INTRODUCTION

One category of tests that examine auditory processing disorders (APD) are the various versions of the "filtered words test" (FWT), whereby a monaural, low-redundancy speech sample is distorted by using filtering to modify its frequency content (Flowers et al., 1970; Wilkeff, 1977; Keith, 1986). Due to the richness of the neural pathways in the auditory system and the redundancy of acoustic information in spoken language, a normal listener is able to recognize speech even when parts of the signal are missing, whereas this ability is often impaired in listeners with APD (Bellis, 2003).

One limitation of the various versions of the FWT is that they are carried out using a constant level of low-pass filtering (e.g., a fixed 1 kHz corner frequency) which makes them prone to ceiling effects (e.g., Farrer & Keith, 1981). In this study, we aimed to counter these effects by modifying the FWT to use a computer-adaptive procedure, to improve the sensitivity of the test over its constant-level counterparts. Preliminary results from participants with normal auditory processing skills are presented.

METHODOLOGY

Participants: 23 adult participants (mean age 29.0 ± 9.5 years) and 32 child participants (mean age 9.1 ± 1.2 years) participated in the study. All the adult participants scored 50% or more correct on a monaural screening test at 15 dB SPL across intervals of 500 Hz through 4000 Hz. All adult participants had passed either the SCAN-C screening test for APD or (ii) a full APD battery performed at the University of Canterbury Speech and Hearing Clinic. An attempt was made to control for gender throughout this study, as suggested by previous studies (Keith, 1986; Farrer & Keith, 1981). In this study, we aimed to counter these effects by modifying the FWT to use a computer-adaptive procedure, to improve the sensitivity of the test over its constant-level counterparts. Preliminary results from participants with normal auditory processing skills are presented.

RESULTS

The test-retest reliability of the 70.7% task was also assessed for both adult and child participants. Because our pilot study indicated a significant learning effect (with scores improving as experience with processing low-pass filtered speech increased), we incorporated a binocular practise run to familiarize the participant with the task, and increased the number of practise reversals. The adult participants showed no significant learning effect, but despite these protocol changes, the child participants still showed a significant improvement in performance between the first and second trials (paired t-test, p = 0.001), as shown in Figure 4 below. This result is consistent with the findings of Amos and Humes (1998), who showed a significant improvement in the performance of children with a repeated administration of the Filtered Words Subtest of the SCAN-C test. Once the learning effect had plateaued, the test-retest reliability for child participants was moderate.

The distribution of LPF corner frequencies as a function of age is shown in Figure 6. The performance of the child participants (aged 8.2 to 11.9 years) tended to improve with age, with the LPF corner frequencies at which they scored either 50% or 70.7% decreasing by around 5% per year. In contrast, the performance of the adult participants (aged 18 to 55 years) slowly deteriorated with age, with LPF corner frequencies increasing at about 0.9% per year.

DISCUSSION

The purpose of the present study was to improve the filtered word test, a form of monaural low-redundancy assessment for APD. Our computer-based implementation of an adaptive version of the test, called UC MAST, showed high test-retest reliability in adults, and moderate reliability in children once the initial learning effect had reached a plateau. The improved performance of child participants with age is consistent with suggestions that neuromaturation of some portions of the auditory system may not be complete until age twelve or later (Ponton et al., 2000). To compare the performance of the UC MAST to standard APD test batteries, we have commenced trialing a modified version of this test on age-matched children with and without APD. The procedural modifications include using: i) a filter function that is less steep (to minimise phase distortion); ii) a weighted updown staircase procedure (Kaernbach, 1991); and iii) pictures instead of words (as shown in Fig. 1). The reduced performance shown by the older adult participants, all of which had normal hearing below 4 kHz, indicates that the UC MAST filtered words test may actually show more promise as a test of auditory processing in older adult participants. While this test cannot by itself distinguish between age-related disorders of auditory processing and amodal cognitive function, the use of test items with spectral content almost entirely below 1 kHz does eliminate the well-documented influence of high-frequency audiometric threshold on test performance (see Humes, 2008).

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REFERENCES


RESULTS

As shown in Figure 3 below, there was a significant (p < 0.05) difference in the LPF corner frequencies at which children and adult participants scored either 50% or 70.7% correct, with adults achieving a score of 50% when stimuli were low-pass filtered at 419 ± 108 Hz (compared to 688 ± 193 Hz for children), and a score of 70.7% when stimuli were low-pass filtered at 662 ± 164 Hz (compared to 1069 ± 235 Hz for children).

DISCUSSION

The purpose of the present study was to improve the filtered word test, a form of monaural low redundancy assessment for APD. Our computer-based implementation of an adaptive version of the test, called UC MAST, showed high test-retest reliability in adults, and moderate reliability in children once the initial learning effect had reached a plateau. The improved performance of child participants with age is consistent with suggestions that neuromaturation of some portions of the auditory system may not be complete until age twelve or later (Ponton et al., 2000). To compare the performance of the UC MAST to standard APD test batteries, we have commenced trialing a modified version of this test on age-matched children with and without APD. The procedural modifications include using: i) a filter function that is less steep (to minimise phase distortion); ii) a weighted updown staircase procedure (Kaernbach, 1991); and iii) pictures instead of words (as shown in Fig. 1). The reduced performance shown by the older adult participants, all of which had normal hearing below 4 kHz, indicates that the UC MAST filtered words test may actually show more promise as a test of auditory processing in older adult participants. While this test cannot by itself distinguish between age-related disorders of auditory processing and amodal cognitive function, the use of test items with spectral content almost entirely below 1 kHz does eliminate the well-documented influence of high-frequency audiometric threshold on test performance (see Humes, 2008).

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