Measuring the Ability of School Children with a History of Otitis Media to Understand Everyday Speech

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Abstract

The present study compared the ability of school-aged children with and without a history of otitis media (OM) to understand everyday speech in noise using the University of Queensland Understanding of Everyday Speech Test (UQUEST). Participants were 484 children (246 boys, 238 girls) attending Grade 3 (272, mean age = 8.25 yr., SD = 0.43) and Grade 4 (212, mean age = 9.28 yr., SD = 0.41) at 19 primary schools in Brisbane metropolitan and Sunshine Coast schools. Children selected for inclusion were native speakers of English with normal hearing on the day of testing and had no reported physical or behavioral impairments. The children were divided into three groups according to the number of episodes of OM since birth. The results showed no significant differences in speech scores across the participant groups. However, a significant difference in mean speech scores was found across the grades and the noise conditions. Although children with a history of OM performed equally well at a group level when compared to the controls, they exhibited a large range of abilities in speech comprehension within the same group.

Key Words: Connected discourse, everyday speech, otitis media, speech perception

Abbreviations: OM = otitis media; SES = socioeconomic status; SNR = signal-to-noise ratio; TTP = tympanometric peak pressure; UQUEST = University of Queensland Understanding of Everyday Speech Test

Sumario

El presente estudio compara la capacidad de los niños de edad escolar, con o sin historia de otitis media (OM) para entender el lenguaje cotidiano en ruido, utilizando la Prueba de la Universidad de Queensland para Entender Lenguaje Cotidiano (UQUEST). Los participantes fueron 484 niños (246 varones y 238 niñas), asistiendo a un tercer grado (272, edad media = 8.25 años, DS = 0.43) y a un cuarto grado (212, edad media = 9.28 años, DS = 0.41), en 19 escuelas primarias en el área metropolitana de Brisbane y en Sunshine Coast. Los niños seleccionados eran angloparlantes naturales con audición normal en el día de la prueba, y no tenía ningún reporte de alteraciones físicas o conductuales. Los niños fueron divididos en tres grupos de acuerdo a número de episodios
Early childhood, in which otitis media (OM) is most prevalent, is a critical developmental period for many skills, including speech and language. Children generally experience their first episode of OM at about 6 to 18 months of age. This is followed by a second prevalence peak, which occurs at around four to six years (Haggard and Hughes, 1991). OM may lead to a temporary, fluctuating conductive hearing loss, due to the possibility of fluid in the middle ear. Hence, conductive hearing loss associated with OM in early childhood may be considered as a type of early auditory deprivation.

While the negative effect of a permanent sensory hearing loss on language and communication development has been well documented, no consensus to date has been reached on the effects of OM on the speech and language development of young children (Friel-Patti, 1990). Some studies show that children with histories of otitis media have significantly poorer phonological and communication skills (e.g., Ruben et al, 1997; Miccio et al, 2001; Petinou et al, 2001). In contrast, Roberts et al (1991) found no relationship between having had early episodes of OM and later language development.

To date, the majority of research in this area has focused on the perception of various aspects of speech as the stimuli. For example, nonsense syllables (Mody et al, 1999), stop consonants (Groenen et al, 1996), monosyllables in quiet (Grievink et al, 1993; Williamson and Sheridan, 1994), monosyllables in noise (Schilder et al, 1994), and sentences in competition (Jerger et al, 1983; Gravel and Wallace, 1992; Brown, 1994) have been used. It may be hypothesized that deficits in one or a combination of these aspects of speech perception can lead to a deficit in understanding everyday speech such as continuous discourse. However, no studies that measure the ability of children with a history of OM to understand everyday speech in background noise have been reported. This measure of speech understanding is important because reports from parents and teachers often indicate that children with a history of OM fail to follow instructions or comprehend conversations (Feagans, 1986; Haggard and Smith, 1997).

Tests that measure children’s understanding of connected speech have been implemented using excerpts of television news broadcasts as the speech stimuli (Kei and Smyth, 1996, 1997). These tests showed that, in general, children with hearing loss performed poorly when compared to their normal-hearing peers and that more favorable signal-to-noise ratios (SNR) enhance performance. However, the speech stimuli used in these tests may not be representative of the speech children use in their daily lives.
Clinically, in developing a speech test for children, the language and cognitive capability of children should be considered (Boothroyd, 1995). To this end, the University of Queensland Understanding of Everyday Speech Test (UQUEST) was developed (Kei et al, 2003). Preparation of the speech material for the UQUEST was based on observations made while children from three to six years were involved in daily life activities. The UQUEST, a computer-based program, is intended to measure the understanding of everyday speech in background noise by children aged between six and ten years. In the UQUEST, speech in noise is accompanied by the simultaneous presentation of video animations on a computer screen. The video animations serve to attract a child's attention without providing cues such as lipreading. The UQUEST provides an interactive, self-paced test environment for each child, and it has been standardized on children studying in Grades 3 and 4 (aged eight and nine years) (Kei et al, 2003). In the present study, the UQUEST was used to investigate the effects of OM on the ability of children to understand everyday speech.

There are a multitude of risk factors associated with OM, including gender and socioeconomic status (SES). Studies show that prevalence rates of OM for boys are slightly higher than that for girls (Pukander et al, 1982; Teele et al, 1990). However, the literature does not provide a clear relationship between SES and OM. For instance, Nittrouer (1996) suggests that low SES increases the risk of the sequelae of OM (e.g., delayed speech and language development), while Roberts et al (1991) could not find any relationship between low SES and OM. Consequently, it remains to be proven whether there is a clear association among OM, SES, and speech perception results.

The primary aim of the present study was to compare the ability of eight- to ten-year-old children with and without significant histories of OM to understand everyday speech in noise. The secondary aims were to evaluate whether children perform differently on the UQUEST in two different signal-to-noise (SNR) conditions and to determine whether socioeconomic factors have any affect on the speech understanding performance of children.

**METHOD**

**Participants**

Participants were 484 children (246 boys, 238 girls), attending Grade 3 (272, mean age = 8.25 yr., SD = 0.43) and Grade 4 (212, mean age = 9.28 yr., SD = 0.41) at 19 primary schools in the Brisbane metropolitan and Sunshine Coast areas in Australia. Parents were required to complete a consent form and a questionnaire containing relevant background and demographic information. Participation in the study was voluntary. The children selected for inclusion were native speakers of English with normal intelligence (as reported by the teachers) and no physical, behavioral, or sensory problems (as indicated by the parental questionnaire). All children were required to pass a pure-tone screening test and tympanometry (see “Procedure” section below) in order to be included in the current study. In the present investigation, the children were divided into groups according to the number of incidents of OM since birth as reported by parents. Children with less than four episodes of OM served as the control group (Group 1). Children with between four and nine episodes of OM formed a group with a mild history of OM (Group 2), and children with ten or greater episodes were classified as having a moderate to severe history of OM (Group 3) (see Table 1). These groupings, especially

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of episodes of OM (range, mean, SD)</th>
<th>Total number of children</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 – 3, 1.5, 1.2</td>
<td>229</td>
</tr>
<tr>
<td>2</td>
<td>4 – 9, 5.4, 1.3</td>
<td>173</td>
</tr>
<tr>
<td>3</td>
<td>10 – 40, 14.6, 6.3</td>
<td>82</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>484</td>
</tr>
</tbody>
</table>
Groups 2 and 3, were made according to the frequency of occurrence of OM in early childhood (Nittrore, 1996). Children from a variety of socioeconomic backgrounds, as determined by parents’ education level and family income, were recruited (see Table 2). Four levels of annual family income were used in the present study: (1) less than AUS$30,000, (2) AUS$30,000–59,000, (3) AUS$60,000–89,000, and (4) equal to or greater than AUS$90,000. The lowest income bracket was chosen in accordance with the median annual income of AUS$43,784 released by the Australian Bureau of Statistics (2001). Hence, families with an annual income of less than AUS$30,000 were considered poor (Bittman and Pixley, 1997).

TABLE 2. Demographic Information of the Participants (N = 484)

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest education level attained by parents</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1(20%)</td>
<td>3(60%)</td>
<td>1(20%)</td>
<td>5(100%)</td>
</tr>
<tr>
<td>Secondary</td>
<td>58(44%)</td>
<td>51(39%)</td>
<td>23(17%)</td>
<td>132(100%)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>141(49%)</td>
<td>102(35%)</td>
<td>47(16%)</td>
<td>290(100%)</td>
</tr>
<tr>
<td>Mother</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>0(0%)</td>
<td>1(100%)</td>
<td>0(0%)</td>
<td>1(100%)</td>
</tr>
<tr>
<td>Secondary</td>
<td>75(43%)</td>
<td>70(40%)</td>
<td>31(17%)</td>
<td>176(100%)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>128(50%)</td>
<td>85(34%)</td>
<td>41(16%)</td>
<td>254(100%)</td>
</tr>
<tr>
<td>Annual Family Income (AUS$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30,000</td>
<td>22(42%)</td>
<td>24(45%)</td>
<td>7(13%)</td>
<td>53(100%)</td>
</tr>
<tr>
<td>30,000–59,999</td>
<td>39(38.5%)</td>
<td>39(38.5%)</td>
<td>23(23%)</td>
<td>101(100%)</td>
</tr>
<tr>
<td>60,000–89,999</td>
<td>44(50%)</td>
<td>36(40%)</td>
<td>9(10%)</td>
<td>88(100%)</td>
</tr>
<tr>
<td>≥90,000</td>
<td>53(54%)</td>
<td>30(31%)</td>
<td>15(15%)</td>
<td>98(100%)</td>
</tr>
</tbody>
</table>

Note: Since completion of the demographic subsection of the questionnaire was optional, the column total does not add up to 484. Groups 1, 2, and 3 represent children with 0–3, 4–9, and ≥10 episodes of otitis media since birth. Row percentages are provided in parentheses.

Any abnormal conditions of the ear canal, which would confound test results.

Tympanometry

A Madsen Zodiac 901 Middle Ear Analyser, calibrated daily according to the manufacturer’s specifications, was used to evaluate middle ear function in children. A “pass” was awarded if a type A or C tympanogram (normal compliance and tympanometric peak pressure [TTP] > -200 daPa) was obtained. In cases other than a Type A or C tympanogram, tympanometry was repeated to confirm the findings. Children with Type B (severely reduced compliance) or C tympanograms (normal compliance and TTP ≤ -200 daPa) on the day of testing failed the screening and were excluded from the study.

Pure-Tone Screening

Children were tested using a Madsen screening audiometer (Micromate 304), calibrated to Australian Standard AS 1591.2 – 1987. The audiometer was fitted with ME70 noise-excluding headsets to attenuate background noise. Pure tones at 500, 1000, 2000, and 4000 Hz were presented to each ear at an intensity of 20 dB HL. This intensity level represents a conservative approach to pass/fail criteria based on a compromise between true thresholds and thresholds obtainable in non–sound treated rooms in available room within each school. The ambient noise, as measured using a CEL Instruments CEL 254 sound level meter calibrated to Australian Standard AS1259 – 1982, ranged from 30 to 50 dBA (mean = 38.8 dBA, SD = 3.4). The children were assessed, one at a time, using the procedures in the following order.

Otoscopy

A visual inspection of each individual’s ears with a handheld otoscope was conducted to exclude children with impacted wax or...
school testing sites. If a child failed to respond twice to three consecutive presentations at any frequency at 20 dB HL, the hearing threshold for that frequency was determined using the Hughson Westlake procedure. A failure on this test occurred if the hearing threshold at any frequency exceeded 20 dB HL in either ear. Failure of pure-tone screening or tympanometry indicated a failure of the overall screening. These children were referred for medical advice from their family doctor. Children who passed pure-tone screening and tympanometry, and met all participant inclusion criteria, were assessed using the UQUEST.

Speech Test Using the UQUEST

The speech material consisted of six test passages and two training passages of connected discourse. In standardizing the UQUEST for use with children aged seven to ten years, Kei et al (2003) found the six test passages to be of comparatively equal difficulty across the two noise conditions utilized in the present study. The duration of the test passages ranged from 31–40 sec (mean = 36.5 sec, SD = 2.9) (see Appendix A for a sample passage with questions). Preparation of speech material for the UQUEST was based on observations made by an audiologist while children from three to six years were involved in real life situations such as birthday parties, eating out at restaurants, spending a day at the kindergarten, and visiting parks and playgrounds. Anecdotal material from mothers regarding the conversations of their children was also included in the speech material. The dialogues of each passage were constructed, simplified, and shortened to provide an age-appropriate language level for six-year-old children.

The speakers for recording the speech material of the UQUEST were native speakers of English. The recording of the speech material was conducted in a language laboratory studio with an ambient noise level of below 25 dBA. A wide-band noise (speech noise) was mixed with the speech signal to create two noise test conditions (SNR of +5 and 0 dB). These conditions were chosen to represent the SNRs commonly experienced in a standard classroom (Bess et al, 1984).

The UQUEST was installed on a Compaq Presario laptop computer that was coupled to an Angus and Coote Portable diagnostic audiometer PD1. The speech material was delivered binaurally at 65 dB SPL to a child’s ears via a pair of Telephonics TDH-39 headphones with the simultaneous presentation of video animations. In the development of the UQUEST, extreme care was taken to avoid the provision of visual cues from the video animations, which may assist a child to identify a correct answer.

The following instructions were given verbally to each child before the test began:

You will watch a video on the screen of the computer. I want you to listen carefully to the video. At the end of the video, you’ll have to answer four questions. The questions will appear on the computer screen and will be read out to you. Use the mouse to click on the correct answer. You can choose your answer as soon as you are ready. After you have finished the last question, press the spacebar to begin the next video.

Adequate training was provided to a child using two training passages until the child was familiar with the test. Once the tester was satisfied that the child understood all test instructions, speech testing commenced. During the actual testing, a test passage was randomly chosen from the pool of six test passages and presented to the child at an SNR of either +5 or 0 dB. This process was repeated until all six passages had been presented. The two SNR conditions were applied to the six passages in a random but balanced order (i.e., three passages for each SNR condition).

After the presentation of each video, the child was asked four content-related questions. The questions were presented to the child both auditorily via headphones and visually as written text on the computer screen. The child was requested to choose an answer from among four choices by clicking on the answer with the computer mouse. One mark was awarded to each correctly answered question. Thus, scoring for each passage ranged from 0 to 4.

RESULTS

All 484 children completed otoscopy, tympanometry, pure-tone screening, and the UQUEST. The entire test procedure took 20–30 minutes to complete.

Figure 1 shows the mean and standard deviation of the speech scores across the two noise conditions (SNR = 0 dB and 5 dB) for
the three participant groups. As shown, the mean scores for the three groups were similar for each noise condition. An examination of the raw data showed a greater range of speech scores for Group 2 and Group 3 than for Group 1 (at SNR = 0 dB, Group 1: 1.67 to 4; Group 2: 0.67 to 4; Group 3: 0.33 to 4). The mean scores of the three groups for the more difficult noise condition (SNR = 0 dB) were poorer than those for the easier noise condition (SNR = 5 dB).

Due to a lack of normalcy in the distribution of speech scores for each subject group, the speech scores were transformed using the Arcsine function. A factorial model that included two factors (group and noise conditions) and all interactions was fitted to the data with speech scores as the dependent variable. The significance of any term was assessed using an analysis of variance (ANOVA). The results showed a significant main effect for the noise condition ($F[1, 481] = 80.99, p < 0.0001$), with a higher speech score for the 5 dB SNR than the 0 dB SNR condition. However, the group effect and the group $\times$ noise condition interaction did not reach significance at the 95% confidence level.

Figure 2 shows the mean and standard deviation of the speech scores across the two noise conditions (SNR = 0 dB and 5 dB) for children studying in Grades 3 and 4. The mean number of episodes of OM since birth was 5.33 for Grade 3 and 5.32 for Grade 4 children. An ANOVA to examine the effects of grade and noise condition on speech scores was applied to the data. The results revealed a main effect for grade ($F[1, 482] = 11.20, p = 0.001$), with Grade 3 children having a significantly lower score than Grade 4 children. The effect for noise condition was also significant ($F[1, 482] = 87.84, p < 0.0001$), with a significantly lower score for the 0 dB SNR condition than for the 5 dB SNR condition. The grade $\times$ noise condition interaction was not significant.

Table 4 shows the speech scores obtained for the three groups of children under two noise conditions ($N = 484$). Groups 1, 2, and 3 represent children with 0–3, 4–9, and ≥10 episodes of OM since birth. The vertical bars represent one standard deviation from the mean.
from the three participant groups across four categories of family income for both noise conditions. To examine the effects of family income and noise condition on speech scores, an ANOVA with repeated measures on noise conditions was applied separately to each group of children. The results showed that apart from the significant main effect for the noise condition, no effect for family income or family income × noise interaction was found.

Table 4. Mean (standard deviation) Speech Scores

<table>
<thead>
<tr>
<th>Noise Condition</th>
<th>Family Income Categories</th>
<th>Group Mean (SD)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNR = 0 dB</td>
<td>&lt;$30,000</td>
<td>2.89(0.59)</td>
<td>3.10(0.70)</td>
<td>3.19(0.77)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$30,000-$59,999</td>
<td>3.08(0.55)</td>
<td>3.06(0.52)</td>
<td>3.13(0.66)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$60,000-$89,999</td>
<td>3.20(0.51)</td>
<td>3.30(0.45)</td>
<td>3.11(0.55)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥$90,000</td>
<td>3.14(0.43)</td>
<td>3.21(0.47)</td>
<td>3.22(0.87)</td>
<td></td>
</tr>
<tr>
<td>SNR = 5 dB</td>
<td>&lt;$30,000</td>
<td>3.30(0.45)</td>
<td>3.36(0.75)</td>
<td>3.43(0.42)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$30,000-$59,999</td>
<td>3.40(0.62)</td>
<td>3.37(0.75)</td>
<td>3.28(0.86)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$60,000-$89,999</td>
<td>3.45(0.43)</td>
<td>3.56(0.41)</td>
<td>3.52(0.34)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥$90,000</td>
<td>3.54(0.37)</td>
<td>3.48(0.52)</td>
<td>3.38(0.91)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Groups 1, 2, and 3 represent children with 0–3, 4–9, and ≥10 episodes of OM since birth.

Figure 2. Mean UQUEST scores under two SNR conditions for 272 Grade 3 and 212 Grade 4 children. The vertical bars represent one standard deviation from the mean.

Table 3. Mean (standard deviation) Speech Scores Obtained from 246 Boys and 238 Girls for the Two Noise Conditions (SNR = 0 dB and 5 dB)

<table>
<thead>
<tr>
<th>Noise Condition</th>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNR 0 dB</td>
<td>Male</td>
<td>3.12(0.55)</td>
<td>3.17(0.55)</td>
</tr>
<tr>
<td>SNR 5 dB</td>
<td>Female</td>
<td>3.42(0.55)</td>
<td>3.41(0.53)</td>
</tr>
</tbody>
</table>

Table 4. Mean (standard deviation) Speech Scores

<table>
<thead>
<tr>
<th>Noise Condition</th>
<th>Family Income Categories</th>
<th>Group Mean (SD)</th>
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</tr>
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<tbody>
<tr>
<td>SNR = 0 dB</td>
<td>&lt;$30,000</td>
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<td>3.10(0.70)</td>
<td>3.19(0.77)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$30,000-$59,999</td>
<td>3.08(0.55)</td>
<td>3.06(0.52)</td>
<td>3.13(0.66)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$60,000-$89,999</td>
<td>3.20(0.51)</td>
<td>3.30(0.45)</td>
<td>3.11(0.55)</td>
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<tr>
<td></td>
<td>≥$90,000</td>
<td>3.14(0.43)</td>
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<td></td>
</tr>
<tr>
<td>SNR = 5 dB</td>
<td>&lt;$30,000</td>
<td>3.30(0.45)</td>
<td>3.36(0.75)</td>
<td>3.43(0.42)</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>$60,000-$89,999</td>
<td>3.45(0.43)</td>
<td>3.56(0.41)</td>
<td>3.52(0.34)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥$90,000</td>
<td>3.54(0.37)</td>
<td>3.48(0.52)</td>
<td>3.38(0.91)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Groups 1, 2, and 3 represent children with 0–3, 4–9, and ≥10 episodes of OM since birth.
DISCUSSION

The present study aimed to measure speech understanding ability in children with and without a history of OM under various levels of background noise. The mean speech scores ranged from 3.1/4 (77.5%) to 3.4/4 (85%) across the two SNR conditions. These results are comparable to the normative data presented in the Kei et al (2003) study, which showed a range of 2.9/4 (74%) to 3.6/4 (89%). Despite the claim that OM-positive children may perform worse than OM-negative peers, the findings from the present study revealed no significant differences in mean speech scores across the three groups of participants. Possible explanations for these findings are discussed below.

It is possible that, on the average, children with a history of OM have similar ability in speech understanding irrespective of whether or not they have had a history of OM. Furthermore, the possibility that children with a history of OM might have already learned coping mechanisms and strategies to assist them during the periods of OM cannot be excluded. It is possible that children with an initial speech and language delay due to recurrent OM might have already caught up with their peers by this age, in agreement with the claims made by Roberts et al (1991) and Roberts et al (2002) that children with early histories of OM, although initially delayed, catch up by their second year of elementary school.

The presentation of the UQUEST speech material at 65 dB SPL might not be hard enough a task for the participants. Gravel and Ellis (1995) used a slightly higher presentation level (70 dB SPL) in their study and found no significant difference in speech scores between children with and without a history of OM. However, when a lower presentation level was used, children with a history of OM performed significantly worse than their OM-free counterparts. Perhaps, presentation of the UQUEST stimuli at lower intensity levels (e.g., 50–55 dB SPL) in future experiments may provide a more sensitive measure of the ability of children to understand everyday speech.

In addition, it may be that the UQUEST is too easy for Grade 3 and 4 children because some children scored 4/4 (100%), even under the more difficult noise condition (SNR = 0 dB). Brown (1994) and Gravel and Wallace (1992) reported that 0 dB SNR might not be sufficiently demanding to observe the effect of recurrent OM on children’s speech reception. Perhaps a more difficult noise condition (e.g., SNR = -5 or -10 dB) should be utilized in future studies, in view of the fact that classroom noise level might sometimes exceed a teacher’s speech level, especially when children are participating in noisy activities. Despite the excellent speech scores obtained by some children in the current study, the mean speech scores ranged from 3.1/4 (77.5%) to 3.4/4 (85%) across the two noise conditions (see Figure 1). According to Dillon (1983), the test difficulty should be in the range of 73% to 87% to achieve maximum sensitivity (defined as the consistent change in test score that accompanies a small change in experimental conditions). Hence, the UQUEST should be considered as a sensitive measure of speech understanding for this cohort of school children since the test difficulty falls within the optimal range of sensitivity.

Finally, the high educational level reported by parents of children in this cohort may be accountable for the insignificant difference in UQUEST scores across the participant groups. Many parents in this cohort have completed high school or tertiary education (see Table 2). It is conceivable that this high standard of education of parents preempts any differences in speech reception skills among the children in the present study. Nittrouer (1996) suggested that parents of a higher SES might provide a better linguistic environment to children than parents of a lower SES. However, the SES of the families in the present study cannot be clearly defined because the relationship of parents’ education level with family income is unclear (see Table 2).

While there were no significant differences in speech scores at a group level, there were children who obtained significantly poor results in comparison to the group means. For instance, one girl obtained a score of 0.33/4 in the 0 dB condition. She had ten episodes of OM since birth. This result is not surprising given that some individuals are more affected by OM than others either due to the early occurrence, extended duration, or recurrent nature of the disease (Finitzio et al, 1990; Gravel and Ellis, 1995). This result suggests that although children with a history...
of OM perform equally well at a group level in a speech understanding task when compared to their OM-free counterparts, some children with a significant history of OM may experience great difficulty in understanding everyday speech.

The current study also showed that children performed significantly worse in the more difficult (SNR = 0 dB) noise condition, compared to the easier (SNR = 5 dB) noise condition. A difference of about 0.3/4 between the mean score obtained under the two noise conditions was observed (see Figure 1). This result is expected, as a higher level of noise would have masked out the weaker speech sounds. The implication from this finding is that the UQUEST is sensitive to small changes in background noise levels.

An interesting, but not unexpected, result from the present study is that Grade 3 children performed significantly worse than Grade 4 children in the UQUEST across the noise conditions (see Figure 2). This result implies, in general, that children at a higher academic level do perform better than those at a lower level on this speech comprehension task. However, the difference in mean UQUEST scores was small (0.16/4 for the 0 dB SNR condition and 0.07/4 for the 5 dB SNR condition).

The present study did not identify any significant gender effects on the UQUEST scores. Given that all children were required to have normal middle ear function and normal hearing, this finding indicates that both boys and girls performed equally well in understanding everyday speech in background noise. In addition, no SES effects (as categorized by the annual family income) on the UQUEST scores across the three participant groups (children with no history, a mild history, and a moderate to severe history of OM) have been identified in the present study. This finding is in good agreement with the results of Roberts et al (1991), who found no difference in language performance between children from low-income and middle-class families.

Several limitations have been identified in the present study. Firstly, the parental report of the number of episodes of OM may not be accurate. According to Rosenfeld et al (1998), parental report is often reliable but inaccurate. Secondly, the ambient noise level at the test site might have affected test results, as the child might be distracted at times due to the fluctuating nature of the noise present at the schools. Lastly, although the UQUEST is intended to measure speech comprehension, it requires the use of short-term auditory memory skills. This is a confounding variable because children with poor short-term memory may experience difficulty in memorizing all the facts presented in a passage (Kei and Smyth, 1996, 1997). In the present study, this variable has been controlled through the use of passages of a shorter duration.

In addition to having good short-term memory, children should also have adequate speech and language competence to perform well in the UQUEST. However, this higher level of cognitive processing has not been ascertained in the present study.

CONCLUSION

Understanding everyday speech is an important component of communication. The present study aimed to measure this component of communication in school children with and without a history of OM. The results showed no significant differences in mean speech scores across the participant groups. Effects of gender and SES on UQUEST scores were not found in this cohort of children. However, differences in the UQUEST scores across the academic levels of children and different background noise levels were significant. In essence, children with a history of OM form a heterogeneous group with varying speech comprehension capabilities as demonstrated by their large range of UQUEST scores. Within this group, some children do experience enormous difficulty in speech understanding.

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REFERENCES


Appendix A. Sample UQUEST Passage and Questions

No. 6: The Haircut

Scene: Two sisters, Sue and Linda, are both in a room talking to each other and playing.

Sue: ‘Did Mum say you were having a haircut today?’
Linda: ‘Yes, I think it’s this afternoon.’
Sue: ‘Do you know what sort of haircut you want?’
Linda: ‘Mum said a trim so my hair stays long enough for my ballet class.’
Sue: ‘Who is taking you to the hairdresser, Mum or Dad?’
Linda: ‘Dad is taking me to the hairdresser this time.’
Sue: ‘Why is mum not taking you there?’
Linda: ‘Because Mum has to work late.’
Sue: ‘Well, tell Dad that Mum said you need your hair coloured green!’

QUESTIONS

1. When did the little girl say she was getting her haircut?
   a) tomorrow
   b) this morning
   c) this afternoon
   d) Wednesday

2. What class did Linda go to?
   a) Netball
   b) Swimming
   c) Drawing
   d) Ballet

3. Who was taking Linda to the hairdresser?
   a) Sue
   b) Mum
   c) Dad
   d) Grandma

4. What colour of hair did her sister suggest Linda could have?
   a) Purple
   b) Red
   c) Yellow
   d) Green