 SDs below the mean scores are provided.

## 3. Comparison of different language versions of the SSQ

Although the F-SSQ scores were statistically significantly lower than the SSQ scores in other

languages, the differences were well below 1. Specifically, they were 0.4 points lower than the D-SSQ (Student's  $t = 2.7$ ,  $p < 0.01$ ) and 0.6 points lower for the F-SSQ *Spatial* scale than the 3 data sets in the literature (fig. 2). Indeed, more than 21 items out of 46 showed a significantly lower score than the Dutch or the English SSQ versions, especially in the *Spatial* scale (fig. 3), in a similar young, normal-hearing population (Student's t-tests with FDR-corrected p values). A correlation analysis did not reveal any significant correlation between NHSs' characteristics, such as better ear PTA, worse ear PTA, age, degree of hearing-loss asymmetry, number of educational years and SSQ scores calculated per item or per subscale.

Nevertheless, regardless of the language version considered, the pattern of the items was remarkably similar, as shown by the correlations between the different language versions SSQs (fig. 3 and 4a): a question with a lower score in one language SSQ will also have a low score in another language. In addition, a question showing a large variability between the NHS will show the same large variability (as indicated by the standard deviation) in a different translation (fig. 4b). Spearman correlation coefficients (table 1) show a very good overall reproducibility in the SSQ regardless of the language used. When analysed by subscale, the best reproducibility is obtained for *Speech* subscale and the worst is observed in the *Qualities* subscale.

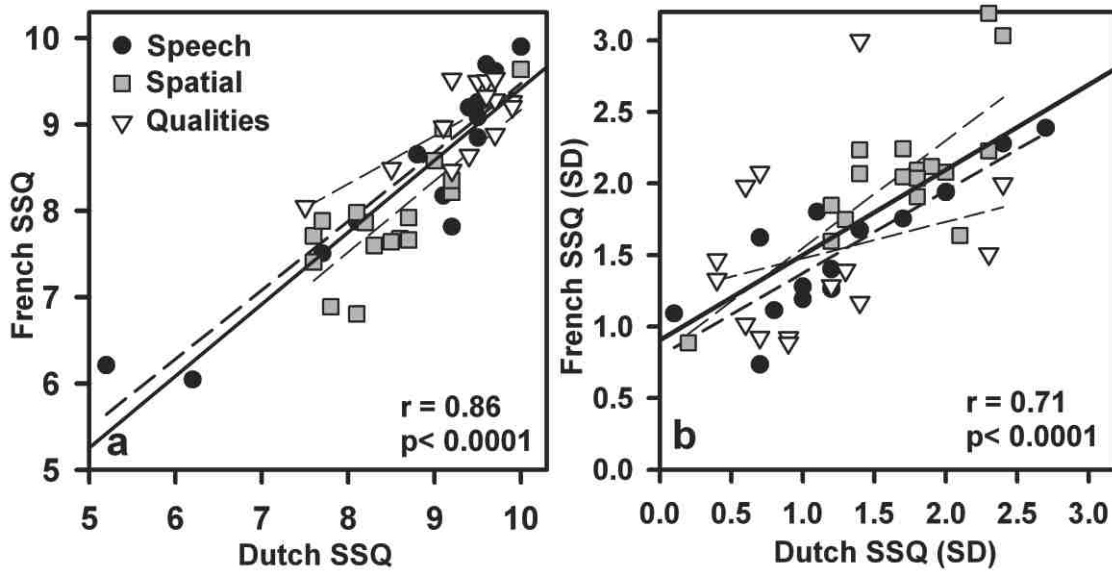


Fig. 4. Relation between French SSQ and Dutch SSQ mean scores (fig. 4a), and SSQ standard deviations (fig. 4b) obtained in similar populations, for 45 SSQ items, split up in the 3 SSQ subscales (black dots for *Speech*; Grey squares for *Spatial* and white triangles for *Qualities*). Spearman correlation coefficients for the 45 items are mentioned.

#### 4. Factor analysis (n=314 subjects)

To maintain the ratio of at least 5 subjects per variable, we performed the factor analysis on 314 subjects and used the 49x49 Pearson correlation matrix (Akeroyd et al, 2014) as input data. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.96 and all values for individual items were greater than 0.93. Bartlett’s test was

highly statistically significant (Chi-squared > 17500,  $p < 0.0001$ ), confirming that correlations between individual items were sufficient. Six factors had an eigenvalue greater than 1, with percentages of variance explained of 51%, 5%, 4% and 2% for the remaining 2 factors. The number of factors to be kept was either 3 or 5 according to Cattell’s scree test and 3 according to a parallel analysis. Thus, like Akeroyd et al (2014), we performed a 3 factors extraction. The

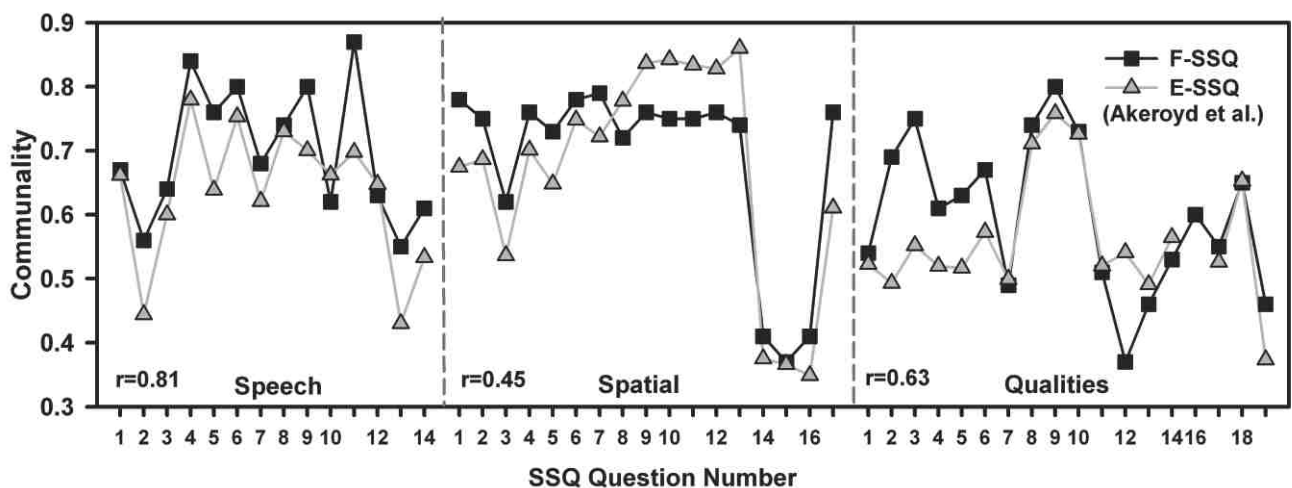


Fig. 5. The communalities (i.e., the amount of variance from 0 to 1 (100%) that is accounted for by the three retained factors), for each one of the 49 F-SSQ items. For comparison, data obtained from the unaided group of Akeroyd et al (2014) are mentioned in grey triangles (E-SSQ). Rank correlation coefficient between the present data and Akeroyd’s data is mentioned for each subscale ( $r=0.80$  for the entire SSQ).

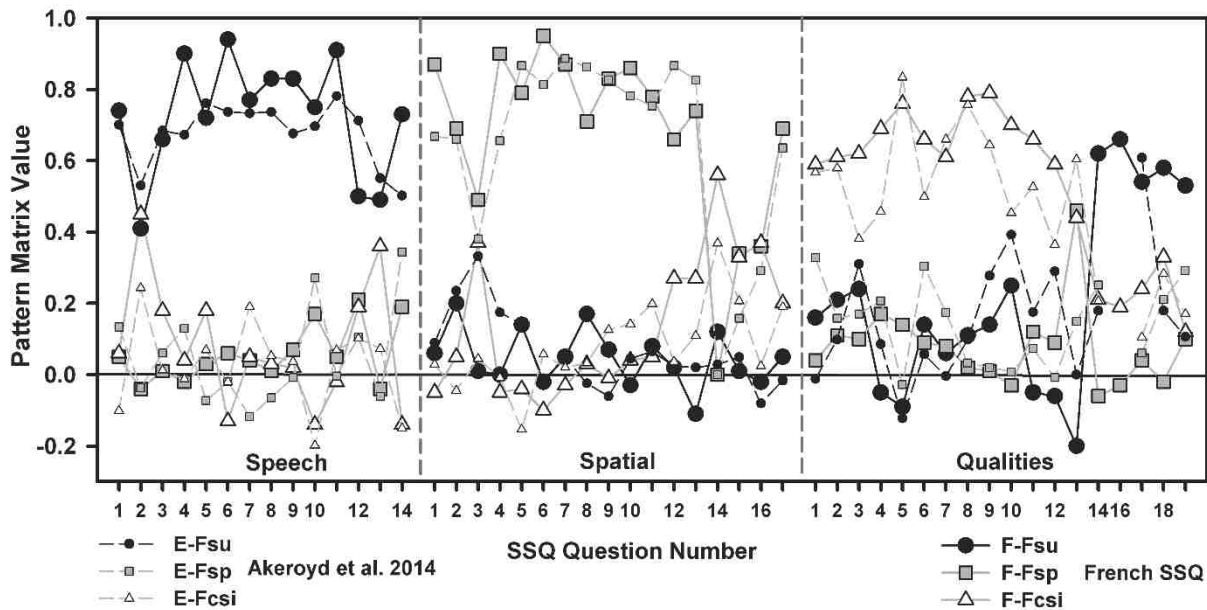


Fig. 6. Factor weights (Pattern Matrix Value) for each one of the 49 SSQ items, obtained by factor analysis using the French SSQ. The symbols (black dots for “*Speech Understanding*”, grey squares for “*Spatial*” and white triangles for “*Clarity, Separation and Identification*”) mark the three rotated factors. For comparison, data obtained with the English SSQ from the group of unaided patients of Akeroyd et al (2014) are presented with smaller symbols (E-F<sub>SU</sub>, E-F<sub>SP</sub> and E-F<sub>CSI</sub>).

fit of the model to the data was good based on a root mean square residuals result of 0.04, where a value below 0.05 is considered a good fit and values between 0.05 and 0.08 considered a fair fit (Field, 2012; Fabrigar et al, 1999).

The average communalities obtained across the 49 items was 0.66 (SD = 0.13). By subscale, the results were 0.70 (SD = 0.10) for *Speech*, 0.68 (SD = 0.14) for *Spatial* and the lowest communalities were obtained for the *Qualities* items: 0.60 (SD = 0.12). The communalities across the 49 items showed a remarkably similar pattern to that found by Akeroyd et al (2014) and the lowest communalities were observed for #2.14, #2.15 and #3.12 (communality < 41%). The other lowest communalities (<50%) were for #3.7, #3.13 and #3.19. (fig. 5). The rank correlation coefficient between the present data and Akeroyd’s data was 0.80 ( $p < 0.0001$ ), indicating very good reproducibility between the two versions of the SSQ tested on 2 different data sets.

The mean factor weighting across each SSQ subscale showed an underlying 3 factors structure, with each factor essentially representing one SSQ subscale. Hence, we chose to use the same acronyms as Akeroyd et al

(2014): F<sub>SU</sub> (*Speech Understanding*), F<sub>SP</sub> (*Spatial Perception*) and F<sub>CSI</sub> (*Clarity, Separation and Identification*). The squared loadings of the 3 factors were similar to each other at 11.7, 11 and 9.5 for F<sub>CSI</sub>, i.e., slightly less than the two others as in Akeroyd et al (2014). The correlations between the 3 factors ranged from 0.62 to 0.66, confirming that they were inter-dependent and justifying the use of an oblique rotation. The individual loadings of each factor on each of the 49 items are shown in fig. 6 along with a comparison to Akeroyd’s data. Correlations between the F-SSQ and the E-SSQ loadings were 0.77 for F<sub>SU</sub>, 0.77 for F<sub>SP</sub> and 0.83 for F<sub>CSI</sub>, showing remarkable similarities between both versions of the SSQ.

For F<sub>SU</sub>, #1.2, #1.12 and #1.13 are weighted lower than the others and the loadings of F<sub>SU</sub> on the *Spatial* subscale are all close to zero. However, F<sub>SU</sub> shows substantial loadings on the final items of the *Qualities* subscale (#3.14, #3.16 to #3.19).

F<sub>SP</sub> has zero loadings on the *Speech* subscale. However, its loadings encompassed the majority of the *Spatial* subscale, except for #2.3, #2.14, #2.15 and #2.16, which show a considerably lower load that is also observed in Akeroyd et

al's data.  $F_{SP}$  also loaded on #3.13 ( $>0.4$ ), which had a low communality.

$F_{CSI}$  is less "subscale specific", showing generally weaker loadings on the *Qualities* subscale, as noted by Akeroyd et al (2014) for the E-SSQ: it has a load close to zero for the final 5 items, on which  $F_{SP}$  showed some loading. The French  $F_{CSI}$  shows some moderate loadings on #1.2, #2.3, and #2.14 to #2.16.

## Discussion

The present work provided data on both NHS and HIS using a French version of the SSQ, allowing for a comparison of the presence of responses, scores and patterns of responses with other languages versions of the SSQ. Within the Universalist model of cross-cultural adaptation of questionnaires, the final equivalence type to be achieved is *Functional equivalence*, which refers to how equally the instrument performs across different languages and cultures (Herdman et al, 1998). This final equivalence involves an appraisal of the statistical results obtained in assessing the other types of equivalence, particularly *Measurement equivalence*, which refers to similarities in the psychometric properties of a questionnaire with its other language equivalents, and *Conceptual equivalence*, which refers to the similarity of the construction of the concepts tested across cultures. The outcome of the factor analysis between the E-SSQ and the F-SSQ, namely the different F-SSQ items loadings on 3 factors being very similar to the model obtained with the E-SSQ with data from the UK (namely *Speech Understanding*, *Spatial Perception*, and *Clarity, Separation and Identification*), is very encouraging as to *Conceptual equivalence*.

The factor analysis showed greater F-SSQ communalities, reflecting a greater proportion of variance in item scores explained by the 3 main factors than the E-SSQ, with a good reproducibility of the pattern of communalities ( $r=0.8$ ) across the 49 items between the two language versions.

For  $F_{SU}$  (*Speech Understanding*), #1.2, #1.12 and #1.13 were weighted lower than the other items. The lower load for #1.2 and #1.13 is in agreement with the E-SSQ. Akeroyd et al (2014) attributed this lower load to the fact that both items refer to very simple "speech in quiet" situations. This hypothesis is in agreement with both items having the highest scores for both the NHS and HIS (9.9 & 9.7 and 8.6 & 7.8, respectively). The lower representation of #1.12 could also be due to the relative easiness of the situation described (speech in quiet where the conversation moves from one person to another with just one person speaking at a time): #1.12 had fairly high scores in both NHS and HIS.  $F_{SU}$  did not have any loadings on *Spatial* items but showed substantial loadings on the final items of the *Qualities* subscale (#3.14, #3.16 to #3.19). All of those items relate to situations involving speech comprehension and, as Akeroyd et al (2014) suggested, subjects relate those items more to the effort needed for speech comprehension rather than to their quality of hearing per se. For the G-SSQ, the F-SSQ and the E-SSQ, #3.17 (and, to a lesser degree, #3.18), which is related to driving a car, yielded a high rate of absent or NA responses. Noble & Gatehouse (2004) already noted the limitations of those items and several authors actually eliminated those items from their analyses. Item #1.2 ("You are talking with one other person in a quiet, carpeted lounge-room. Can you follow what the other person says?") was already noted to be different from the other items by Akeroyd et al (2014). Here, #1.2 showed some load from  $F_{CSI}$  as it is more related to "clarity" of speech. It showed lower communalities and was associated with a lower loading from  $F_{SU}$ . Additionally, it had the lowest item-total correlation in the NHS and a greater number of missing or NA answers from the HIS. This rate of missing answers might be due to the reference to a "carpeted floor", which was reported to be a fairly uncommon listening situation in France and could be a problem of *Item equivalence*.

$F_{SP}$  (*Spatial Perception*), had no loadings on the *Speech* subscale, as in Akeroyd et al (2014), and encompassed the majority of the *Spatial* scale, except for a lower load for #2.3 and #2.14 to #2.16. Items #2.14 to #2.16 had the highest

number of missing and NA answers in several languages (F-SSQ, G-SSQ and E-SSQ), which indicates more of a general problem than a problem specific to the French translation. The two other items, #2.15 (“*Do the sounds of people or things you hear, but cannot see at first, turn out to be closer than expected when you do see them?*”) and #2.16 (“*Do the sounds of people... .. turn out to be further away than expected...*”), referred to situations that were reported by subjects as difficult to understand, with both a high number of NA answers and the greatest standard deviation for the NHS. In addition, they had the most words of all of the questions in both French and English, and had the lowest readability. Lastly, the communalities were at their lowest for those 3 items, as in the E-SSQ data. Akeroyd et al (2014) hypothesised that the nature of the localisation situation asked by the items, i.e., distance evaluation for #2.15 and #2.16 and perceived location for #2.17, is likely responsible for those specific results. However, another hypothesis would be the difficulties in understanding the questions, especially when using a self-report administration mode, rather than an interview mode that offers the opportunity for better, individual explanations of the items. The greater number of missing responses and the more difficult readability point towards a more cognitive difficulty problem. The substantial loading of  $F_{CSI}$  on #2.14 ( $>0.5$ ) suggests that the situation depicted is more likely related to a problem of clarity, separation of sounds than to a localisation/spatial problem. The situation is different for #2.3, which showed relatively lower communalities (but still  $>0.60$ ), a lower load of  $F_{SP}$ , and a substantial load of  $F_{CSI}$ . Like the E-SSQ data from different sources (Gatehouse & Noble, 2004; Banh et al, 2012) and the D-SSQ data (Demeester et al, 2012), this item showed the highest scores in the *Spatial* subscale, both in NHS and HIS (9.6 and 8.3, respectively). It actually describes an easy situation (“*You are sitting in between two people. One of them starts to speak. Can you tell right away whether it is the person on your left or your right, without having to look?*”) where there is no need to understand what is spoken but only to localise a sound presented from the side. It is, therefore, not surprising that  $F_{CSI}$  loads, to a small degree (0.4), on this item.

$F_{CSI}$  (*Clarity, Separation, and Identification*), is less subscale-specific, but loaded mostly on *Qualities* items from #3.1 to #3.12 and showed generally weaker loadings than the other two factors, as noted by Akeroyd et al (2014) for the E-SSQ. It has a load close to zero for the final 5 items, on which  $F_{SU}$  showed some loadings (as discussed above). Items #3.11, #3.12 and #3.13 shared low communalities and significantly lower scores for the NHS than the D-SSQ and the E-SSQ. In addition, #3.11 shows a greater variability in the NHS than other items and a greater rate of NA responses in the NHS. Indeed, #3.11 “*Do everyday sounds that you hear seem to have an artificial or unnatural quality?*” does not seem relevant to NHS, nor does #3.12 “*Does your own voice sound natural to you?*”.

On the whole, the factor analysis showed very good reproducibility with the results of Akeroyd et al (2014), even though the two analyses were performed on different populations, in different languages and countries and in a different mode (self-report versus interview), which argues strongly in favour of the robustness of the SSQ. Although the factor analysis gave good insight into the reproducibility of a cross-cultural adaptation of the SSQ, revealing the same problematic items across languages, other indices, such as reproducibility in the missing values and scores needs to be considered. Although the SSQ was originally designed to be administered in an interview format (Gatehouse & Noble, 2004), several authors use it more widely in a mailed mode, which is much less time-consuming (House et al, 2010; Kiessling et al, 2011). Although we used a mailed mode, the fact that the clinician specifically instructed the subjects on how to complete the questionnaire could explain our very high rate of return of over 80%, versus approximately 60% in most of the literature (e.g., 55% in House et al, 2010, and 65% in Kiessling et al, 2011) and our lower rate of missing answers than in Kiessling et al (2011) (though it was slightly higher than in Akeroyd et al (2014), who used an interview format). The significant increase in missing and NA answers with the difficulty in item readability, might be due to either an inherent difficulty of the specific item, or to a translation problem. However, similarities in patterns of absent responses

between the NHS and HIS as well as the same similarities observed across different languages (English, German and French) show that the high percentage of missing answers in some items was not due to a specific translation of the SSQ, but rather to a more general aspect.

Knowledge of ceiling performance has a potential impact on the interpretation of outcome measures, in particular when the maximum score of 10 out of 10 is not reached, even by subjects from a healthy, young, normal-hearing reference population, as observed in our NHS and in recent literature data. The NHS exhibited SSQ score patterns across items that were similar to those reported in the literature. Hence, the relative degree of difficulty from one question to another is not lost in translation in a very homogenous, young, normal-hearing group. However, a dip in scores for the *Spatial* subscale relative to the *Speech* and *Qualities* subscales is observed in only the NHS and is more pronounced in the F-SSQ than other versions, especially for questions #2.4 to #2.9. This effect may be due to the self-administered as opposed to interview format. Indeed, by comparing interview and mailing modes, Singh & Pichora-Fuller (2010) reported that the test-retest correlations of the *Spatial* subscale (more than the other subscales) dropped from 0.86 in an interview/interview format to 0.56 in a mail/mail format and suggested the importance of the clarification of contexts by the interviewers. However, reproducibility of scores between the F-SSQ and both the D-SSQ and the E-SSQ was quite high across both *Speech* and *Spatial* subscales, with higher reproducibility for the *Speech* subscale. Banh et al (2012) observed a very good reproducibility of the pattern of scores across items between two normal-hearing populations of different ages, with the highest reproducibility for the *Speech* scale (Pearson  $r$  at 0.93). The reproducibility between different language versions was observed for the variability of the item scores as well (i.e., highly variable items in one language were highly variable in another language) with the same result: higher reproducibility for the *Speech* scale and low reproducibility for the *Qualities* subscale, with no significant correlation between the standard deviations of item scores in the NHS from one language version to the others. The

communalities obtained for the items of that subscale were somewhat lower than the others, both for the F-SSQ and the E-SSQ, and the rate of missing responses tended to be higher. As the present work shows that several aspects of the SSQ are common between languages, with the same items often somewhat failing their intended purpose, it seems possible to develop a short form version that would be compatible across several languages (Arlinger, 2000). A companion paper (Moulin & Richard, 2015) deals with the different sources of variability of SSQ scores, including different short form scores, in the same NHS and HIS population.

## **Conclusion**

This study aimed to validate a French-language version of the SSQ and to compare psychometric properties of the SSQ across versions in different languages. The very good reproducibility of the SSQ across subject groups, administration modes and different countries/languages confirmed its potential as an international standard for hearing disability and hearing aid benefit evaluation.

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### **Declaration of conflict of interests**

None declared. The sponsors for this study did not have any involvement in the design of the study, protocol, data analysis, nor the writing of the paper.

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## **Supplementary material**

### **Appendix 2: Data and supplementary results**

### **Appendix 1: French version of the SSQ**

	Item	NH subjects			r item/total correlations	
		mean	SD	-2SD	NH	HI
	1	8.8	1.6	5.6	0.62	0.70
	2	9.9	1.1	7.7	0.38	0.70
	3	9.6	0.7	8.1	0.42	0.74
	4	8.7	1.4	5.8	0.50	0.80
	5	9.3	1.1	7.0	0.62	0.80
	6	7.5	1.8	4.0	0.63	0.76
<b>Speech</b>	7	9.1	1.3	6.5	0.52	0.70
	8	7.9	1.9	4.0	0.71	0.69
	9	8.2	1.7	4.8	0.84	0.75
	10	6.0	2.4	1.3	0.59	0.69
	11	7.8	1.8	4.2	0.78	0.80
	12	9.2	1.3	6.7	0.55	0.78
	13	9.7	1.2	7.3	0.59	0.69
	14	6.2	2.3	1.7	0.55	0.69
	1	7.7	2.1	3.5	0.68	0.78
	2	8.2	1.7	4.7	0.72	0.81
	3	9.6	0.9	7.9	0.56	0.75
	4	7.7	2.1	3.5	0.80	0.77
	5	7.6	2.2	3.1	0.74	0.80
	6	7.9	2.1	3.7	0.80	0.74
	7	7.6	2.0	3.6	0.78	0.77
<b>Spatial</b>	8	6.9	2.0	2.8	0.80	0.79
	9	6.8	2.2	2.3	0.80	0.79
	10	7.9	2.2	3.4	0.58	0.78
	11	8.0	1.9	4.2	0.58	0.80
	12	8.6	1.6	5.4	0.71	0.82
	13	8.3	1.8	4.7	0.77	0.81
	14	8.9	2.1	4.8	0.44	0.54
	15	7.4	3.2	1.0	0.46	0.55
	16	7.7	3.0	1.6	0.57	0.58
	17	7.9	1.6	4.6	0.79	0.81
	1	9.3	1.5	6.3	0.64	0.58
	2	9.0	1.4	6.2	0.74	0.80
	3	9.2	1.3	6.5	0.73	0.82
	4	9.5	0.9	7.7	0.55	0.74
	5	9.5	1.0	7.5	0.39	0.75
	6	9.5	0.9	7.8	0.62	0.79
	7	8.0	2.0	4.0	0.40	0.69
<b>Qualities</b>	8	9.3	2.0	5.3	0.61	0.74
	9	9.3	1.2	7.0	0.69	0.80
	10	9.5	0.9	7.7	0.70	0.78
	11	8.6	3.0	2.6	0.47	0.72
	12	8.9	2.1	4.7	0.57	0.58
	13	8.5	1.3	5.9	0.56	0.59
	14	8.5	1.5	5.5	0.52	0.56
	16	8.7	1.6	5.5	0.65	0.63
	17	8.9	2.7	3.4	0.62	0.75
	18	9.5	1.0	7.5	0.43	0.77
	19	8.1	1.8	4.4	0.56	0.63

			NH subjects			Spearman correlations with SSQ		Cronbach 's alphas		Readability Gunning-Fog index		Readability Flesh-Kincaid index	
			mean	SD	- 2 SD	NH	HI	NH	HI	E-SSQ	F-SSQ	E-SSQ	F-SSQ
<b>Total</b>	<b>Total</b>	49 SSQ	8.46	1.00	6.46	1	1	0.97	0.98	8.1	7.7	11.0	10.5
<b>main subscales</b>	<b>Speech</b>		8.42	1.02	6.38	0.84	0.90	0.91	0.96	8.7	7	11.8	10.6
	<b>Spatial</b>		7.92	1.46	5.00	0.93	0.92	0.93	0.97	6.6	7.5	9.3	9.7
	<b>Qualities</b>		8.99	0.90	7.19	0.84	0.93	0.95	0.96	7.5	8.9	8.9	11.8
<b>Pragmatic Subscales (Gatehouse &amp; Akeroyd, 2006)</b>	<b>Speech Domain</b>	SiQ	9.76	0.50	8.75	0.41	0.79						
		SiN	8.56	1.19	6.19	0.76	0.86						
		SiSCont	8.23	1.44	5.35	0.78	0.83						
		MultStream	7.15	1.61	3.93	0.71	0.84						
	<b>Spatial Domain</b>	LOC	8.12	1.64	4.83	0.87	0.88						
		DisMOV	7.67	1.58	4.51	0.90	0.89						
	<b>Qualities Domain</b>	SegSnd	9.15	1.29	6.57	0.65	0.80						
		IdSnd	9.01	0.83	7.35	0.69	0.77						
		Qlty	9.15	1.12	6.90	0.68	0.80						
		Effort	8.16	1.48	5.20	0.68	0.74						

## Questionnaire d'habiletés auditives

### Conseils pour répondre aux questions

Les questions suivantes concernent vos capacités et votre expérience en matière d'audition et d'écoute dans le cadre de situations diverses.

Pour chacune des questions, vous devez mettre la réponse sur l'échelle située à droite, à l'aide d'une croix, à l'endroit choisi entre 0 et 10. Une croix sur la valeur 10 signifie que vous êtes parfaitement capable de faire ce qui est décrit dans la question correspondante. Une croix sur la valeur 0 indique que vous ne pouvez pas faire ce qui est décrit.

### Exemple :

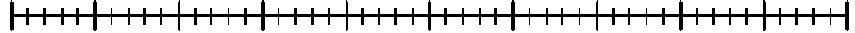
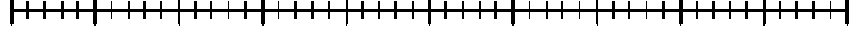
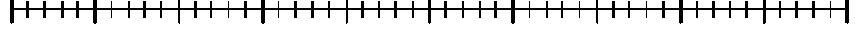
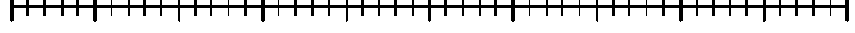
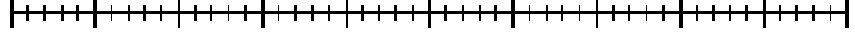
<p>0. Vous pouvez suivre une conversation avec une personne en face de vous, dans le calme.</p>	<p style="text-align: center;"><i><b>Non, pas du tout</b></i> <span style="float: right;"><i><b>Oui, parfaitement</b></i></span></p> <p style="text-align: center;"> ----- ----- ----- ----- ----- ----- ----- ----- ----- ----- </p> <p style="text-align: center;">0   1   2   3   4   5   6   7   8   9   10   <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
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*La question 0 se rapporte à votre capacité de suivre une conversation. Si vous êtes tout à fait capable de le faire, placez une croix sur l'extrémité droite de l'échelle, sur le nombre 10. Si vous êtes capable de suivre environ la moitié de la conversation dans une telle situation, placez la marque vers le milieu de l'échelle (le 5) et ainsi de suite. Si vous n'arrivez pas du tout à suivre une conversation, placez la croix sur le 0, à gauche de l'échelle.*

Nous espérons que toutes les questions sont pertinentes au regard de votre vie quotidienne. Si ce n'est pas le cas pour certaines questions, veuillez cocher la case « non applicable ». Merci de bien vouloir expliquer en quelques mots à côté de la question la raison pour laquelle elle n'est pas pertinente dans votre cas.

Date: \_\_\_\_\_

**1ère partie : Audition de la parole**


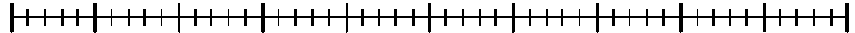
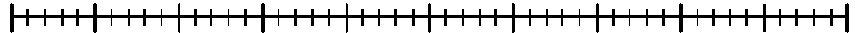

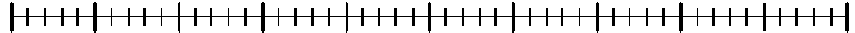
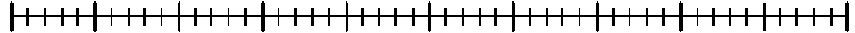
<p>1. Vous discutez avec une autre personne dans une pièce dans laquelle un téléviseur est allumé. Pouvez-vous suivre les propos de votre interlocuteur sans baisser le son du téléviseur ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>             0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/> </p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>2. Vous discutez avec quelqu'un dans un salon calme et dont le sol est recouvert de moquette. Pouvez-vous suivre ce que dit cette personne ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>             0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/> </p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>3. Vous êtes assis autour d'une table avec un groupe de cinq personnes environ. L'endroit est calme. Vous pouvez voir toutes les personnes du groupe. Pouvez-vous suivre la conversation ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>             0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/> </p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>4. Vous êtes assis autour d'une table avec un groupe de cinq personnes environ, dans un restaurant animé. Vous pouvez voir toutes les personnes du groupe. Pouvez-vous suivre la conversation ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>             0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/> </p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>5. Vous discutez avec une autre personne. Il y a un bruit de fond continu (ventilateur ou eau qui coule par exemple). Pouvez-vous suivre ce que dit l'autre personne ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>             0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/> </p> <p style="text-align: right;"><i>Non applicable</i></p>

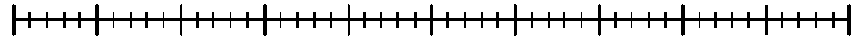
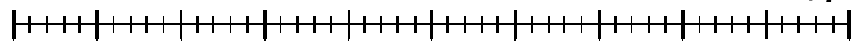
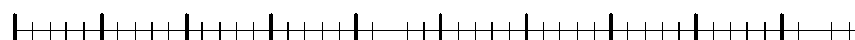

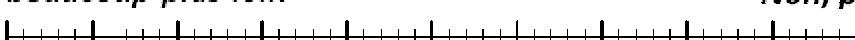







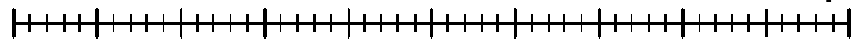
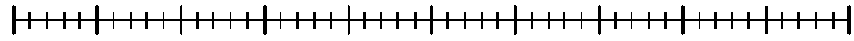
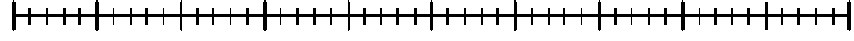
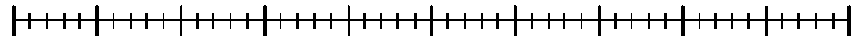
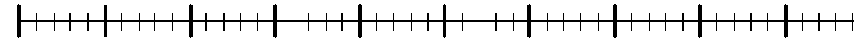
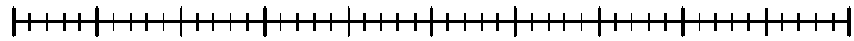


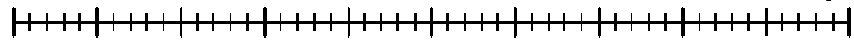
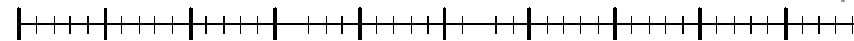

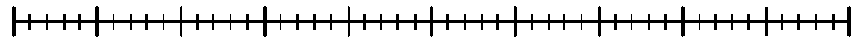
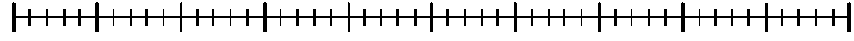
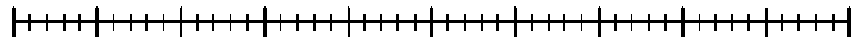
<p>6. Vous êtes à l'extérieur. Un chien aboie bruyamment. Pouvez-vous indiquer immédiatement où il se trouve, sans regarder ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>7. Vous êtes sur le trottoir d'une rue animée. Pouvez-vous entendre immédiatement de quelle direction un bus ou un camion arrive avant de l'avoir vu ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>8. Dans la rue, pouvez-vous dire à quelle distance se trouve une personne uniquement au son de sa voix ou de ses pas ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>9. Pouvez-vous indiquer à quelle distance se trouve un bus ou un camion, juste en entendant le bruit qu'il fait ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>10. Pouvez-vous dire, à partir du bruit fait par un bus ou un camion, dans quel sens il se déplace, par exemple de votre gauche à votre droite ou inversement ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>11. Pouvez-vous indiquer dans quelle direction une personne se déplace, uniquement au son de sa voix ou de ses pas, par exemple de votre gauche à votre droite ou inversement ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>

<p>12. Pouvez-vous dire si une personne s'éloigne ou se rapproche de vous, uniquement à partir de sa voix ou du bruit de ses pas ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>13. Pouvez-vous dire si un bus ou un camion s'éloigne ou se rapproche de vous, uniquement à partir du bruit qu'il fait ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>14. Avez-vous l'impression que les bruits et sons que vous entendez se trouvent plutôt à l'intérieur de votre tête ou plutôt dans le monde extérieur ?</p>	<p><i>A l'intérieur de ma tête</i> <span style="float: right;"><i>Dans le monde extérieur</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>15. Les choses ou les personnes que vous entendez et que vous ne pouvez pas voir dans un premier temps sont-elles généralement <u>plus près de vous</u> que vous ne l'aviez imaginé avant de les voir ?</p>	<p><i>Oui, beaucoup plus près</i> <span style="float: right;"><i>Non, pas plus près</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>16. Les choses ou les personnes que vous entendez et que vous ne pouvez pas voir dans un premier temps sont-elles <u>plus éloignées</u> que vous ne l'aviez imaginé avant de les voir ?</p>	<p><i>Oui, beaucoup plus loin</i> <span style="float: right;"><i>Non, pas plus loin</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>17. Pouvez-vous évaluer correctement l'endroit d'où les sons proviennent ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>

**3ème partie : Qualité d'audition**

<p>1. Imaginez que vous entendez deux choses en même temps, par exemple de l'eau qui coule dans un lavabo et la radio. Avez-vous l'impression que ces deux bruits sont parfaitement distincts l'un de l'autre ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p> ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>2. Lorsque vous entendez plusieurs sons à la fois, pouvez-vous les distinguer clairement les uns des autres ou avez-vous l'impression qu'il s'agit d'un seul bruit confus ?</p>	<p><i>Un bruit confus</i> <span style="float: right;"><i>Sons distincts</i></span></p> <p> ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>3. Vous vous tenez dans une pièce et vous entendez de la musique à la radio. Une autre personne parle dans la pièce. Entendez-vous la voix de la personne comme clairement séparée de la musique ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p> ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>4. Pouvez-vous reconnaître facilement les différentes personnes que vous connaissez, au son de leur voix ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p> ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>5. Pouvez-vous reconnaître facilement les différents morceaux de musique que vous connaissez ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p> ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>6. Pouvez-vous différencier certains bruits, par exemple une voiture par rapport à un bus ou de l'eau qui bout par rapport à la nourriture qui frit dans une poêle ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p> ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ ++++ </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>

<p>7. Lorsque vous écoutez de la musique, pouvez-vous discerner les différents instruments ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>8. Lorsque vous écoutez de la musique, est-ce qu'elle vous semble claire et naturelle ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>9. Les bruits quotidiens que vous entendez facilement, vous semblent-ils clairs et distincts (non brouillés, non mélangés) ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>10. Les voix des autres personnes vous semblent-elles claires et naturelles ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>11. Les bruits quotidiens que vous entendez vous paraissent-ils naturels ou artificiels ?</p>	<p><i>Artificiels</i> <span style="float: right;"><i>Naturels</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>12. Votre propre voix vous semble t'elle naturelle ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p>  <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>

<p>13. Pouvez-vous facilement juger de l'humeur d'une personne au son de sa voix ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>14. Devez-vous vous concentrer intensément lorsque vous écoutez quelqu'un ou quelque chose ?</p>	<p><i>Oui, concentration intense</i> <span style="float: right;"><i>Non, pas du tout</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>15. Devez-vous faire beaucoup d'efforts pour comprendre ce qui se dit au cours d'une conversation avec d'autres personnes ?</p>	<p><i>Oui, beaucoup d'efforts</i> <span style="float: right;"><i>Non, aucun effort</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>16. Lorsque vous conduisez une voiture, pouvez-vous facilement entendre ce que dit la personne assise à côté de vous ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>17. Lorsque vous êtes passager d'une voiture, pouvez-vous facilement entendre ce que dit le conducteur assis à côté de vous ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>
<p>18. Pouvez-vous ignorer facilement les autres bruits, lorsque vous essayez d'écouter quelque chose ?</p>	<p><i>Non, pas du tout</i> <span style="float: right;"><i>Oui, parfaitement</i></span></p> <p>  </p> <p>0 1 2 3 4 5 6 7 8 9 10 <input type="checkbox"/></p> <p style="text-align: right;"><i>Non applicable</i></p>