Turkish Validity and Reliability Study of the Speech, Spatial and Qualities of Hearing Scale

Original Investigation

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Abstract

Objective: The Speech, Spatial and Qualities of Hearing Scale (SSQ) is a self-report scale that evaluates hearing in complex daily life situations in the areas of hearing quality, speech perception, and spatial perception. It is also frequently used in the follow-up of hearing-impaired people, hearing aid and cochlear implant users. It is aimed to translate and adapt SSQ into Turkish, and to investigate its test-retest reliability, and construct validity and reliability, and further to present associations of SSQ scores with the pure tone averages (PTA).

Methods: The Turkish SSQ (Tr-SSQ) scale was administered on 114 adults including those with and without hearing loss. Cronbach's alpha was used to assess its reliability. The reliability coefficient of the scale was calculated by test-retest method. Associations of SSQ scores with PTAs in better and worse hearing ears (BHE and WHE) were evaluated.

Results: Tr-SSQ presented high internal consistency (Cronbach's alpha = 0.984) and test-retest reliability (r=0.994). Tr-SSQ scores were lower in the subjects with hearing loss and correlated with PTAs. Age was found to be correlated with PTAs; regression analysis demonstrated that only WHE-PTA was extracted as explanatory variable for average Tr-SSQ, speech perception and spatial perception scores while both BHE-PTA and WHE-PTA were found to be predictors of hearing quality, but not age for any of Tr-SSQ scores.

Conclusion: Tr-SSQ is a convenient tool for assessing the hearing abilities of individuals with hearing impaired.

Keywords: Hearing loss, self-report, audiology, questionnaire, pure tone audiometry, reproducibility of results

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Introduction

Hearing is one of the most important senses that connect man to the outside world. "Normal" hearing is necessary to ensure adequate and effective communication and adaptation to the environment. Restoration of communication via hearing needs more refined auditory functions and this is the most difficult aspect of

the audiologic intervention and rehabilitation. Routine clinical audiological evaluation for hearing covers pure tone audiometry and speech audiometry including also speech in noise tests, which are the subjective tests; and the objective tests such as (immitancemetric measurements, otoacoustic emissions, and auditory brainstem response tests). By using these assessment methods, audiologists can manage to make diagnosis about the type, degree, and localization of hearing loss and intervention. However, these tests provide limited information about the impact of hearing loss on people and their daily lives (1-4); therefore, intervention strategies recommended to the subjects suffering from hearing impairment may not meet the exact needs of those subjects when only these tests are used.

The self-report scales, which are self-evaluated and graded by the patient about their own illnesses, handicaps and/or health problems have an important role in the evaluation of patients in the field of health (5, 6). These scales contain substances that are standardized in different areas and provide reliable and comprehensive information in the clinic. Furthermore, they ensure that the effectiveness of the therapy and/or treatment is concrete and measurable. Such scales that evaluate complaints about hearing are closely associated with the person's perception of his or her hearing disability and the healing process. Speech, Spatial and Qualities of Hearing Scale (SSQ) was developed by William Noble and Stuart Gatehouse in 2004 to evaluate the sub-components of hearing and quality of hearing in adults and to determine the level of disability perception of the current hearing problem. It is an assessment tool that allows self-evaluation of a wide range of hearing reality in everyday life (7).

The SSQ scale includes 3 sub-scales which are speech perception, spatial perception, and qualities of hearing (7). The developers declare that the first subscale, "Speech", measures the ability to understand, discriminate and follow the speech sounds. As stated by Gatehouse and Noble (7), the second subscale, "Spatial", presents the data about the ability to determine the direction, distance and mobility of the audible voice, and "Qualities" is the third subscale of SSQ which contains items about the identifiability of simultaneous sounds experienced in daily life and provides quantity for the clarity, naturalness, comprehensibility, and effort of hearing. Gatehouse and Noble (7) pointed out that the elements in Qualities subscale were to some extent driven by capacities in the speech and space domains, as well. In each item, complex listening conditions from daily life are described and the person is asked to evaluate his/her hearing by imagining this situation.

The translated versions of SSQ scale have been widely used in the Western languages [in Dutch by (8); in German by (9); in French by (10), in Portuguese by (11)], and in Columbian Spanish by (12), and in the Eastern languages [in Korean by (13); in Malay by (14) and in Persian by (15)]. By using the SSQ scale, the data about the efficacy of amplification by hearing aids, cochlear implants and bone-conducted hearing aids (16), advantages of bilateral hearing aids (17-19), effects of aging on hearing (20-21) have been documented.

Turkish version of SSQ scale has not been developed yet; therefore, the aim of this study is to translate and culturally adapt SSQ into Turkish, and to investigate its test/retest reliability, and construct validity and reliability.

Methods

This study was carried out at the audiology center of a university hospital between December 15th, 2015 and May 25th, 2017. The written informed consent was obtained from all the participants of the study. The study design and the consent form were approved by the Clinical Research Ethics Committee of Gazi University under protocols 77082166-604.01.02.

In this study, the original English version of SSQ scale was used (7). The first step of the process was translation and back translation. Then test validation and the test reliability studies were performed.

In the first step of the study, translation of SSQ into Turkish was done by the first translator, and then the second translator performed the back translation into English. Both translators were bilingual native Turkish speakers. A committee composed of two audiologists and an experienced bilingual translator reviewed the preliminary Turkish version of the SSQ. This version was applied to 20 participants who were randomly selected. Then their recommendations about the clarity, content and order of the questions were examined and Turkish version of the SSQ (Tr-SSQ) was completed by making minor changes in line with these recommendations. The Tr-SSQ, which was named as KUİK (Konuşma, Uzaysal Algı ve İşitme Kalitesi Ölçeği) (Appendix 1) in Turkish, comprised 49 items and 3 sub-scales which are speech perception, spatial perception and qualities of hearing, as in the original one (7). In each item, complex listening conditions from daily life are described and the person is asked to evaluate his or her hearing by imagining this situation. Each item in the scale is scored from "0" to "10"; "10" points indicate that the skill can be performed perfectly in the situation described, "0" point indicates that the described thing cannot be done.

The next step was the construct validity. The reliability coefficient of the scale was calculated by test-retest method. For these steps, Tr-SSQ scale was applied to volunteers aged between 18 and 55 years. The subjects were recruited from the patients suffering from hearing loss in the department, their relatives accompanying them and the staff or students of the university hospital. The literate subjects with normal

otoscopic examination were included. The exclusion criteria for the study were as follows: abnormal tympanogram, conductive and/or mixed type-hearing loss, inadequate cognitive ability to fill the scale, and inability to complete the survey.

At this stage, the participants were informed, a quiet environment was provided, and sufficient time was given for them to fill out the scale. Each participant completed the scale independently. The construct validity of the Tr-SSQ Scale was calculated via factor analysis, and the internal consistency reliability was calculated via Cronbach's alpha (α) coefficient. The reliability coefficient of the scale was calculated via test-retest method. The invariance of the scale according to time was evaluated by using the same method. At this stage, randomly selected 60 participants were re-tested four weeks after the first application of the scale. Pearson test was used for test-retest reliability analysis. In order to test the homogeneity of variances, Levene's test was used. According to the result of the Levene's tests, homogeneity or non-homogeneity of variances for the groups were determined and independent two sample t-test was conducted. By using analysis of variance test, the differences between groups were assessed. Average SSQ score is calculated by summing all item scores and dividing by 49. Speech, Spatial and Qualities scores in the Tr-SSQ are obtained by dividing the total score in each subscale by the number of items in the subscale, which results in14 items for Speech, 17 for Spatial and 18 for Qualities, respectively, as originally described by Gatehouse and Noble in 2004 (7).

The audiological evaluation was performed by using calibrated clinical audiometer (Interacoustic AC-40) with Telephonics TDH 49 headphones in a quiet soundproof room. Pure tone audiometry performed between frequencies 125-8,000 Hz, pure tone average (PTA) was calculated between frequencies of 500-4,000 Hz. While the subjects presenting PTA over 15 dB-HL in one or two ears without any gap higher than 10 dB-HL between air and bone thresholds were included in the sensorineural hearing loss (SNHL) subgroup. Those with PTA lower or equal to 15 dB-HL in both ears were included in the normal hearing (NH) subgroup. Then, PTA of the better hearing ears (BHE) and worse hearing ears (WHE) of each subject were calculated to test the relationship of SSQ score with hearing levels, and to find out the relationship between SSQ scores and audiological variables by using correlation and regression tests.

Statistical analyses were performed using the e Statistical Package for the Social Sciences 21 for Windows (SPSS Inc., Armonk, NY, USA), p-values ≤0.05 were considered significant. The evaluation of distribution of variables was investigated using Kolmogorov-Simirnov/Shapiro-Wilk's tests. As the A correlation analyses were performed between groups of subjects and SSQ score and subscale scores, age, and hearing loss with Spearman correlation test. Linear regression analyses were used to identify predictors of Tr-SSQ scores.

Results

Validity-Reliability

As a result of the factor analysis of the participants' responses to 49 items, it was seen that the responses to the items were expressed with a total of four factors. For each item, four factor values are given in the Table 1.

The questionnaire had a high level of internal consistency with a 0.984 Cronbach's alpha value. In the first column of Table 2, the effect on the scale score mean when the item is removed and in the last column the change of Cronbach's Alpha value when the item is removed are shown. As can be seen, the removal of any items from the questionnaire did not increase the number of Alpha higher than the initial value shown in Table 2.

The reliability coefficient of the scale was calculated by test-retest method. Test–retest interval was four weeks with 60 participants. The Pearson correlation coefficient between the first and second assessment for Tr-SSQ scale scores were r=0.994, p=0.00, for Speech scale r=0.987, p=0.00 for Spatial scale r=0.989, p=0.00 for Qualities scale r=0.982 p=0.00. They were very close to +1. In this case, it has been determined that our scale is a steady and consistent measure which is not based on time. These findings showed that Tr-SSQ scale demonstrated high test-retest reliability and the measurement accuracy of the scale did not change radically over time.

Of 114 participants (female: 62, mean age: 34.9±9.4; male: 52, mean age: 36.3±10.9) enrolled in this study, 53 (female: 27, mean age: 39.3±11.4; male: 26, mean age: 38.3±10.5) were diagnosed with SNHL (bilateral: 40, unilateral: 13); (Table 3), while 61 (female: 36, mean age: 32.5±7.8; male: 25, mean age: 33.0±9.5) had NH in both ears. Means of BHE-PTA and WHE-PTA are presented in Table 3. There was no difference in female/male ratio between the subjects in SNHL and NH subgroups (x^2 test, p=0.544) (Table 3). Age was significantly lower in NH subjects than those with SNHL (Mann-Whitney U test, p=0.002), and age was correlated with both BHE-PTA (r=0.373 p=0.00) and WHE-PTA (r=0.340 p=0.00) in the total group, but not in the subgroups (p> 0.05).

In Table 4, no difference in average SSQ score and subscale scores was detected between males and females in either total group or the subgroups (Student t-test, p>0.05). Mann-Whitney U tests showed that average Tr-SSQ and subscale scores of the NH and bilateral SNHL groups were different, p=0.00 for all pairs. It was observed that average Tr-SSQ, Speech, Spatial and Qualities scores were significantly

Table 1. Factor values of items

Items	Factor					
	1	2	3	4	5	6
Speech-1	0.550	0.455	0.314	0.323	0.173	0.112
Speech-2	0.754	0.286	0.138	0.143	0.083	0.156
Speech-3	0.597	0.456	0.310	0.100	0.102	0.133
Speech-4	0.434	0.686	0.287	0.049	0.189	0.039
Speech-5	0.466	0.639	0.334	0.142	0.186	-0.010
Speech-6	0.238	0.701	0.414	0.249	-0.031	0.123
Speech-7	0.444	0.724	0.263	0.271	0.039	0.052
Speech-8	0.316	0.684	0.227	0.017	0.323	0.040
Speech-9	0.393	0.708	0.245	0.200	0.159	0.121
Speech-10	0.190	0.751	0.267	0.284	0.247	-0.010
Speech-11	0.340	0.733	0.286	0.286	0.032	0.031
Speech-12	0.299	0.744	0.303	0.328	0.117	-0.068
Speech-13	0.758	0.242	0.154	0.242	0.115	0.106
Speech-13	0.207	0.647	0.439	0.334	0.157	-0.097
Spatial-1	0.491	0.336	0.533	0.026	0.378	0.059
Spatial-2	0.559	0.305	0.458	0.063	0.330	0.112
Spatial-3	0.764	0.151	0.362	0.135	0.155	0.124
Spatial-4	0.584	0.236	0.580	0.072	0.236	-0.014
Spatial-5	0.409	0.261	0.636	0.214	0.284	-0.039
Spatial-6	0.368	0.302	0.646	0.196	0.262	0.137
Spatial-7	0.404	0.305	0.508	0.321	0.100	-0.087
Spatial-8	0.248	0.289	0.708	0.291	0.024	-0.047
Spatial-9	0.306	0.288	0.717	0.302	0.051	0.005
Spatial-10	0.188	0.318	0.808	0.233	0.012	-0.064
Spatial-11	0.169	0.434	0.777	0.206	0.026	0.075
Spatial-12	0.466	0.234	0.671	0.121	0.169	0.172
Spatial-13	0.458	0.202	0.701	0.153	0.210	0.211
Spatial-14	0.128	0.153	0.227	0.300	0.746	0.114
Spatial-15	0.193	0.231	0.369	0.561	0.392	0.203
Spatial-16	0.153	0.126	0.279	0.628	0.308	0.339
Spatial-17	0.367	0.289	0.531	0.545	0.101	0.094
Qualities-1	0.796	0.203	0.321	0.123	0.200	0.048
Qualities-2	0.298	0.306	0.043	0.055	0.631	-0.260
Qualities-3	0.709	0.379	0.151	0.196	0.272	0.010
Qualities-4	0.776	0.265	0.309	0.200	0.133	0.156
Qualities-5	0.139	0.034	0.057	0.066	-0.028	0.836
Qualities-6	0.770	0.178	0.313	0.164	0.091	0.160
Qualities-7	0.615	0.420	0.380	0.111	0.107	-0.035
Qualities-8	0.647	0.356	0.372	0.384	-0.003	0.044
Qualities-9	0.685	0.330	0.254	0.454	-0.014	0.011

Table 1. contiuned

Qualities-10	0.650	0.350	0.253	0.520	-0.044	-0.126
Qualities-11	0.516	0.332	0.232	0.591	0.171	-0.059
Qualities-12	0.589	0.212	0.347	0.352	-0.042	-0.169
Qualities-13	0.672	0.448	0.171	0.048	0.257	-0.133
Qualities-14	0.312	0.421	0.270	0.612	0.106	0.054
Qualities-15	0.470	0.432	0.305	0.523	0.105	0.005
Qualities-16	0.692	0.340	0.248	0.446	0.054	-0.101
Qualities-17	0.689	0.307	0.261	0.350	0.120	-0.127
Qualities-18	0.353	0.441	0.277	0.475	0.123	-0.158

higher in NH subgroup than in the subjects with SNHL (p=0.00) for three comparisons. Qualities subscale showed highest score in all three group. Due to the small sample size of the unilateral NH group, no comparison was performed with this group.

The correlation analysis disclosed that age was correlated with SSQ scores in total group (Spearman's test; r=-0.258 (p=0.006) (Table 5), but not in the subgroups (Spearman's test, p>0.05). As presented in Table 5, the SSQ scores in all subjects and those with bilateral SNHL were significantly correlated with PTA values in a negative direction (Spearman's test). In the subjects with NH, WHE-PTA was correlated with total SSQ, Speech and Qualities scores while BHE-PTA was only correlated with Qualities score. Qualities score presented highest correlations in all groups.

Stepwise regression analysis including age, BHE-PTA and WHE-PTA revealed that only WHE-PTA was extracted as explanatory variable for Tr-SSQ (R^2: 0.464; B: -0.036; p<0.0001), Speech (R^2: 0.367, B: -0.4, p= 0.001) and Spatial: (R^2: 0.392, B: -0.34, p=0.002). For Qualities, both WHE-PTA and BHE-PTA were found to be its predictors (R^2: 0.499; for WHE-PTA B: -0.35, p=0.001; for BHE-PTA, B: -0.026; p=0.03). When age was taken out from the independent variable list, no explanatory variable change was seen. When WHE-PTA was taken out, BHE-PTA was appeared as the only explanatory variable for all SSQ scores.

Discussion

The data of this study clearly supports that SSQ can be conveniently used for the assessment of hearing handicap in everyday complex situations in Turkish, as in other languages (7-9, 11-15).

In the adaptation study conducted by Moulin et al. (10), it was determined that the scale had four factors and Cronbach's Alpha coefficient was found to be 0.91. In our study, the validity of the scale was determined by factor analysis in parallel with these studies and it was revealed that 49 items in the scale were expressed with four factors. The internal consistency of the scale was calculated as Cronbach's alpha coefficient and found to be 0.984 or 98.4%. Since this result is higher than the 70% threshold, it can be said that the internal consistency of the survey is quite high. Moreover, in this study, test- retest method was used to determine the reliability of the scale. Reliability is a concept associated with the test-retest sub-assessment and the stability of the tool used. The high value of reliability is one of the important assessment points for any measurement tools. In our study, Tr-SSQ scale was administered to the same participants twice with an interval of approximately four weeks. The correlation between the scores obtained from these two evaluations was analysed and r=0.813 was found (p<0.001), which was in accordance with the original study (7).

In our study, the subjects with NH were younger than those with SNHL, as in the previous studies (8-10). Demeester et al. (8) presented the data of young subjects with normal hearing, the older subjects with clinically normal hearing according to PTA, and the older subjects with hearing loss. Maulin et al. (10) compared difficulty SSQ scores between normal hearing subjects and those with hearing impairment and demonstrated that it is higher in the subjects with hearing loss (mean age: 54.2) then in normal hearing subjects (mean age: 20.8).

Mean average SSQ scores in our study, found in the subjects with bilateral normal hearing and unilateral and bilateral hearing loss (8.1, 7.1, and 6.0, respectively), were in accordance with the previous studies. In the study of Demeester et al. (8) mean average SSQ in young subjects (18–25 years of age) with normal hearing and clinically normal hearing subjects between 55 and 65 years of age were 8.8 and 8.1, respectively. Banh et al. (20) also compared normal hearing young and older adults and reported that younger adults with mean age of 19 years presented higher scores (8.8) than older adults (7.7). Mean of average SSQ in our NH subgroup composed of the subjects aged between 18 and 50 years (mean age: 32.7) was 8.1.

Table 2. Change of Cronbach's alpha value for 49 items in the scale

Item	Total mean when item is removed	Total variance when item is removed	Item total correlation coefficient	Coefficient of multiple determination (R2)	Cronbach's when item is removed
Speech-1	7.10	6703.14	0.851	0.861	0.983
Speech-2	7.13	6771.25	0.717	0.864	0.984
Speech-3	7.14	6730.26	0.780	0.891	0.984
Speech-4	7.15	6715.79	0.786	0.864	0.984
Speech-5	7.16	6679.58	0.834	0.884	0.983
Speech-6	7.17	6694.87	0.768	0.856	0.984
Speech-7	7.16	6672.77	0.850	0.912	0.983
Speech-8	7.15	6741.82	0.698	0.854	0.984
Speech-9	7.15	6708.59	0.803	0.890	0.984
Speech-10	7.17	6683.10	0.755	0.899	0.984
Speech-11	7.16	6677.33	0.806	0.898	0.984
Speech-12	7.16	6660.30	0.819	0.904	0.984
Speech-13	7.14	6741.77	0.746	0.823	0.984
Speech-13	7.17	6678.93	0.790	0.870	0.984
Spatial-1	7.15	6711.14	0.798	0.874	0.984
Spatial-2	7.15	6722.35	0.789	0.881	0.984
Spatial-3	7.14	6727.17	0.777	0.898	0.984
Spatial-4	7.15	6703.04	0.803	0.901	0.984
Spatial-5	7.16	6707.37	0.797	0.900	0.984
Spatial-6	7.15	6697.46	0.801	0.849	0.984
Spatial-7	7.16	6711.24	0.753	0.831	0.984
Spatial-8	7.16	6737.72	0.725	0.871	0.984
Spatial-9	7.16	6727.61	0.777	0.911	0.984
Spatial-10	7.16	6713.50	0.722	0.898	0.984
Spatial-11	7.16	6700.46	0.762	0.929	0.984
Spatial-12	7.15	6737.66	0.790	0.903	0.984
Spatial-13	7.15	6729.10	0.810	0.930	0.984
Spatial-14	7.15	6787.72	0.513	0.723	0.984
Spatial-15	7.16	6749.13	0.681	0.805	0.984
Spatial-16	7.15	6783.46	0.573	0.785	0.984
Spatial-17	7.15	6701.50	0.824	0.899	0.984
Qualities-1	7.13	6722.39	0.801	0.916	0.984
Qualities-2	7.15	6808.75	0.468	0.568	0.984
Qualities-3	7.14	6701.35	0.797	0.866	0.984
Qualities-4	7.13	6725.85	0.839	0.898	0.984
Qualities-5	7.13	6866.28	0.173	0.737	0.984
Qualities-6	7.14	6742.43	0.773	0.878	0.984
Qualities-7	7.14	6712.52	0.804	0.886	0.984
Qualities-8	7.14	6685.58	0.870	0.926	0.983
Qualities-9	7.14	6712.25	0.841	0.944	0.984
Qualities-10	7.14	6702.83	0.835	0.952	0.984
Qualities-11	7.14	6706.90	0.811	0.866	0.984
Qualities-12	7.14	6767.23	0.712	0.842	0.984
Qualities-13	7.14	6754.83	0.758	0.885	0.984
Qualities-14	7.16	6665.76	0.752	0.860	0.984
Qualities-15	7.15	6640.46	0.838	0.900	0.983
Qualities-16	7.14	6688.65	0.849	0.921	0.983
Qualities-17	7.14	6700.29	0.813	0.869	0.984
Qualities-18	7.16	6703.15	0.732	0.769	0.984

Table 3. Mean age and audiological values (BHE-PTA and WHE PTA) of the subjects

Groups		Males: Females	Age (years)	BHE-PTA (dB HL)	WHE-PTA (dB HL)
NH subgroup (n=61)		25:36	32.7±8.5 (18–50)	6.4±3.6 (0–14)	8.4±4.2 (0–15)
Subjects with SNHL	Bilateral (n=40)	19:21	39.1±11.0 (18–50)	39.9±18.2 (16–88)	46.4±19.9 (18–90)
	Unilateral (n=13)	08:05	37.8±10.9 (18–50)	36.9±19.9 (5–15)	8.4±4.2 (18–85)
Total (n=114)		52:62	35.5±10.1	18.5±19.3	25.3±22.9

BHE, better hearing ears, n: Number of the subjects, NH: Normal hearing, PTA: Pure tone averages at 5,000 to 4,000 Hz, SNHL: Sensorineural hearing loss, WHE: Worse hearing ears

Table 4. SSQ scores in the study group

		Speech	Spatial	Qualities	Tr-SSQ
Gender	Males	7.2±1.7	7.3±1.7	7.7±1.7	7.4±1.7
	Females	6.7±1.9	6.8±1.7	7.6±1.8	7.1±1.7
NH subgroup (n=61)		7.8±1.4	7.8±1.3	8.5±1.0	8.1±1.1
Subjects with Bilateral SNHL (n=40)		5.9±2.0	5.8±1.7	6.3±2.1	6.0±1.8
All subjects (n=114)		7.0±1.8	7.0±1.7	7.6±1.8	7.2±1.7

BHE: Better hearing ears, n: Number of the subjects, NH: Normal hearing, PTA: Pure tone averages at 5,000 to 4,000 Hz, SNHL: Sensorineural hearing loss, Tr-SSQ: Average score over all items of speech, spatial and quality of hearing scale, WHE: Worse hearing ears

Table 5. Spearman's rho correlations of SSQ scores with age and audiological values

All subjects (n=114)				The subjects with bilateral SNHL (n=40)			The subjects with bilateral NH (n=61)		
	Age	BHE-PTA	WHE- PTA	Age	BHE- PTA	WHE- PTA	Age	BHE- PTA	WHE- PTA
Tr-SSQ	r=-0.258 p=0.006	r=-0.550 p=0.000	r= -0.654 p=0.000	r=0.103 p=0.528	r=-0.453 p=0.003	r=-0.518 p=0.001	r=-0.194 p=0.13	r=-0.231 p=0.073	r=-0.364 p=0.004
Speech	r=-0.212 p =0.024	r=-0.470 p=0.000	r= -0.581 p=0.000	r=0.124 p=0.44	r=-0.470 p=0.002	r=-0.520 p=0.001	r=-0.187 p=0.150	r=-0.234 p=0.069,	r=-0.37 p=0.003
Spatial	r=-0.246 p=0.008	r=-0.514 p=0.000	r=-0.602 p=0.000	r=0.114 p=0.484	r=-0.357 p=0.024	r=-0.460 p=0.003	r=0.147 p=0.259	r=-0.109 p=0.401	r=-0.218 p=0.092
Qualities	r=-0.301 p=0.001	r=-0.605 p=0.000	r=-0,696 p=0,000	r=0.066 p=0.688	r=-0.537 p=0.000	r=-0.602 p=0.000	r=-0.216 p=0.094	r=-0.333 p=0.009	r=-0.438 p=0.000

BHE: Better hearing ears, n: Number of the subjects, NH: Normal hearing, PTA: Pure tone averages at 5,000 to 4,000 Hz, SNHL: Sensorineural hearing loss, Tr-SSQ: Average score over all items of speech, spatial and quality of hearing scale, WHE: Worse hearing ears

Ages of the subjects with SNHL in our study were between 18 and 50 years, and Demeester et al. (8) documented that mean average SSQ score was 7.7 for the subjects with hearing loss between the ages of 55 and 65 years. In the study of Gatehouse and Noble (7) average SSQ score was 5.5 in the subjects with mean age of 71 years. In Iran, average SSQ was found to be 5.1 in the hearing-impaired subjects with a mean age of 62 (15).

Maulin et al. (10) compared SSQ scales in Dutch, German and French and reported that regardless of the language version considered, the pattern of the items was remarkably similar. They pointed out that a question with a lower score in one SSQ language would also have a low score in another language. They reported Qualities subscale as the most difficult and the spatial subscale as the easiest, and the best reproducibility was found for Speech and the worst was seen in Qualities. In the study of Demeester at al. (8), the highest score was obtained from Qualities subscale in all groups, like our findings. Noble and Gatehouse (17) also documented that the highest score in the subjects with SNHL was found in Qualities subscale. Although Speech presented the lowest score in both the studies of Demeester et al. (8) and Noble and Gatehouse (17) values of Speech and Spatial were very close to each other in our study.

Moulin and Richard (22) reported that correlation between BHE-PTA and total SSQ score were r=-0.56, speech r=-0.57, spatial r=-0.47, qualities r=-0.49, WHE-PTA and total ssq r=-0.52, speech r=-0.43, spatial r=-0.56, qualities r=-0.44 in SNHL group. They claimed that BHE-PTA predictor for scale score after regression analysis. According to their results SSQ and subscale scores decreased with increased PTA values. In our study both WHE-PTA (-0.52) and BHE-PTA (-0.45) correlated negatively with SSQ and subscale scores but in contrast to Moulin and Richard (22) WHE-PTA showed higher correlation for hearing impaired groups. NH group also showed significant and negative correlations with WHE-PTA except Spatial subscale. However, compared to hearing-impaired group, the NH group showed the smallest correlation with WHE-PTA (Table 5). This may be due to small changes in NH participants' PTA values (between 0–15 dB). On the other hand, our analyses on NH group BHE-PTA did not show any significant correlation between Tr-SSQ, Speech and Spatial scores except Qualities score. These values support the results of validation study of French version of SSQ (10). They stated that there was no significant correlation between NH's PTA values and SSQ scale/subscale scores. Zahorik and Rothpletz (23) pointed out that even young normal-hearing listeners did not necessarily rate their listening abilities at the top of the ability scale. As pointed out above, Demeester et al. (8) and Banh et al. (20) reported worse SSQ scores in the older subjects with clinically normal hearing than younger adults with normal hearing. Previously, Banh et al. (20) looked for correlations of SSQ scores with bilateral PTA and Words-in-Noise test thresholds in the normal hearing groups composed of younger and older adults, and reported that the younger adults showed significant correlation only between Speech and Words-in-Noise test thresholds while a positive correlation between Spatial and bilateral PTA was seen. The correlations we observed between SSQ scores and PTA could be either due to our normal hearing subgroup composed of the subjects between the ages of 18 and 50 years or the use of WHE-PTA and BHE-PTA instead of mean PTA values of the subjects.

Since age was also different between NH and SNHL subgroups, step-wise regression analysis was performed and it was seen that WHE-PTA value were predictors for SSQ score. Only Qualities subscale revealed both BHE-PTA and WHE-PTA as the predictors. Age was not observed as a predictor of SSQ scores in any setting.

In our study regression analysis and correlations showed that WHE-PTA was the stronger predictor than BHE-PTA. As expected, we found that as WE-PTA increased, the scale scores decreased. Noble and Gatehouse (24) researched the interaural asymmetry of hearing loss and they demonstrated that average SSQ score was negatively correlated with WHE-PTA (-0.40) and BHE-PTA (-0.43) in the subjects with symmetric hearing loss (24) which was in accordance with our data. But, since our unilateral sample was small, our data in this study was not useful to evaluate the interaural asymmetry.

The major limitation of our study, since number of individuals in the group with unilateral hearing loss was small, the scale and subscale scores in the unilateral subjects were not compared with other groups. As known, unilateral hearing loss has an important negative effect on hearing perception of the subjects in everyday life. For revealing this aspect future studies are necessary. Furthermore, the average age of the normal hearing was lower than in SNHL groups, and there were apparent correlations between age and PTA values in the better and worse ears; correspondingly age was negatively correlated with SSQ scores. However, age was not found as an explanatory variable of Tr-SSQ. These data also support that Tr-SSQ is directly related with only WHE-PTA, not in direct variables. Therefore, although age difference between the study groups was a drawback of this study, Tr-SSQ is a capable scale presenting directly hearing reality in everyday life.

Conclusion

In line with the other versions of SSQ in English, Dutch, German, French, Korean, Portuguese, Persian, Malay and Columbian Spanish, our data supports that Turkish version of SSQ (Tr-SSQ) is a convenient and reliable scale to screen hearing impaired people within the society before inviting to them to the clinics for audiological evaluation and to further evaluate the benefits supplied by hearing aids or cochlear implants via speech, spatial and quality aspects of hearing, which are important in daily life. Since all screening tools including screening of hearing loss recently become more and more popular during COVID-19 pandemic, Tr-SSQ would provide a great opportunity not only to audiologists and otolaryngologists but also to all healthcare professionals who are in charge of following hearing disability of the

special groups, such as people who are regularly exposed to noise in work or the elder subjects. However, as pointed out by Maulin and Richard (22), filling out the whole scale that is composed of 49 questions requires substantial cognitive effort and takes time. Therefore, the use of short SSQ form appears to be more optimistic for easy screening.

Ethics Committee Approval: The study design and the consent form were approved by the clinical research ethics committee of Gazi University under protocols 77082166-604.01.02.

Informed Consent: The written informed consent was obtained from all the participants of the study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: No conflict of interest was declared by the authors.

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Authorship Contributions

Conception: N.K., G.İ.Ş.K., İ.B., Design: N.K., G.İ.Ş.K., B.G., Supervision: B.G., İ.B., Data Collection and/or Processing: N.K., Analysis and/or Interpretation: N.K., G.İ.Ş.K., Y.K.K., Literature Review: N.K., G.İ.Ş.K., B.G., İ.B., Y.K.K., Writing: G.İ.Ş.K., Y.K.K., Critical Review: G.İ.Ş.K., B.G., İ.B., Y.K.K.

Main Points

- The SSQ Scale is a self-report scale, which evaluates hearing abilities in complex daily life situations.
- The Tr-SSQ Scale is a valid and reliable tool, presenting high internal consistency and test-retest reliability.
- Since the Tr-SSQ is a convenient scale to assess hearing loss, it could also be used for evaluating effectiveness of the hearing aids, cochlear implants, etc.

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Appendix 1. Konuşma, uzaysal algı ve işitme kalitesi (KUİK) ölçeği

KONUŞMA, UZAYSAL ALGI VE İŞİTME KALİTESİ (KUİK) ÖLÇEĞİ

Aşağıdaki soruların amacı günlük işitme koşullarınızdaki farklı durumlarda işitme ve dinleme yeteneğinizi ve deneyiminizi ortaya koymaktır. Her soru için, soruların karşısında gösterilen, "0" ila "10" aralığındaki ölçeğin herhangi bir noktasını çarpı (x) ile işaretleyin. "10" noktasına bir işaret koyulması, soruda tanımlanan şeyi kusursuz biçimde yapabilir durumda olduğunuz; "0" noktasına bir işaret koyulması ise tanımlanan şeyi yapamayacak durumda olduğunuz anlamına gelir. Örneğin, 1. soruda televizyon açıkken aynı anda biriyle sohbet edilmesi ile ilgili bir soru yöneltilmektedir. Eğer bunu yapabilecek durumdaysanız, ölçeğin sağ ucuna yakın bir yere işaret koyun. Böyle bir ortamda sohbetin yarısını takip edebilecek durumdaysanız, ortadaki bir noktaya işaret koyun ve diğer durumlarda da aynı yöntemi kullanın. Tüm soruların günlük deneyimlerinize uygun sorular olduğunu düşünüyoruz, ancak bir soru sizin için geçerli olmayan bir durumu tanımlıyorsa, "uygun değil" (UD) kutusuna çarpı işareti koyun.	Ad Soyad: Tarih: İşitme cihazı kullanıyor musunuz? □ Evet □ Hayır Kullanıyorsanız □ Sağ Kulak □ Sol Kulak □ Her iki kulak Ne kadar zamandır kullanıyorsunuz? _____ yıldır _____ aydır veya _____haftadır (İki cihazınızı da farklı zamanlarda aldıysanız lütfen belirtiniz)

KONUŞMA ALGISI

Bir kişiyle konuşuyorsunuz ve aynı oda içinde açık bir televizyon var. Televizyonu kapatmadan konuştuğunuz kişinin ne söylediğini takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Sessiz bir salonda bir başka kişiyle konuşuyorsunuz. Karşınızdaki kişinin söylediklerini takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Bir masanın etrafında oturan beş kişilik bir grubun içindesiniz. Bulunduğunuz yer sessiz bir ortam. Gruptaki herkesi görebiliyorsunuz. Sohbeti takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Kalabalık bir restoranda beş kişilik bir grubun içindesiniz. Gruptaki herkesi görebiliyorsunuz. Sohbeti takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Bir kişiyle konuşuyorsunuz. Arka planda fan veya akan su sesi gibi sürekli bir gürültü var. Kişinin söylediklerini takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Kalabalık bir restoranda beş kişilik bir grubun içindesiniz. Gruptaki herkesi göremiyorsunuz. Sohbeti takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Cami ya da tren garı gibi çok yankı yapan bir yerde biriyle konuşuyorsunuz. Karşınızdaki kişinin söylediklerini takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Sesi sizin konuştuğunuz kişiyle aynı tonda olan başka bir kişi konuşurken, biriyle sohbet edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Sesi sizin konuştuğunuz kişiden farklı tonda olan başka bir kişi konuşurken, biriyle sohbet edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Sizinle konuşan birini dinliyorsunuz ve aynı anda televizyondaki spikeri takip etmeye çalışıyorsunuz. Her iki kişinin de ne dediğini anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Birçok kişinin konuşmakta olduğu bir odada bir kişiyle sohbet ediyorsunuz. Konuştuğunuz kişinin ne dediğini takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Bir grup ile birliktesiniz ve sohbet bir kişiden diğerine çok çabuk geçiyor. Her yeni konuşmacının ilk söylediklerini kaçırmadan sohbeti kolayca takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Telefonda kolaylıkla sohbet edebiliyor musunuz? [cihaz kullanmadan, bir ya da iki cihaz kullanarak]

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Telefonda birini dinliyorsunuz ve yanınızdaki kişi konuşmaya başlıyor. Her iki konuşmacının da ne dediğini takip edebilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

UZAYSAL ALGI

Bilmediğiniz bir dış mekanda bulunuyorsunuz. Birinin çim biçme makinesi kullandığını işitiyorsunuz. Nerede olduğunu göremiyorsunuz. Sesin nereden geldiğini anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Birkaç kişiyle bir masanın etrafında oturuyorsunuz veya toplantı yapıyorsunuz. Herkesi göremiyorsunuz. Bir kişi konuşmaya başlar başlamaz o kişinin nerede olduğunu anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

İki kişinin ortasında oturuyorsunuz. Biri konuşmaya başlıyor. Konuşan kişinin solunuzdaki kişi mi yoksa sağınızdaki kişi mi olduğunu bakmadan anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Bilmediğiniz bir evde bulunuyorsunuz. Ev sessiz. Bir kapının gürültüyle kapandığını işitiyorsunuz. Bu sesin nereden geldiğini anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Bir binanın altınızda ve üstünüzde katların olduğu merdiven boşluğundasınız. Başka bir kattan sesler duyuyorsunuz. Sesin nereden geldiğini kolayca anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Dışarıdasınız. Bir köpek yüksek sesle havlıyor. Köpeğin nerede olduğunu bakmadan anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

Kalabalık bir sokağın kaldırımında ayakta duruyorsunuz. Gelen aracın bir kamyon mu ya da otobüs mü olduğunu bakmadan anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

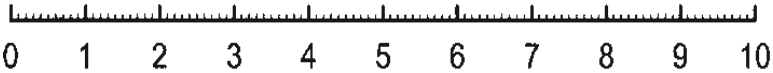
Sokaktayken, yürüyen bir kişinin kendi sesinden veya ayak sesinden o kişinin ne kadar uzakta olduğunu anlayabilir misiniz?

UD □

(Kesinlikle değil) 0 1 2 3 4 5 6 7 8 9 10 (Mükemmel bir şekilde)

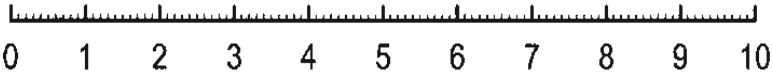
Bir otobüs ya da kamyonun ne kadar uzakta olduğunu sesinden anlayabilir misiniz?

UD □



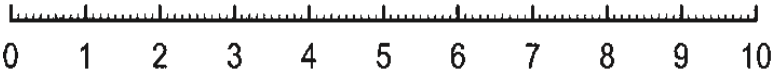
Bir otobüs ya da kamyonun hangi yönde hareket ettiğini sesinden anlayabilir misiniz, örneğin soldan sağa mı yoksa sağdan sola mı hareket ediyor?

UD □



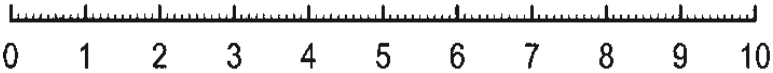
Bir kişinin hangi yönde hareket ettiğini sesinden veya ayak sesinden anlayabilir misiniz, örneğin soldan sağa mı yoksa sağdan sola mı hareket ediyor?

UD □



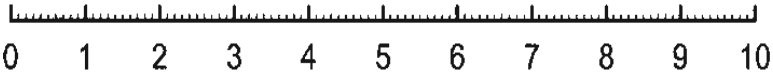
Bir kişinin size doğru mu geliyor yoksa uzaklaşıyor mu olduğunu sesinden ya da ayak sesinden anlayabilir misiniz?

UD □



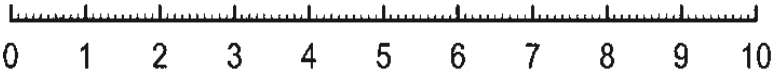
Bir otobüs veya kamyonun size doğru mu geliyor yoksa uzaklaşıyor mu olduğunu sesinden anlayabilir misiniz?

UD □



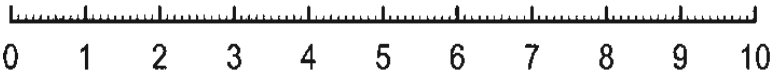
Duyduğunuz sesler size dış dünyadan değil de kafanızın içindeymiş gibi mi geliyor?

UD □



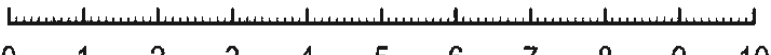
Sesini duyduğunuz ancak ilk başta göremediğiniz kişi veya nesnelere baktığınızda, tahmin ettiğinizden daha yakında olduğunu mu görüyorsunuz?

UD □



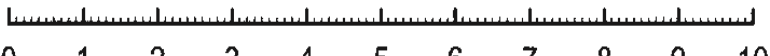
Sesini duyduğunuz ancak ilk başta göremediğiniz kişi veya nesnelere baktığınızda, seslerinin tahmin ettiğinizden daha uzakta olduğunu mu görüyorsunuz?

UD □



Seslerin tam olarak tahmin ettiğiniz yerden geldiğini mi düşünüyorsunuz?

UD □



İŞİTME KALİTESİ

İki sesi aynı anda duyduğunuzu hayal edin; örneğin, suyun lavaboya akışı ve bir radyonun çalışı. Bu seslerin birbirinden ayrı olduğunu fark edebilir misiniz?

UD □

(Kesinlikle değil) (Mükemmel bir şekilde)

Aynı anda birden fazla ses duyduğunuzda, bunlar size birbiriyle karışmış tek bir ses gibi mi geliyor?

UD □

(Karışmış) (Karışmamış)

Radyodan müzik sesinin geldiği bir odadasınız. Aynı odada başka biri de konuşuyor. Konuşan kişinin sesini müzikten ayrı olarak duyabilir misiniz?

UD □

(Kesinlikle değil) (Mükemmel bir şekilde)

Bildiğiniz farklı kişileri seslerinden kolayca tanıyabilir misiniz?

UD □

(Kesinlikle değil) (Mükemmel bir şekilde)

Aşina olduğunuz farklı müzik parçalarını birbirinden kolayca ayırt edebilir misiniz?

UD □

(Kesinlikle değil) (Mükemmel bir şekilde)

Farklı sesler arasındaki farkı anlayabiliyor musunuz; örneğin, bir otomobil ile otobüs; tencerede kaynayan su ile tavada pişen yiyecekler?

UD □

(Kesinlikle değil) (Mükemmel bir şekilde)

Müzik dinlerken, bildiğiniz kadarıyla hangi enstrümanların çalındığını anlayabiliyor musunuz?

UD □

(Kesinlikle değil) (Mükemmel bir şekilde)

Müzik dinlerken, sesler net ve doğal geliyor mu?

UD □

(Kesinlikle değil) (Mükemmel bir şekilde)

Günlük hayatta duyduğunuz sesler size net bir şekilde geliyor mu?

UD □

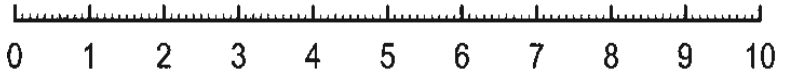
(Kesinlikle değil) (Mükemmel bir şekilde)

Diğer insanların konuşma sesleri size net ve doğal geliyor mu?

UD □

Günlük hayatta duyduğunuz sesler size yapay ve doğal olmayan bir şekilde mi geliyor?

UD □



Konuştuğunuzda, sesiniz kendinize doğal geliyor mu?

UD □

Başka bir kişinin ruh halini sesinden kolayca tahmin edebiliyor musunuz?

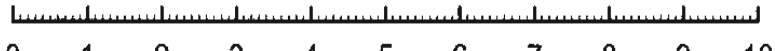
UD □

Bir kişiyi veya şeyi dinlerken çok fazla konsantre olmak zorunda kalıyor musunuz?

UD □

Başkalarıyla konuşurken ne dediklerini anlamak için çok fazla çaba sarf ediyor musunuz?

UD □



Bir arabada sürücü olarak bulunduğunuz sırada, yan koltuğunuzda oturan kişinin ne söylediğini kolayca işitebilir misiniz?

UD □

Yolcu olarak bulunduğunuzda, yan koltuğunuzda oturan sürücünün ne dediğini kolayca işitebilir misiniz?

UD □

Bir şeyi dinlemeye çalışırken diğer sesleri kolayca yok sayabiliyor musunuz?

UD □