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The Test–Retest Reliability of Questionnaires Regarding Attitudes and Beliefs Toward Noise, Hearing Loss, and Hearing Protector Devices in Young Adults

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Abstract

Context: Young people expose themselves to high noise levels during leisure activities, and might thus be at risk of acquiring hearing-related problems. Therefore, information regarding risk-taking behavior is necessary to prevent future hearing problems and to optimize future preventive campaigns. **Aim:** This study evaluated the test–retest reliability of the Youth Attitude to Noise Scale (YANS) and beliefs about hearing protection and hearing loss (BAHPHL) instrument. **Settings and Design:** Forty-three young adults between 18 and 29 years filled in a questionnaire at two test moments. **Materials and Methods:** The YANS and BAHPHL instrument were used to evaluate the attitudes toward noise, hearing loss, and hearing protection. Each participant completed the retest within 21–55 days after the first administration of the questionnaire. **Results:** Paired Student's *t*-tests showed no significant differences in mean scores between test and retest for both the entire YANS and BAHPHL instrument as well as their factors. Furthermore, a good agreement between test and retest scores was seen by Bland–Altman analyses. Intraclass correlation coefficients were above 0.70 for the entire YANS and the factor related to youth culture as well as for the entire BAHPHL and all the factors of the BAHPHL instrument, except for the factor related to the severity of the consequences of hearing loss. **Conclusion:** Reliable test–retest measurements of the YANS and BAHPHL instrument can be performed. Hence, these questionnaires can be used in longitudinal studies to explore young adults' changes in attitudes toward noise, hearing loss, and hearing protection, with or without an educational intervention.

Keywords: Attitudes, leisure noise exposure, reliability, young adults

INTRODUCTION

In scientific literature and widespread media, there is a concern regarding the effects of leisure noise exposure on the auditory system of young adults. Youngsters voluntarily participate at various leisure activities such as music venues, and many of them also use personal music players.^[1-4] Regular exposure to high noise levels during leisure activities can lead to hearing loss and/or the development of hearing-related symptoms such as tinnitus. Results regarding the prevalence of hearing loss in young people are, however, inconclusive.^[5-8] Moreover, Carter *et al.*^[9] recently stated that there is insufficient evidence for the widespread or increasing prevalence of hearing loss in young populations due to leisure noise. Nevertheless, in an epidemiologic study in young adults between 18 and 30 years in Flanders, that is, the Dutch-speaking part of Belgium,

chronic tinnitus due to leisure noise exposure in at least one ear was present in 6.4% of the participants.^[10] In addition to these prevalence studies, cross-sectional studies aim at evaluating the association between leisure noise exposure and hearing-related symptoms. A recent systematic review suggested an association between music and hearing loss, although the evidence is not uniform.^[11] In the previously mentioned epidemiologic study, participants with a higher lifetime noise level for nightclubs and music venues were significantly more likely to experience chronic tinnitus.^[10] However, an individual's risk-taking behavior must also be

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taken into account, because it was found that young people's attitudes and beliefs regarding noise, hearing loss, and hearing protector devices (HPDs) had a significant impact on their hearing status, as well as on the use of HPDs.^[12] Furthermore, hearing conservation programs usually provide information regarding the effects of hearing loss, thus increasing the awareness of the risk of excessive noise exposure and knowledge concerning the availability and use of HPDs,^[13] which might lead to behavioral changes.

In contrast to cross-sectional studies, longitudinal studies in young adults are limited but indicate that there are changes in leisure noise exposure during lifetime and that there is a deterioration of hearing over time.^[3,14,15] In addition to the investigation of the age of onset and the progression of hearing-related problems, evaluating an individual's risk-taking behavior would make it possible to evaluate possible changes in attitudes and behavior regarding leisure noise exposure.

To evaluate an individual's risk-taking behavior, several theoretical frameworks can be used, such as the theory of planned behavior (TPB)^[16] and the health belief model (HBM).^[17] Widen^[18] specifically developed a theoretical framework to explain young people's attitudes and behaviors toward leisure noise exposure by combining all the factors from the TPB, that is, attitudes, subjective norms, and perceived behavioral control, with the perceived benefits and barriers to modify the behavior and triggers to action from the HBM. Within this framework, attitudes can be described as the tendency to respond positively or negatively toward a certain phenomenon, whereas subjective norms refer to the perceived social pressure to engage or not engage in a particular behavior (e.g., wearing HPDs). Perceived behavioral control deals with an individual's perception about the ease or difficulty of undertaking a specific behavior. Finally, risk-taking behavior can be transformed into health-oriented behavior depending on the perceived benefits and barriers of performing the behavior.^[17] In addition to these factors of the TPB and the HBM, Widen^[18] added a risk perception factor to his theoretical framework, which referred to an individual's awareness of the risks of noise exposure.

Attitudes can be evaluated through the Youth Attitude to Noise Scale (YANS). This questionnaire was first developed in Swedish by Widen and Erlandsson,^[19] and was translated in other languages.^[20–22] Furthermore, an instrument questioning the beliefs about hearing protection and hearing loss (BAHPHL)^[23] focusing on leisure noise exposure in young adults^[22] can be used to evaluate the items regarding the subjective norms, perceived behavioral control, perceived benefits and barriers to modify the behavior, and risk perception. The internal consistency of the Dutch versions of the YANS and BAHPHL instrument was investigated previously.^[22,24] However, the test–retest reliability of both adapted instruments is unknown. Knowledge regarding the reliability of these instruments

would be valuable in longitudinal studies to explore young adults' changes in attitudes toward noise, hearing loss, and HPDs with or without an educational intervention.

The aim of the current study is, therefore, to evaluate the test–retest reliability of the Dutch versions of the YANS and BAHPHL instrument regarding the attitudes and beliefs toward noise, hearing loss, and HPDs.

MATERIALS AND METHODS

Questionnaire

The Dutch version of the YANS^[22] consists of 19 items that are categorized into the following four factors: attitudes toward noise associated with the elements of youth culture (factor 1: eight items), the ability to concentrate in noisy environments (factor 2: three items), daily noises (factor 3: four items), and intent to influence the sound environment (factor 4: four items). All items were scored on a five-degree Likert scale ranging from “totally disagree” to “totally agree.” The answers on the YANS were coded from one to five, whereby a higher score indicated a more positive attitude, representing an attitude where noise is seen as unproblematic.

The Dutch version of the BAHPHL questionnaire contained 24 items.^[22] These items were categorized into the following seven factors: susceptibility to hearing loss (factor 1: six items), the severity of the consequences of hearing loss (factor 2: three items), the benefits of preventive action (factor 3: three items), barriers to preventive action (factor 4: four items), behavioral intentions (factor 5: three items), social norms (factor 6: two items), and self-efficacy (factor 7: three items). Consistent with the YANS, a five-degree Likert scale was used, and the answers were coded from one to five. The higher the score on the BAHPHL instrument, the more positive the attitudes, meaning that one does not care about the possible consequences of hearing loss and is unaware regarding the benefits of wearing HPDs.

Besides the YANS and BAHPHL instrument, demographic information, subjective hearing status, the presence of tinnitus, and the use of HPDs during leisure noise activities were questioned.

An electronic version of the questionnaire was completed by the same respondents at two test moments. The two test moments were planned to take place within 8 weeks to minimize the chance of contact with any educational hearing program or the emergence of hearing-related symptoms that might influence the results. On average, the time between both tests was 36.8 days [standard deviation (SD) 6.70] with a range between 21 and 55 days.

Respondents

Young adults between 18 and 30 years were recruited in Flanders. Individuals were invited to participate in the study by distributing an invitation letter through email or online (school) platforms. On the basis of the invitation letter,

individuals contacted the researchers and were then offered the ability to complete the questionnaire online. Forty-three respondents, of which were 30 females and 13 males, voluntarily participated in the study. Their age at the first test moment was on average 24.56 years (SD 2.98, range 18–29 years). At both test moments, 20 respondents (46.5%) were students, and the remaining 23 respondents (53.5%) were a part of the working population.

The study was approved by the local ethical committee, and all participants agreed with the informed consent in accordance with the ethical standards of the Declaration of Helsinki for research involving human participants.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 23.0 software (IBM Corp., New York, USA).

Descriptive parameters were established for the questionnaire outcomes. Furthermore, Pearson correlation coefficients were calculated to examine possible correlations between the test–retest interval (in days) and the differences in the scores between test A and test B for the entire YANS and BAHPHL instrument as well as their factors.

To determine the test–retest reliability of the YANS and BAHPHL instrument, several statistical measures were applied. First, paired Student’s *t*-tests were executed to evaluate differences between the entire scores as well as scores on the factors of both the YANS and BAHPHL instrument at test and retest. Furthermore, Bland–Altman analysis was performed to determine the degree of agreement between the entire score on the YANS and BAHPHL instrument at both test moments.^[25] Second, a two-way random single measures intraclass correlation coefficient (ICC) was used to determine the consistency of the position of individual scores relative to others between both test moments for the entire scores on the YANS and BAHPHL instrument as well as their factors. Third, the

standard error of measurement (SEM) was determined to evaluate the reliability within repeated measures in one participant. Specifically, the SEM was calculated as $SEM = s(1-ICC)$, where “*s*” represented the SD of all measurements. Finally, the SEM was used to calculate the minimum detectable difference (MDD). The MDD can be defined as the difference between the means of the YANS and BAHPHL scores at test and retest, which must exist to conclude that there is a significant effect. To indicate the 95% confidence interval to detect a real difference between the scores, the equation $1.962SEM$ was used.

For all statistical analyses, a significance level of $P < 0.05$ was used.

RESULTS

Questionnaire outcomes

The majority of the respondents (95.4%) indicated that they had good or very good hearing at both test moments, while 4.6% of the respondents evaluated their hearing as “not that good.” With regard to the presence of tinnitus due to leisure activities, 32 participants (74.4%) experienced temporary tinnitus, while six respondents (14.0%) reported to have chronic tinnitus. Five respondents (11.6%) had never experienced tinnitus after exposure to leisure noise. These results were the same at both test moments. Thirty-seven respondents (86.0%) indicated on both test moments to have used HPDs at least once.

The descriptive values of the scores on the factors of the YANS and BAHPHL instrument are reflected in Table 1. At both test moments, the highest mean score for the YANS was found for the factor related to daily noise (factor 3), whereas the lowest mean score for the YANS was the factor related to the intent to influence the sound environment (factor 4). For the BAHPHL instrument, the highest and lowest mean scores at both test moments were seen, respectively, for the factors social norms (factor 6) and the severity of the consequences of hearing loss (factor 2).

Table 1: For the YANS and BAHPHL instrument, the mean, standard deviation (SD), and the range of scores are reflected for test and retest ($n = 43$)

		Test			Retest		
		Mean	SD	Range	Mean	SD	Range
YANS	Elements of youth culture	2.27	0.61	1.25–3.50	2.23	0.62	1.38–3.88
	Concentration in noisy environments	2.75	0.85	1.00–4.33	2.92	0.78	1.33–4.33
	Daily noise	3.62	0.70	2.25–5.00	3.66	0.79	1.25–4.75
	Intent to influence sound environment	2.02	0.59	1.00–3.50	1.93	0.54	1.00–3.00
	Entire YANS	2.58	0.42	1.95–3.79	2.58	0.45	1.47–3.79
BAHPHL instrument	Susceptibility to hearing loss	1.51	0.50	1.00–2.67	1.54	0.48	1.00–2.50
	Severity of the consequences of hearing loss	1.34	0.34	1.00–2.33	1.37	0.44	1.00–2.67
	Benefits of preventive action	1.52	0.55	1.00–3.33	1.55	0.50	1.00–3.00
	Barriers to preventive action	2.38	0.92	1.00–4.00	2.42	0.97	1.00–4.50
	Behavioral intentions	1.98	1.08	1.00–4.33	2.01	0.95	1.00–4.33
	Social norms	2.73	0.82	1.00–4.00	2.67	0.94	1.00–4.50
	Self-efficacy	2.08	0.82	1.00–4.67	1.94	0.70	1.00–4.33
	Entire BAHPHL	1.87	0.46	1.21–3.13	1.87	0.46	1.04–2.79

Test-retest reliability

Comparing the scores on the YANS at test and retest resulted in a mean difference of 0.001 for the entire YANS score and mean differences ranging between -0.17 and 0.09 for the factors of the YANS. For the entire BAHPHL score, the mean difference was -0.002 between test and retest, whereas the mean differences of the scores for the factors of the BAHPHL instrument were mostly negative, ranging between -0.03 and 0.14. No significant correlation was found between the test-retest interval and the differences in the entire scores of the YANS and BAHPHL instrument as well as their factors (Pearson correlation, $P > 0.05$).

Paired Student's *t*-tests showed no significant differences in mean scores between test and retest for both the entire YANS and BAHPHL instrument as well as their factors ($P > 0.05$) [Table 2]. Furthermore, the Bland-Altman analysis for the entire YANS and BAHPHL instrument is depicted in Figure 1.

In Table 3, the ICCs, SEMs, and MDDs are reflected. For all factors of the YANS and BAHPHL instrument, ICCs with highly significant between-subjects variability were obtained ($P < 0.001$). ICCs were above 0.70 for the factor of the YANS related to youth culture (factor 1) and the entire YANS. For the remaining factors of the YANS, the ICCs were between 0.50 and 0.70. Regarding the BAHPHL, ICCs were above 0.70 for the entire BAHPHL and all factors of the BAHPHL instrument, except for the factor related to the severity of the consequences of hearing loss (factor 2). The latter factor had an ICC of 0.36 between test and retest.

DISCUSSION

Questionnaires, such as the YANS and the BAHPHL instrument, are frequently used in cross-sectional studies to evaluate an individual's risk-taking behavior regarding leisure noise exposure. The highest mean scores on the

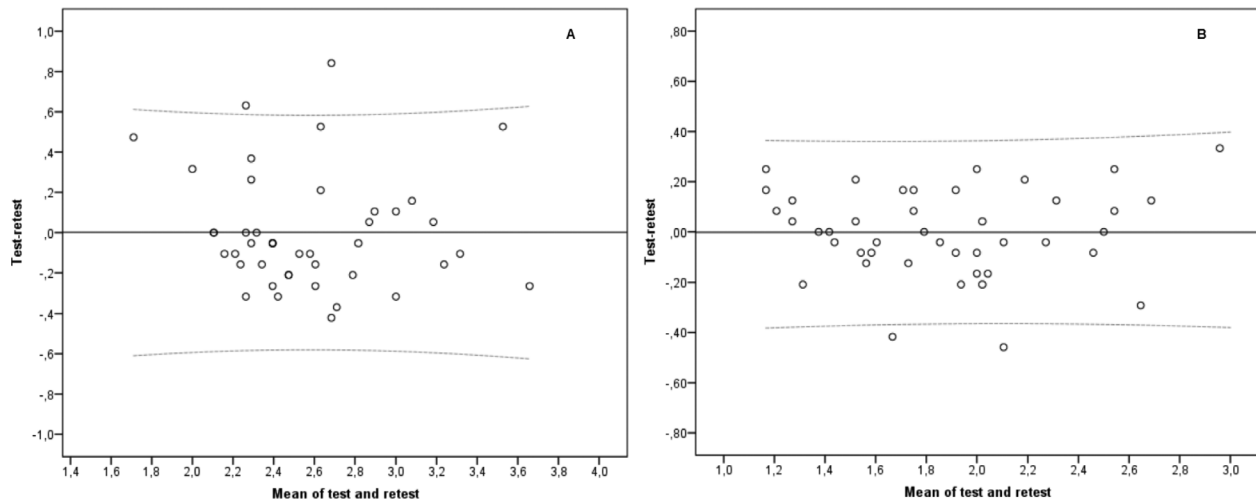


Figure 1: Bland and Altman plot for the entire score on the YANS (A) and the BAHPHL (B) with the black line representing the mean score, and the gray dotted lines the limit of agreement (95% confidence interval)

Table 2: The mean and standard deviation (SD) of the paired differences between test and retest, 95% confidence interval (CI), and the results from the paired samples *t*-test are given for the entire YANS and BAHPHL scores as well as their factors ($n = 43$)

		Paired differences		95% CI of the difference		Paired samples <i>t</i> -test	
		Mean	SD	Lower	Upper	<i>t</i>	<i>P</i>
YANS	Elements of youth culture	0.04	0.33	-0.06	-0.14	0.877	0.386
	Concentration in noisy environments	-0.17	0.65	-0.37	0.03	-1.726	0.092
	Daily noise	-0.04	0.71	-0.26	0.18	-0.376	0.709
	Intent to influence sound environment	0.09	0.54	-0.08	0.25	1.060	0.295
	Entire YANS	0.001	0.28	-0.09	0.09	0.028	0.978
BAHPHL instrument	Susceptibility to hearing loss	-0.03	0.30	-0.12	0.06	-0.687	0.496
	Severity of the consequences of hearing loss	-0.03	0.45	-0.17	0.11	-0.455	0.652
	Benefits of preventive action	-0.03	0.40	-0.15	0.09	-0.512	0.611
	Barriers to preventive action	-0.03	0.37	-0.15	0.08	-0.621	0.538
	Behavioral intentions	-0.02	0.52	-0.18	0.14	-0.292	0.771
	Social norms	0.06	0.67	-0.15	0.27	0.565	0.575
	Self-efficacy	0.14	0.52	-0.02	0.30	1.757	0.086
	Entire BAHPHL	-0.002	0.18	-0.06	0.05	-0.072	0.943

Table 3: ICCs, SEMs, and MDDs for the entire scores and the scores of the factors of the YANS and BAHPHL instrument between test and retest are presented ($n = 43$)

		ICC	SEM	MDD
YANS	Elements of youth culture	0.859	0.23	0.65
	Concentration in noisy environments	0.687	0.46	1.27
	Daily noise	0.551	0.50	1.39
	Intent to influence sound environment	0.546	0.38	1.06
	Entire YANS	0.787	0.20	0.56
BAHPHL instrument	Susceptibility to hearing loss	0.817	0.21	0.58
	Severity of the consequences of hearing loss	0.356	0.31	0.87
	Benefits of preventive action	0.714	0.28	0.79
	Barriers to preventive action	0.924	0.26	0.73
	Behavioral intentions	0.868	0.37	1.03
	Social norms	0.707	0.48	1.32
	Self-efficacy	0.767	0.37	1.02
	Entire BAHPHL	0.962	0.12	0.34

YANS and BAHPHL instrument found in the current study were related to daily noise and social norms, respectively, which confirms the results of previous studies.^[12,20,24,26,27] This indicates that young adults have more problematic positive attitudes toward daily noise and social norms. In addition, consistent with previous findings,^[12,27] the lowest mean scores on the YANS and BAHPHL instrument were found for the YANS factor related to the intent to influence the sound environment and BAHPHL factor regarding the severity of the consequences of hearing loss. This indicates that young adults tend to do something to make the environment quieter, and that they are more aware of the consequences of hearing loss. Nevertheless, sociodemographic factors such as age, gender, and socioeconomic status, as well as cultural differences, might influence the scores on the questionnaire.^[20,28]

To evaluate a change in an individual's risk-taking behavior in longitudinal studies, knowledge regarding the test–retest reliability of the used questionnaires is necessary. The Brazilian Portuguese version of the YANS was retested in 50 high-school students within 30–90 days.^[21] In 85 students, a Chinese adapted version of the YANS was retested after 45 days.^[29] In both studies, nonsignificant mean differences of the entire YANS score between the test and retest of 0.000^[21] and 0.002^[29] were found. In the current study, the mean difference of the entire YANS score was 0.001, and the Bland–Altman test showed good agreement^[30] between scores on test and retest, which is consistent with these previous studies.^[21,29] However, the test–retest reliability of the BAHPHL instrument and its factors as well as regarding the test–retest reliability of the different factors of the YANS is unknown. Regarding the BAHPHL instrument, this study found a mean difference of the entire BAHPHL score of -0.002 as well as a good agreement between the scores at both test moments based on the Bland–Altman test.^[30] Moreover, the factors of the YANS and BAHPHL instrument also showed good agreement between test and retest, with mean differences in the scores between both test moments ranging between

-0.17 and 0.09 , and between -0.03 and 0.14 , respectively. Furthermore, highly significant ICCs between the entire YANS and BAHPHL scores as well as the scores on the factors of the YANS and BAHPHL instrument were found, with the exception of the BAHPHL factor related to the severity of the consequences of hearing loss. Although there is no consensus regarding a value for a good ICC due to the used version and the variability of that data,^[31] the homogenous distribution of the scores could explain the lower ICC on this BAHPHL factor. However, the between-subjects variability reached significance, thereby not compromising the validity of the ICC. In addition to the ICCs, this study also calculated the SEM and MDD for both the entire YANS and BAHPHL scores and their factors. Using the MDD enables the detection of a significant change in the scores on these questionnaires. For example, if a second measurement exceeds the MDD for one or more factors of the YANS or BAHPHL, the observed difference is probably due to a real or genuine difference.

This study evaluated the short-term test–retest reliability of the YANS and the BAHPHL instrument to explore young adults' changes in attitudes toward noise, hearing loss, and HPDs. Such short-term analysis might have led to a possible recall of the answers by our respondents. Nevertheless, the test–retest interval in this study ranged between 21 and 55 days, which made it possible to evaluate the effect of the time interval on the scores of the YANS and BAHPHL instrument. If, for example, a recall of the answer was present, one could expect that the difference in the scores between both tests would be smaller for shorter time intervals. However, no significant correlation was found between the test–retest interval and the difference in the scores between both tests for the entire YANS and BAHPHL instrument as well as their factors. Future research including test–retest reliability over a longer period of time (e.g., months or years) would be interesting to explore the reliability of both the YANS and BAHPHL in the long term. Furthermore, such longitudinal research would make it possible to also investigate the influencing factors of test–retest reliability (e.g., gender,

age, cultural differences, and so on).^[18] Nevertheless, the sample used in this study was a representative subset of the population of young adults based on their sociodemographic variables, and mean scores on both instruments were consistent with previous findings.

In conclusion, this study indicates that the Dutch versions of the YANS and BAHPHL instrument have a high test–retest reliability. Hence, these questionnaires can be used in longitudinal studies to explore young adults' changes in attitudes toward noise, hearing loss, and hearing protection, with or without an educational intervention.

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Conflicts of interest

There are no conflicts of interest.

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