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Translation and validation of the Listen Inventory for Education Revised into Dutch

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ABSTRACT

Introduction: In Belgium the majority of children with CI's are being educated in mainstream schools. In mainstream schools difficult listening situations occur (e.g. due to background noise) which may result in educational risks for children with CI's. A tool that identifies potential listening difficulties, the English Listen inventory for Education Revised (LIFE-R), was translated and validated into Dutch for elementary and secondary schools (LIFE-NL, LIFE2-NL respectively).

Methods: Two forward-backward translations were performed followed by a linguistic evaluation and validation by a multidisciplinary committee. The LIFE-NL was further validated on content by pre-testing the questionnaire in 5 students with hearing loss (8–13 years). After minor cross-cultural adaptations normative data were assembled from 187 normal-hearing (NH) students enrolled in mainstream secondary education (1st to 4th grade). The normative data were further analysed based on grade and school type. Additionally, the internal consistency was evaluated by calculating Cronbach's alpha for 3 different scales of the LIFE2-NL: the LIFE total (situation 1–15), LIFE class (situation 1–10: listening situations in classroom) and LIFE social (situation 11–15: social listening situations in school).

Results: NH students scored on average 72.0 (SD = 19.9%) on the LIFE2-NL, indicating they experience some difficulties in secondary mainstream schools. The most difficult listening situations were those where fellow students are noisy or when students have to listen in large classrooms. NH students scored significantly higher on the LIFE class compared to the LIFE social (84.1 ± 14.7% vs. 68.1 ± 19.0%, $p < .000$). Moreover the LIFE social tend to decrease from the 3rd grade on. The different subscales of the LIFE2-NL showed high internal consistency (Cronbach's alpha of 0.86, 0.89 and 0.75 for LIFE total, LIFE class and LIFE social respectively).

Conclusion: The LIFE-NL and LIFE2-NL are valid Dutch translations of the original LIFE-R and are fully comprehensible for students with hearing loss. The normative data of the LIFE2-NL provide a representative framework for interpreting the results of mainstreamed students with hearing loss in secondary schools.

1. Introduction

Increasingly more children with cochlear implants (CI's) are being educated in mainstream schools. In Belgium, already 45–74% of the deaf students with a CI are enrolled in regular elementary and secondary schools [1]. This high number is a direct result of two important turning points in the legislation of Flanders (Belgium).

First, Flanders introduced a Universal Newborn Hearing Screening Program (UNHSP) in 1998, which has led to early diagnosis of congenitally deaf children (i.e. before the age of 3 months) and early intervention. Early intervention is currently provided with hearings aids and cochlear implants before the age of 4 months and 1 year respectively [2]. Early cochlear implantation positively affects the speech and language outcomes of children with CI's, which facilitates their participation in mainstream education [2].

Second, the government has issued the M decree (effective from September 2015), which aims at increasing the number of children with disabilities and additional educational needs in mainstream schools. As a result, more students who are deaf or hard of hearing (D/HH) make their transition into mainstream education.

Despite the effort to mainstream CI children, remarkably little support is provided in schools. The majority of mainstreamed CI children (80–90%, CORA [1]) rely on the support of peripatetic teachers (i.e. teachers of special education who support children in mainstream

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education) and speech and language pathologists for a maximum of 4 h a week in total. To a lesser extent (20–30%, [1]), CI children also rely on notetakers and sign language interpreters in class. For the majority of CI children the educational support is limited to a few hours a week, but children may experience listening difficulties throughout the entire day [3]. Listening difficulties may occur in class due to background noise, large class sizes, poor room acoustics and lack of visual support. These listening difficulties can result in subtle misconceptions, misunderstandings, and subsequently learning difficulties, which are often not noticed by mainstream teachers [4,5]. In secondary schools, there are a number of different course lecturers creating even more listening difficulties and increasing the risk that listening difficulties in CI children remain unnoticed.

Different questionnaires exist to assess the functioning of D/HH children in school, such as the Teacher Evaluation of Auditory/oral performance of Children (TEACH) [6,7], the Teacher Evaluation of Auditory Performance (TEAP) [8], The Listening Inventory (TLI) [9] and the Screening Identification for Targeting Educational Risk (SIFTER) [10]. In these questionnaires teachers have to rate their students based on their listening behavior (TEACH, TEAP) or overall performance (TLI, SIFTER) in class. There is however only one questionnaire that thoroughly assesses the specific listening difficulties in classroom by means of both teacher and self-report, i.e. the Listen Inventory for Education (LIFE). Anderson et al. published a first edition in 1998, which was later revised with 15 up-to-date listening situations (LIFE-R, [11]). In addition to the identification of difficult listening situations in class, the LIFE-R gives insight into the listening environment and listening strategies of the child, as well as their self-advocacy skills. By extension the LIFE-R can be used as an evaluation tool for classroom interventions in pre- and post-test format. In this format the LIFE-R was used in a few recent studies to measure the effectiveness of a specific intervention, for instance for the evaluation of electrical acoustic stimulation [12] and Frequency Modulating systems [13] (both studies included the teacher appraisal only). Zanin and Rance [14] assessed the benefit of assistive listening devices in mainstreamed students with hearing loss (12–18 years) with both teacher and student appraisal. In the latter study listening with CI only (pre-test condition) was compared to listening with CI and a remote microphone (post-test condition). With the remote microphone significantly higher scores were obtained for speech perception in babble noise and the LIFE-R (student and teacher appraisal). Mean scores of the LIFE-R of students were 49.6% (SD = 23.07%) in pre-test versus 70.8% (SD = 18.19%) in post-test condition, whereas teachers scored their students 56.7% (SD = 23.14%) and 73.2% (SD = 22.06%) respectively. This result demonstrate that the LIFE-R can provide interesting information about the listening difficulties of D/HH students in mainstream classes and it seems to be a sensitive tool to measure changes in listening experience by classroom interventions.

The growing percentage of CI students in mainstream education in Flanders, the Dutch speaking part of Belgium, increases the need for proper assessment tools in Dutch. In the Netherlands, it already has been shown that normal-hearing peers outperform their mainstreamed CI students on their communication skills at school (kindergarten and elementary schools) [15]. These results were obtained with the Dutch version of the SIFTER questionnaire, which only includes 3 questions concerning communication, more specifically about the receptive and expressive language skills, but does not give detailed information about their specific communication needs and possible listening difficulties in classroom.

To date, no detailed assessment tool in Dutch is available to identify potential listening difficulties in class. To respond to this shortcoming the LIFE-R was translated and validated into Dutch and normative data of secondary school-age students were collected.

2. Method

2.1. LIFE-R materials

The LIFE-R includes a student and a teacher appraisal. The student appraisal comprises 3 parts: the Before LIFE-R, the student LIFE-R and the After LIFE-R. The Before LIFE-R describes the listening environment of the student in class by means of 6 multiple-choice questions. The student LIFE-R evaluates the challenge of 15 typical listening situations in school on a 5-point-Likert scale (10-7-5-2-0 with 0 for 'always challenged' up to 10 for 'no challenge'). The first 10 listening situations describe classroom activities (LIFE class) complemented by 5 additional social listening situations (LIFE social). In total (LIFE total), 150 points or 100% (no challenge) could be obtained. The After LIFE-R, describes the student's listening strategies by means of six multiple-choice questions.

The teacher appraisal comprises two parts: the teacher LIFE-R and Self-advocacy skills. In the teacher LIFE-R, the teachers have to estimate the challenges of the student by rating 15 items on a 5-point Likert scale. A score between 15 (always challenged) and 75 (no listening challenge) can be obtained. In the self-advocacy questionnaire, teachers have to rate how often and in which situations the student is using self-advocacy strategies in the classroom. For this part 8 situations have to be evaluated on a 5-point Likert scale.

2.2. Translation and linguistic validation

The LIFE-R was translated into Dutch, based on the guidelines of Guillemin, Bombardier [16]. Guillemin and colleagues [16] suggested several translations and back-translations in order to create a methodological substantiated translation.

First, two independent translations were performed by two persons with mother tongue Dutch and professional proficiency in English. A multidisciplinary committee was assembled to compare both translations and to generate a first version (LIFE-NL version 1). The committee consisted of a teacher, a speech and language pathologist and an audiologist, all of them working with D/HH children.

Secondly, LIFE-NL version 1 was translated back into the source language (English), by a translator with mother tongue English. The back translation was compared to the source questionnaire to check for equivalence. Based on this comparison adaptations were made to LIFE-NL version 1 by the committee and a second version (LIFE-NL version 2) was generated. The adaptations were approved by the author of the original LIFE-R.

2.3. Content validation

To validate the Dutch translation, the questionnaire (LIFE-NL version 2) was pre-tested in a small subject group, consisting of 5 D/HH children for the validation of the student appraisal. The D/HH children were recruited from the Ear, Nose, Throat department of the University Hospital of Ghent. Subjects were 8–13 years old and enrolled in mainstream elementary (n = 2) or secondary education (n = 3). The children were fitted with hearing aids (1) or cochlear implants (4) (see Table 1 for full demographics).

The teacher appraisal was administered in 5 teachers. In elementary schools the teacher of the child was interviewed (n = 2), whereas in secondary school the tutor of the child was interviewed (n = 3).

The questionnaires were validated in a semi-structured interview by means of a probe technique. After each question, the following probe question was asked: "Wat bedoel je?" (What do you mean?). This technique enabled us to verify whether the translation was properly interpreted and if the questionnaire was, therefore, valid. For the interviews with the two youngest children (subject 1 and 2) the LIFE-R with the accompanying photos of the English LIFE-R version were used.

Table 1
Demographics of five D/HH students included for the pre-testing of LIFE-NL.

Subject	Age (y,m)	HA or CI	Age of implantation (y,m)	School	Grade
1	10,3	HA	N/A	Elementary	5th
2	11,3	BiCI	0,6 and 1,3	Elementary	6th
3	14,6	UniCI	1,4	Secondary	3rd
4	13,5	UniCI	0,9	Secondary	2rd
5	14,7	UniCI	1,5	Secondary	3rd

Years (y), months (m), hearing aid (HA), Unilateral CI (UniCI), Bilateral CI's (BiCI).

2.4. Concept validation and cross-cultural adaptation

The questionnaires were checked on concept equivalence for listening situations in Belgium (cross-cultural validation). The D/HH children were asked if the listening situations often occur at their school or in their classroom. This question allowed us to identify typically American listening situations opposed to Belgian situations. If situations did not occur in Belgium, these items were adjusted to more typical listening situations in Belgium.

2.5. Normative data

The questionnaires were filled out in 11 different classes in secondary schools in Belgium, see Table 2 for the specifications of the participating classes. The classes are classified in A-stream and B-stream classes for the first cycle (1st and 2nd grade). In 3rd grade, the classes are further divided into three types: general secondary education (ASO), technical secondary education (TSO) and vocational secondary education (BSO).

For the collection of normative data the questions or answers related to hearing loss were omitted to avoid confusion in the normal-hearing students and to minimize the focus on their D/HH peer (see demarcations (**) in Appendix B).

In both the before LIFE-NL and the after LIFE-NL question 6 was omitted ('How do you feel about listening with your hearing equipment in class' and 'What would you do if your listening technology is not working?').

Omitted answers were reported as 'OM' in the analyses. In the after LIFE-NL an additional thick box with 'not applicable' was added to the answers.

The local Ethics Committee approved the study and all participants and their parents signed informed consent prior to participation.

2.6. Statistical analysis

Statistical analysis were performed with IBM SPSS statistics version 22.0 (SPSS Inc., Chicago, Illinois). Normality of the data was evaluated with QQ plots and Shapiro Wilk tests. Differences between groups and classes were determined with One-way ANOVA and Kruskal-Wallis tests depending on the normality of the data. Differences between subscales LIFE class and LIFE social were analysed with the Wilcoxon signed-rank test. Results were considered to be statistically significant for p values less than 0.05.

The internal consistancy reliability of the LIFE listening situations of the student appraisal was analysed by determining the Cronbach's coëfficient alpha. A coëfficient of 0.7 or more represents good internal consistancy [17]. Cronbach's alpha was calculated for the 15 listening situations (LIFE total) and for the class and social listening situations separately (LIFE class and LIFE social respectively).

Table 2
Information of eleven included classes: grade, type of school (A or B stream for first cycle or ASO, TSO BSO for second cycle) and class size.

Class number	Grade	Type of school	Class size
1	1st	A	13
2	1st	A	18
3	1st	A	15
4	1st	B	9
5	1st	B	15
6	2nd	A	22
7	2nd	A	21
8	2nd	A	17
9	3rd	ASO	19
10	4th	ASO	23
11	4th	TSO	15

3. Results

3.1. Translation and linguistic validation

The LIFE-R was successfully translated into the LIFE-NL (see Appendix A). Ambiguities were eliminated based on feedback from the author of the original version and our multidisciplinary committee.

3.2. Content validation

The D/HH children had no problems with the interpretation of the questions and the possible answers but needed in some cases help with complex sentence structures. Complex sentences from the verbatim translation were therefore replaced in the final version by semantically equivalent sentences to enhance readability and comprehension. For the interviews with the two youngest children (subject 1 and 2) the LIFE-R with the accompanying photos were used. Although this visual feedback helps them to engage with the questionnaire, it was considerable more difficult for them to differentiate between the listening situations and to make a realistic estimate of their hearing capability in these situations.

3.3. Concept validation and cross-cultural adaptation

One item of the student LIFE-R did not occur in class according to the D/HH children in pre-test condition, i.e. the listening situation in which announcements are played from speakers in class. This item was replaced by the item 'how well do you understand the teacher in gym class'.

Moreover, the translation was further adapted for use in secondary schools. 'Teacher' was substituted by 'tutor' and 'in class' was specified with 'during the lessons with your tutor' (LIFE2-NL, Appendix B).

3.4. Weighting scores

The amount of items to score is in the Dutch version is identical to the original version. The scoring method of the original LIFE-R could therefore be retained. Nevertheless, we noticed that the teacher appraisal of the original LIFE-R, which also includes 15 listening situations, uses another weighting scale compared to the student version. By equalizing the scoring method for both appraisals, a more adequate comparison is allowed.

3.5. Normative data

Normative data of 187 students were collected with the student appraisal of the LIFE2-NL.

3.5.1. Before LIFE2-NL

Results of the multiple-choice questions of the before LIFE2-NL were plotted in bar charts representing the percentage of cases checked by the students (Fig. 1). Each student was allowed to check multiple answers for each question. The total amount of checked answers are displayed in the subtitles of the figures for each question. Omitted

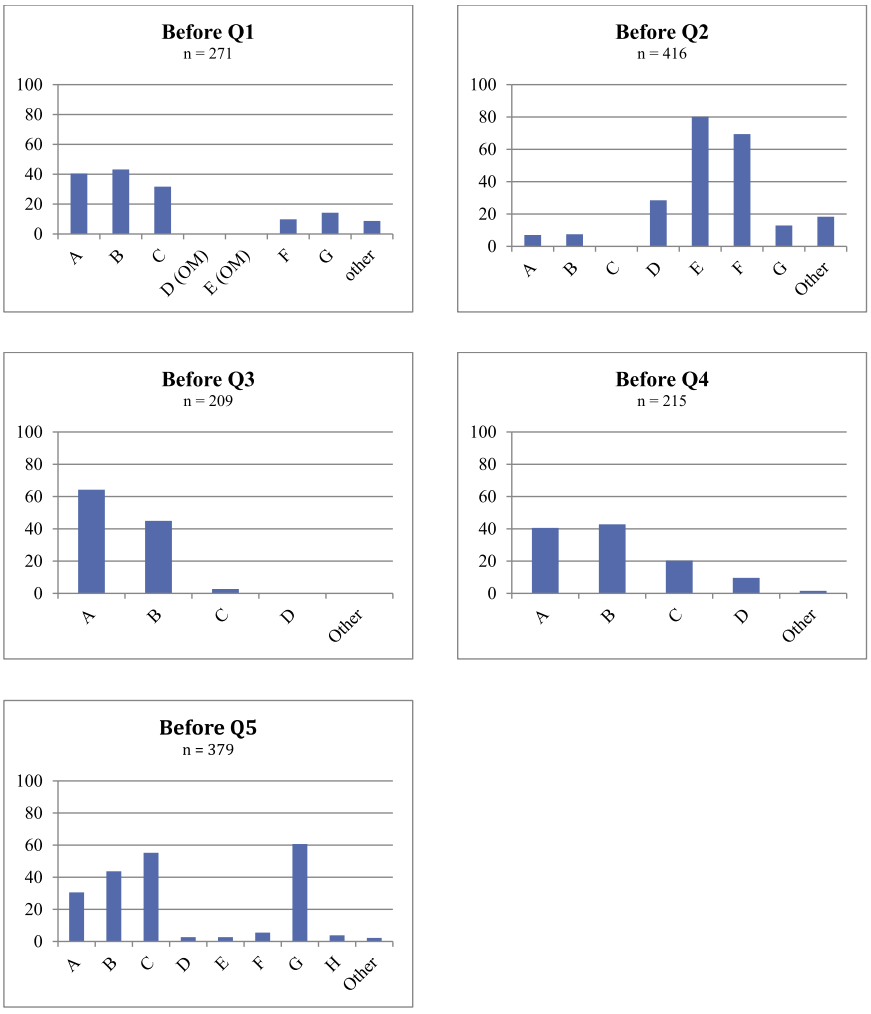

Fig. 1. Plots of frequency percentages of checked answers for the Before LIFE2-NL administered in 11 classes (N = 187). Amount of checked answers for each questions are tabulated in the subtitles. 'OM' means that this answer option was omitted for the normal-hearing children.

answers are indicated with the letters 'OM'. The 'other' possibilities were listed in Appendix C for the 5 before LIFE2-NL questions.

For question 1 (Q1), question 4 (Q4) and question 5 (Q5) all possible answers were checked at least one time. Interfering noises in classroom never originate from an aquarium in class (question 2, Q2). For question 3 (Q3) normal-hearing students indicate in most of the cases they hear their teacher well, whereas 'not at all' and 'other' were never checked.

3.5.2. LIFE2-NL

Normal-hearing students achieved on average 72.0% (SD = 13.9%) on the 15 LIFE listening situations (LIFE total). This means that normal-hearing students experience 'sometimes difficulties' in school settings. The listening situations experienced as most difficulties are: listening when other students make noise (sit6, 5.8 ± 2.4), listening simultaneous large and small group.

(sit10, 6.0 ± 2.4) and listening in a large room (sit 13, 6.1 ± 2.5) (see Fig. 2 for full overview of the 15 listening situations). The classroom listening situations (LIFE class) are on average experienced as less effortful compared to the social listening situations (LIFE social) (84.1 ± 14.7% vs. 68.1 ± 19.0%). This difference was statistical significant (Wilcoxon signed rank test, $Z = -9.153$, $p < 0.000$).

When comparing the two subscales separately for the different grades (1st to 4th grade) we notice an interesting borderline significant trend, i.e. that the scores for LIFE class stagnate across grades (Kruskal Wallis, $X^2(3) = 6.167$, $p = .105$), but the scores for LIFE social decline in higher grades (Kruskal Wallis, $X^2(3) = 7.720$, $p = .052$). The LIFE total scores were also significant different across grades (One-way ANOVA, $F(3) = 3.115$, $p = .028$). Post hoc tests showed a significant lower score in the 3rd grade (Tukey HSD, $p = 0.032$).

When comparing the LIFE total, LIFE class, LIFE social between A-stream with B-stream no statistical differences could be found.

3.5.3. After LIFE2-NL

Results for the After LIFE2-NL are depicted for each question (Q1 to Q5) in Fig. 3. In the after LIFE2-NL all possible answers were checked, including the thick box for 'other' and 'not applicable'. The 'other' possibilities were listed in Appendix C.

Overall normal-hearing students tend to use assertive listening strategies, but these are more pronounced in social activities (Q4-Q5) compared to the classroom activities (Q1-Q2). For instance in Q2 where 30.8% of the students indicated they would do nothing if they did not hear their teacher due to noise in classroom.

3.6. Internal consistency

Cronbach's alpha was 0.86 for the LIFE total. For the subscales Cronbach's alphas of 0.89 and 0.75 were found for the LIFE class and LIFE social respectively.

4. Discussion

Although children with CI's seem to perform well in mainstream education they could encounter communication problems in classroom [15]. These communication problems may occur during difficult listening situations and are often hard to identify by mainstream teachers.

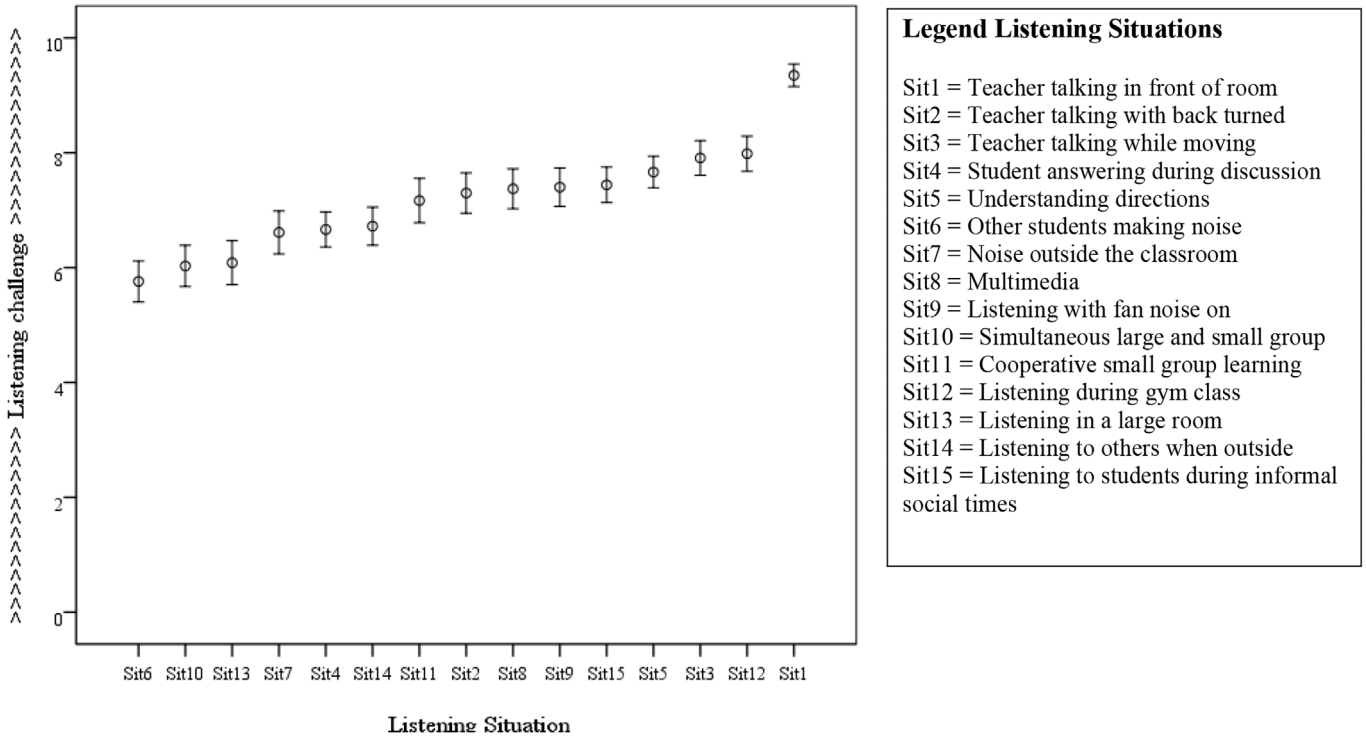

Fig. 2. 95% confidence intervals based on the standard error of the mean for the 15 LIFE-R listening situations (sit1 to sit15) from 187 normal-hearing students. Intervals were plotted in order of perceived difficulty, with the most difficulties on the left and easiest listening difficulties on the right.

However, these problems should not be neglected as they may entail important education risks. In Belgium increasingly more CI users enter mainstream education but no behavioural assessment tool is currently available in Dutch to identify potential listening difficulties. For this reason, the LIFE-R was translated and validated into Dutch. We managed to develop a valid Dutch translation (LIFE-NL) that is fully comprehensible for D/HH students. The content of the translation was validated by means of probe questioning in 5 D/HH children with hearing aids or cochlear implants (10–15 years). The 15 'listening situations in classrooms' were adapted to situations that occur in Flemish schools to which the students can relate (cross cultural validation).

When the LIFE-R is administered with the set of accompanying photos of the English LIFE-R version it is applicable in children from 8 years and older [11]. However, when performing the pre-testing in young students we noticed that children in elementary schools found it more difficult to accurately respond to the questions and empathize with the listening situations. Different studies also show that younger children tend to overestimate their abilities in self-reports (see Ref. [18] for a comprehensive review of self-report results in CI children). For this reason we believe that the LIFE-NL is ideal for D/HH students in secondary schools. Hence, the LIFE-NL was further adapted to use in secondary schools, where students have different classes from different teachers (LIFE2-NL, Appendix B).

Data were collected with the adapted questionnaire for secondary education from 187 normal-hearing students in 11 secondary schools (age 12–15 years). The normative data allows us to interpret the results of students with hearing loss compared to the "average" hearing student in class. Results show that normal-hearing students experience some difficulties in mainstream schools with an average total score of 72.0% (SD = 19.9%) on the LIFE2-NL listening situations. The most difficult listening situations were those where fellow students are noisy or when students have to listen in large classrooms. Exhaustive background noise will diminish speech comprehension in class, even for normal-hearing students [19]. Signal to noise ratio's (SNR's) of +10 or +15 dB are recommended for optimal hearing and learning in classroom [20]. Nevertheless, in occupied classrooms poorer SNR's were measured ranging from +5 to −7 SNR [21]. In larger classrooms the distance between teacher and student increases, which affects the intensity of the speech signal, i.e. with 6 dB for every doubling of distance (inverse square law).

Subsequently, speech comprehension may be affected by reverberation in class.

Late reflections can distort the temporal and spectral cues of the speech signal and flatten formant transitions [22,23]. Several studies showed that the combination of both noise and reverberation results in a greater detrimental effect on speech comprehension than the individual effects separately [20,23,24]. For children with hearing impairment and limited access to the speech signal, the combination can be highly disruptive [22].

Furthermore, results show that normal-hearing students experience significantly more listening difficulties in social listening situations at school compared to the listening situations in classroom. In social listening situations background noise may increase, resulting in even more difficulties to communicate. These difficulties seem to increase when students progress to 3rd or 4th grade. This increase in reported difficulties could have several reasons. Younger adolescents tend to have a more positive self-image and higher social acceptance than older adolescents [18]. Older adolescents might thus be stricter regarding their psycho-social well-being and how well they fit in when filling out questionnaires about their social activities. Moreover, some schools separate first cycle (1st and 2nd grade) from the higher grades in secondary schools in Belgium ("mid school" vs. "high school"). In high school the rooms where social activities take place are usually larger and the amount of students increase.

Finally, the reliability of the questionnaire was explored by means of the Cronbach's alpha, which indicated high internal consistency for the LIFE total scale, as well as for the two subscales, LIFE class and LIFE social.

Based on the results of the normative data new suggestions for adaptations of the LIFE2-NL students arose. In the before LIFE2-NL, nobody checked 'aquarium' as an interfering noise, whereas 11 persons indicate they heard the beamer in classroom. In the After LIFE2-NL,

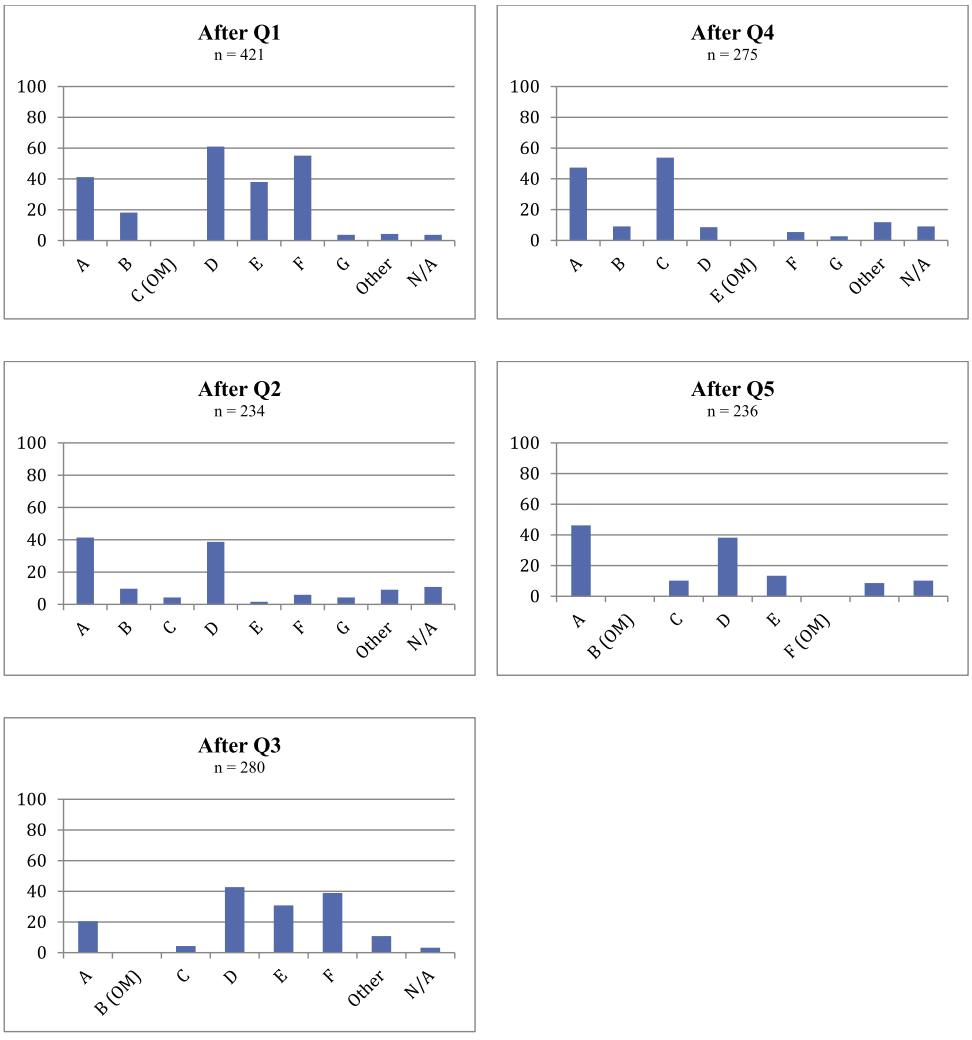

Fig. 3. Plots of frequency percentages of checked answers for the AFTER LIFE2-NL administered in 11 classes (N = 187). Amount of checked answers for each questions are tabulated in the subtitles. 'OM' means that this answer option was omitted for the normal-hearing children.

students answered 'they would just ask' if they could not hear their peers in social interactions outside the class (Q4). These adaptations were added to the final version of the LIFE2-NL that will be freely available on the website of the original LIFE-R (http://successforkidswithhearingloss.com/).

5. Conclusion

The LIFE-NL and LIFE2-NL are both unique tools that can support Dutch teachers in mainstream education in determining the listening difficulties of their D/HH students.

These listening difficulties should be further explored with the LIFE2-NL questionnaires and compared to the normative data collected in the current issue. Once the hearing difficulties are identified, teachers can try to accommodate their students with additional technology, class interventions and self-advocacy skills. By minimizing the listening difficulties in classroom, optimal auditory access will be provided at school and this will have a beneficial effect on the participation and overall performance of D/HH students in mainstream schools.

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None of the authors have a conflict of interest.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ijporl.2018.01.018.

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