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ORIGINAL ARTICLE

Clinical note: Validation of the Swedish version of the Parents' Evaluation of Aural/Oral Performance of Children (PEACH) Rating Scale for normal hearing infants and children

K. JONAS BRÄNNSTRÖM[1], JOSEFINE LUDVIGSSON[1], DAVID MORRIS[2] & TINA IBERTSSON[1]

[1]*Department of Logopedics, Phoniatrics and Audiology, Clinical Sciences in Lund, Lund University, Sweden, and* [2]*Department of Scandinavian Studies and Linguistics, University of Copenhagen, Copenhagen, Denmark*

Abstract

Objective: The aims of the present pilot study were to translate the PEACH Rating Scale into Swedish, examine the preliminary psychometric properties of this translation, and explore the association between age and the reported outcome. *Study design:* Responses on the PEACH Rating Scale were collected for 27 families with children aged six to 50 months of age (mean = 18.3 months; standard deviation, SD = 13.1 months). *Results:* The Swedish translation demonstrates high internal consistency, indicating that all items measure the same construct and the corrected item-total correlations also suggest that each item contributes logically to the scale. The total scores increase rapidly with increasing age until about 20 months after which the score increase tails off and is asymptotic beyond 50 months of age. *Conclusions:* Parental responses from the Swedish translation show psychometric characteristics similar to those previously reported and this version shows a similar relationship between total score on the scale and age, as found in previous studies.

Key words: *questionnaire, auditory behaviour, assessment*

Introduction

Although objective measures of aided performance, e.g. real ear measurements, are important for verifying hearing aid fitting in paediatric populations (2), they do not capture the contribution of amplification to a child's everyday life. Nor do they provide information as to the success or lack of success that a particular amplification strategy yields with a given child in a given acoustic environment. For example, previous studies outside the laboratory suggest that one of 3–4 children prefer or perform better with less or more hearing aid gain than prescribed (3,4). In addition, these measurements do not provide information on how the child's auditory behaviour develops with the use of hearing aids. Therefore, it is necessary to complement these objective measurements with more subjective tools such as questionnaires completed by the clinician together with the child or by parents, teachers or other persons in the child's life (5,6).

Internationally there are a number of questionnaires available for infants and children that target different age groups, degrees and types of hearing loss (6–11). These questionnaires are developed to be used as both hearing aid/cochlear implant fitting outcome measures and to evaluate how children develop their auditory ability over time. For example, Bagatto, Moodie, Seewald, Bartlett and Scollie (11) identified 12 different auditory-related subjective paediatric outcome evaluation tools. Based on a number of selection criteria including response burden, ecological validity, and clinical feasibility, they identified two questionnaires to be included in an outcome evaluation guideline for infants and children: LittlEARS Auditory Questionnaire (7,12,13) and Parent's Evaluation of Aural/

Correspondence: K. J. Brännström, Department of Logopedics, Phoniatrics, and Audiology, Clinical Sciences Lund, Lund University, SE-221 85 Lund, Sweden. Tel: +46 0 46 177103. E-mail: jonas.brannstrom@med.lu.se

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Oral Performance of Children (PEACH) Rating Scale (9). LittlEARS Auditory Questionnaire is used for children aged 0–2 years or until a ceiling effect is seen. There is a Swedish translation of the LittlEARS Auditory Questionnaire available (14) that has been validated (15), but it is not available in peer reviewed literature. However, use of this questionnaire is limited since it is not applicable to children above two years of age.

To reduce the administration time and facilitate analysis, the PEACH Rating Scale (9) was developed from the PEACH Diary (10), which requires that parents make notes on the child's listening experience observed over the period of a week (1,10). In a similar manner to the Diary, the PEACH Rating Scale is based on how the hearing impaired child has reacted in different listening situations during the last week. The scale can be used with children aged about one month to the late teens and it can be used on children with normal hearing and with different degrees of hearing loss.

For normal hearing subjects, only Bagatto et al. (16) report some psychometric properties of the PEACH Rating Scale. They demonstrated similar psychometric properties and association between age and scores comparing their results with those of Ching and Hill (1), who reported this for the PEACH diary (i.e. the scores on the scale were selected by the clinician from interview-administered questions). Based on the similarities between these two versions, the following can be said about the psychometric properties. The test-retest reliability is good (1,17). Construct validity has been examined and normative values for both normal hearing (1,16,17) and hearing impaired children have been reported (1). Internal consistency is high (1,16,17). The concurrent validity has been tested in young infants fitted with hearing aids by central auditory evoked potentials showing a moderate positive association with the PEACH Rating Scale (18). Both Quar et al. (17) and Bagatto et al. (16) demonstrated similar psychometric properties and association between age and scores comparing their results with those of Ching and Hill (2007).

In summary, there is currently one validated questionnaire in Swedish for use on children aged 0–2 years available to clinicians (LittlEARS; (15)). The use of this questionnaire is however limited due to the age constraints. Therefore, there is a need for a questionnaire that can be used to measure the development of auditory ability over several years. With age related normative values available for both normal hearing and hearing impaired children it would be possible for both researchers and clinical paediatric audiologists to follow the individual child's development and also compare it to children of the same age who have similar hearing status. In this way, this validation is of value for local clinicians while it also provides further confirmation of the value of parental responses in paediatric routine.

Based on this, the aims of the present study were to translate the PEACH Rating Scale into Swedish, examine the preliminary psychometric properties of this translation, and explore the association between age and the reported outcome.

Material and methods

Subjects and procedure

Thirty-nine families who had children aged between 6 and 50 months in this age group were recruited through two open kindergartens in Lund municipality on six occasions. The families were initially informed about the purpose and content of the study. Thirty-five families agreed to participate. Upon agreeing to participate the families were given an information letter about the study and an informed consent to sign. To be included, the child was required to have been born with a gestation period no shorter than 37 weeks. The child had to have passed neonatal otoacoustic emission screening in both ears at the birth clinic and have no report of regular ear infections, e.g. recurrent secretory otitis media. The parents had to be proficient in Swedish but it need not necessarily be their mother tongue.

After receiving oral and written instructions, the responses on the PEACH Rating Scale from these 35 families were collected in the presence of an audiologist. Based on responses to an accompanying demographic survey (including questions about the child's age, gender, language preferences, neonatal otoacoustic emission screening, ear infections, hereditary risk for hearing loss), two children did not meet these inclusion criteria as they had not been through the neonatal screening programme and they were therefore excluded. One child was excluded as the parents did not provide informed consent. An additional five children were excluded since the parents had not completed all items of the PEACH Rating Scale. After these exclusions, the responses on the PEACH Rating Scale for 27 families with children (mean = 18.3 months; standard deviation, SD = 13.1 months) were analysed. The sample consisted of 15 (55.6 %) girls and 12 (44.4 %) boys. The Internal Ethics Review Board at the Section of Logopedics, Phoniatrics, and Audiology, Lund University, approved the project.

The PEACH Rating Scale

The PEACH Rating Scale consists of 13 items. The first two items are related to the hearing impaired child's hearing aid/cochlear implant use and are not included when calculating the final score (9). The families were instructed not to complete these two items since their children did not use any of these devices. Hence the families completed items 3 to 13 in which they observed and rated the auditory behaviour of the child in different listening situations during the last week using a 5-point scale ranging from 0 to 4. The response options had the following description: 0 = never, 1 = seldom or 1–25% of the time, 2 = sometimes or 26–50% of the time, 3 = often or 51–75% of the time, and 4 = always or 75–100% of the time. Items 3 to 13 were added to give a total score which then was converted into a percentage by dividing by 44, i.e. the maximum total score possible for the whole scale. The scores on two subscales were also calculated in a similar way: items 3, 4, 7, 8, 11, and 12 were added to form the 'Quiet' subscale and percentage was calculated by dividing by 24, i.e. the maximum total score possible for this subscale; items 5, 6, 9, 10, and 13 were added to form the 'Noise' subscale and percentage was calculated by dividing by 20, i.e. the maximum total score possible for this subscale (9).

Translation of PEACH Rating Scale into Swedish

The translation of the PEACH Rating Scale (both instructions and the scale) was made using a back-to-back translation to ensure that the content of the translation did not deviate too far from the original: as a first step the Australian version was translated by the second author into Swedish. This translation was audited by the first and last authors. As a second step, this Swedish translation was translated back into Australian English by the third author who was a native speaker proficient in Swedish, and who was informed as to the purpose of the translation but was not familiar with the questionnaire. This translation was checked with the original for inconsistencies by the first, second and last authors. The back translation was deemed consistent with the original. The Swedish translation of the PEACH Rating Scale can be obtained from the corresponding author by contacting him by email at jonas.brannstrom@med.lu.se.

Results

Statistical analyses were made using SPSS v.21. In all analyses, significance was determined using an alpha level of 0.05. The mean, SD, and ranges for the total scores on the PEACH Rating Scale and its subscales are presented in Table I. The high Cronbach's alphas for the total score and subscales seen in Table I suggest high inter-item correlations, high internal consistency, and that the items measure the same construct. Corrected item-total correlations, which are the correlation between the item and the composite score from all other items, ranged from 0.606 to 0.892 (see Table II), also suggesting that each item contributes to the total scale. To further test this and to investigate if each item contributes to the overall internal consistency, each item was removed in turn and Cronbach's alpha was recalculated, as seen in Table II. Only the removal of item 13 resulted in a slight increase of Cronbach's alpha by 0.01.

Table I. The mean, SD, and ranges for the total scores on the PEACH Rating Scale and subscales Quiet and Noise for all subjects together with Cronbach's alphas ($n = 27$).

	Total	Quiet	Noise
Mean	74.4	75.7	74.1
SD	23.2	24.8	22.2
Min	20.5	16.7	25.0
Max	100.0	100.0	100.0
Cronbach's alpha	0.939	0.902	0.834

A principal component analysis (PCA) with varimax rotation and Kaiser normalization was made to explore the factor structure of the PEACH Rating Scale. The results are shown in Table II. The unrotated PCA showed that two factors met Kaiser's criterion with eigenvalues exceeding 1.0 and lay above the Cattell's point of inflexion in the scree plot. These two factors together accounted for 76.2% of the total variance. After rotation and suppressing loadings less than 0.60, factor 1 consisting of items 3, 4, 5, 6, 7, 8, 9, and 13 accounted for 46.0% of the variance in scores and factor 2 consisting of items 10, 11, and 12 accounted for 30.2%. The sum scores on these two factors were highly associated (rho = 0.718, $p < 0.001$), showing that about 51.6% of the variance in one factor could explain the variance in the other factor.

Two additional PCAs with varimax rotation and Kaiser normalization were made to test the construct of the two previously suggested subscales (Quiet and Noise; 1, 9). The results are also shown in Table II. In the first analysis, the unrotated PCA showed that only a single factor met Kaiser's criterion with eigenvalues exceeding 1.0 and lay above the Cattell's point of inflexion in the scree plot. This factor accounted for 71.8% of the total variance. In the second analysis, the unrotated PCA showed that only a single factor met Kaiser's criterion with eigenvalues exceeding 1.0 and lay above the Cattell's point of inflexion in the scree plot. This factor accounted for 61.8% of the total variance. The sum scores on the two subscales were

Table II. Corrected item-total correlations, Cronbach's alphas if item deleted, and factor scores for both PCAs (see text for details) ($n = 27$).

Item	Corrected item-total correlations	Cronbach's alpha if item deleted	PCA 1: Factor 1	PCA 1: Factor 2	PCA 2: Subscale Quiet	PCA 2: Subscale Noise
3	.839**	0.936	0.85		0.89	
4	.873**	0.927	0.74		0.90	
5	.699**	0.935	0.71			0.83
6	.892**	0.926	0.76			0.92
7	.802**	0.930	0.85		0.88	
8	.654**	0.937	0.61		0.69	
9	.736**	0.933	0.70			0.85
10	.641**	0.937		0.92		0.61
11	.756**	0.933		0.89	0.79	
12	.864**	0.928		0.76	0.91	
13	.606**	0.940	0.84			0.69
Variance explained			46.0%	30.2%	71.8%	61.8%

**$p < 0.01$.

highly associated (rho = 0.941, $p < 0.001$), indicating that about 85.6% of the variance in one factor could explain the variance in the other factor. This suggests that the two subscales measure the same construct.

Finally, the relationship between the overall PEACH Rating Scale scores and age was examined with a curve estimation procedure using an inverse regression model. The result of this analysis is shown in Figure 1. Visual inspection suggests that the scores increase rapidly with increasing age until about 20 months. The regression line that describes the data flattens out above 20 months and is asymptotic beyond 50 months of age (standardized coefficient Beta = −0.654, standard error = 78.443, adjusted $R^2 = 0.405$, $t = -4.323$, $p < 0.001$). This means that maximum PEACH scores were observed between two and about four years of age.

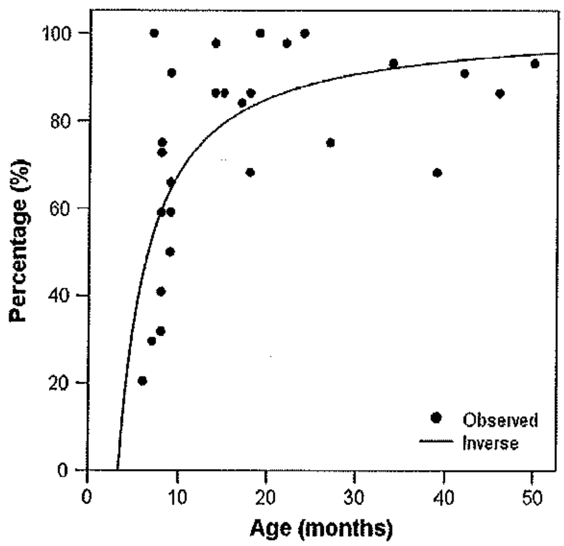

Figure 1. Scatter plot for the PEACH Rating Scale total score in percent (see text for definition) for all subjects ($n = 27$). The regression line was obtained from a curve estimation procedure using an inverse regression model. See text for R^2.

Discussion

The aims of the present study were to translate the PEACH Rating Scale into Swedish, examine the preliminary psychometric properties of this translation, and explore the association between age and the reported outcome. The preliminary findings suggest that the Swedish translation demonstrates psychometric characteristics similar to those previously reported. The findings also suggest that this version shows a relationship between total score on the scale and age, as seen in previous studies.

To the best of our knowledge only Bagatto et al. (16) have reported some psychometric properties of the Australian English version of the PEACH Rating Scale. When comparing their results with those of Ching and Hill (1), using the PEACH Scale (scores from interview-administered questions), Bagatto et al. (16) demonstrated similar psychometric properties and association between age and scores. Therefore, the following discussion is based on both the findings of Bagatto et al. (16) and those studies using the PEACH diary on normal hearing children (e.g. (1,17)).

The high Cronbach's alpha and the high inter-item correlations indicate that the Swedish translation demonstrates high internal consistency, suggesting that all items in the PEACH Rating Scale measure the same construct. The corrected item-total correlations also suggest that each item contributes logically to the scale. These findings are similar to previous studies using the Australian

English version (1,16) and the Malay version (17). In addition, to further test this latter assumption and to investigate whether each item contributes to the overall internal consistency, items were removed in turn and Cronbach's alpha was recalculated. In this analysis, the only removal that caused an increase in Cronbach's alpha was for item 13. This finding differs from that of Quar et al. (17) where the removal of each item did not result in increases in the value of Cronbach's alpha. However, the present increase was only marginal (0.01), which may suggest that this item can be kept in the scale. Future studies on a larger sample than that used in the present study may provide a more valid indication in this matter.

The factor structure of the PEACH Rating Scale was explored using two PCAs. The first PCA demonstrated that the Swedish version could be divided into two factors: the first consisting of items 3, 4, 5, 6, 7, 8, 9, and 13 and the second consisting of items 10, 11, and 12. The items in the first factor are concerned with auditory behaviour in both quiet and noise, while the items in the second factor probe speaker and sound recognition and listening in specific situations. What may be the common denominator for the items in the second factor is a situation where it is either clear or not evident that the child can see the speaker at all times. However, the sum scores on these two factors were highly associated suggesting that this division may not be valid, at least in normal hearing children. This factor structure also differs from the one reported by Ching and Hill (1). This may be attributed to differences in the administration modes of the questionnaire between our study and Ching and Hill. It may also reflect that the present study used data from only normal hearing subjects, while Ching and Hill used data from both normal hearing and hearing impaired children in the factor analysis.

The second PCA was made to test the construct of two previously suggested subscales, Quiet and Noise (1). It was demonstrated that the items in these subscales seem to measure the same construct, as only one factor was extracted in the analysis of each subscale. This is a finding that is similar to previous studies (1). In addition, a large part of the item variance could be explained within these subscales. However, the association between these two subscales was very high, suggesting that about 85.6% of the variance in one subscale could explain the variance in the other subscale. This suggests that the two subscales measure the same construct in the Swedish version. However, this may hold only for normal hearing children and future studies on hearing impaired children may find that this strong association between the subscales is not evident. A similar association between these two subscales has previously been demonstrated in a sample with both normal hearing and hearing impaired children (1).

The relationship between the overall PEACH Rating Scale scores and age was examined. Visual inspection suggests that the scores increase rapidly with increasing age until about 20 months where the increase tails off and is asymptotic beyond 50 months of age. This is a finding very similar to those of Ching and Hill (1) and Quar et al. (17) but it differs from that of Bagatto and Scollie (2013) who reported an asymptotic relationship between score and age at about 30 months (16). The present study is limited in that no formal behavioural hearing screening was conducted on the children in association with data collection, yet all children had passed neonatal hearing screening. This may have affected the validity of the association between the scores and age, but it should not influence the preliminary psychometric properties of the questionnaire. The results of the present study support those of Quar et al. (17), where measures of the internal consistency of the PEACH Rating Scale scores were observed. Further studies are required to examine the test-retest differences as a means of examining the reliability of parental observation of a child's listening behaviour.

The PEACH Rating Scale is intended for children with hearing impairment and it reflects how the hearing impaired child has reacted in different listening situations during the last week. In the present study, the responses on the PEACH Rating Scale were collected for normal hearing children. This was done to be able to compare the Swedish translation with those previously reported without hearing loss as a confounding factor. Using the present translation, future studies could examine the influence of degree of hearing loss on the PEACH Rating Scale scores.

In summary, the present findings are preliminary due to the small sample size, but the Swedish translation made using back-to-back translation seems to demonstrate psychometric properties similar to those previously reported for normal hearing subjects.

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alone are responsible for the content and writing of the paper.

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