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Cognition and Speech Perception in Noise

Rajesh Ranjan, MASLP, Jayashree Bhat, Ph.D. and
Ajith Kumar U. Ph.D.

Abstract

Background: Daily communication requires individual's ability to understand speech in varying degrees of background noise. The normal hearing individuals usually does this with remarkable success without much problems even in even in adverse listening condition. However, elderly listeners exhibit difficulty in understanding speech, particularly in background noise or reverberation. It is unclear at present whether auditory or cognitive mechanisms responsible for reduced recognition ability in elderly listeners.

Methods: A total of 30 participants participated in the study. They were divided in to two groups (i) 15 young adults in the age range of 20-30 years (ii) 15 elderly participants in the age range of 50-65 years. All the participants had pure tone thresholds less than 25dBHL at octave frequencies Subsequently none of the selected participants had difficulty in understanding speech in daily listening conditions and had no recent history of otologic disease, history or presence of neurological symptoms. Min mental state examination and Speech in Noise test was administered to assess the cognitive abilities and speech perception ability in both the groups.

Result: Speech in noise perception abilities was similar in more favourable signal to noise ratio (SNRs) in both the groups. However, at higher SNRs (less favourable) elderly participants performed significantly poorer compared to young individuals.

Conclusion: We hypothesize that reduced temporal processing abilities in older individuals might have contributed to poor speech understanding abilities in elderly individuals.

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Key words: Coginition, Mini mental state examination (MMSE), Speech in Noise(SIN), &Signal to Noise Ratio (SNR).

Cognition and speech perception in Noise

Daily communication requires individual's ability to understand speech in varying degrees of background noise. The normal hearing individuals usually does this with remarkable success without much problems even in adverse listening condition (1). However, elderly listeners exhibit difficulty in understanding speech, particularly in background noise or reverberation (2-7). These speech understanding difficulties seen in elderly individuals may be because of decline in the auditory processing abilities (8) or decline in the cognitive abilities that are associated with the aging (9-10) .

It has been reported that difficulties observed in elderly hearing-impaired listeners seem to be associated with problems in the identification of consonants rather than vowels(11), and it is greatest for stops, fricatives and manner-of-articulation (6, 11-12). However others (8) have reported that age-related changes in understanding naturally produced rapid speech reflect a decline in rapid information processing. Moreover, this decline in processing speed interacts with the linguistic redundancy in the spoken message and these findings overall are consistent with cognitive theories of aging that suggest there is an overall decline in the speed of mental perceptual processing with increasing age (9-10).

To assess cognition ability of individuals one of the most frequently used screening tools are Mini-mental state examination (MMSE) (13). The MMSE is used as a both research and clinical diagnostic tool for finding out person's intellectual capacities, which can be divided into two sections, the first section requires only oral responses; it covers temporal and spatial orientation, memory (registration, repetition and recall of three objects) and attention (Counting backwards in units of seven, starting with 100, or spelling the word backward). The second section tests language and visuospatial function, it requires the subject to name simple objects (watch and pencil), follow verbal and written commands, write a sentence spontaneously and copy two intersecting pentagons. To assess speech in noise various test are available among which one of the Indian language test is speech in noise (SIN) test in Kannada (14). SIN has 12 lists of sentences with eight talker babble. In each list seven sentences are presented at signal-to-noise ratio (SNR) of 20, 15, 10, 5, 0,-5 and -10dB.

Aim of the Study

The aim of the study was to assess relationship between cognition and speech perception in noise in elderly individuals.

Methods

A total of 30 participants participated in the study. They were divided in to two groups (i) 15 young adults in the age range of 20-30 years (ii) 15 elderly participants in the age range of 50-65 years. All the participants had pure tone thresholds less than 25dBHL at octave frequencies. Further, it was ascertained from a structured interview that none of the selected participants had difficulty in understanding speech in daily listening conditions and had no recent history of otologic disease, history or presence of neurological symptoms. Subsequently, Mini Mental State Examination (MMSE) was administered to assess the

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cognitive abilities followed by SIN. SIN test was administered first at +20 dB SNR and the SNR was reduced in 5 dB steps for the subsequent sentences till -10 dB SNR. These ranges of SNRs were chosen based on pilot study done on 5 subjects that showed 100% and 0% of speech recognition scores at +20 dB SNR and 0 dB SNR respectively. Speech stimuli were presented from the Dell Inspiron 1545 Laptop equipped with good quality sound card. Subject listened to the sentences monaurally in the right ear through Senheiser stereo head phone at most comfortable level preferred by the participant.

Results and Discussion

The average speech recognition scores in younger and elderly individuals along with 1 SD of variations are depicted in Figure 1.

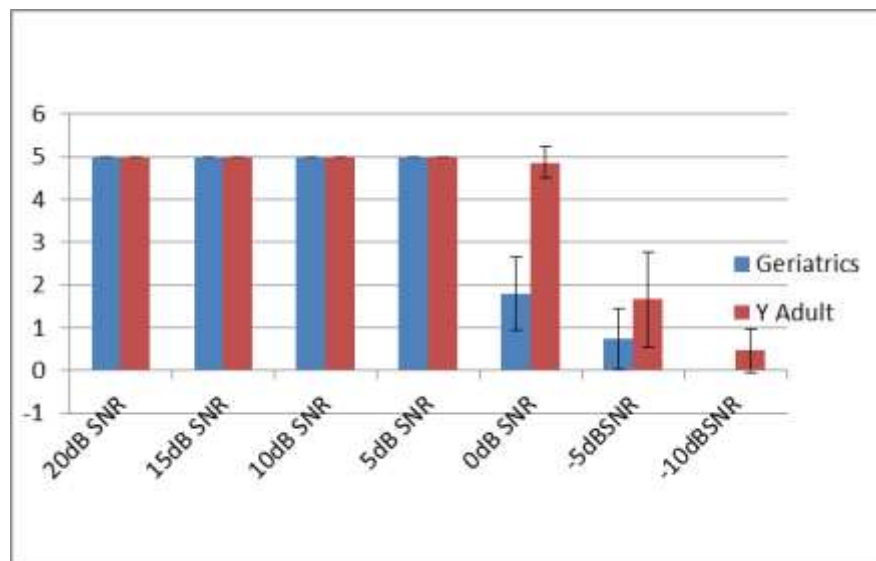


Figure 1: Mean speech recognition scores for different subject groups. Error bars indicate 1 SD of error.

From the Figure 1 it is clear that performance of both the groups were similar in more favourable SNRs compared to less favourable conditions. Both the groups reached ceiling when tested under +20 dB, +15 dB, +10 dB and +5 dB SNR. However, at 0 dB, -5 dB and -10 dB SNR elderly individuals performed poorer compared to young adults.

A MANOVA was carried out to find out the significance of difference in speech recognition scores between two groups at different SNRs. MMSE scores were used as a co-variants. MANOVA revealed a significant main effect of subject groups on speech recognition scores even after factor outting the MMSE scores. Boneferronie's post-hoc analysis revealed that elderly individuals had significantly poorer speech recognition scores at 0 dB, -5 dB and -10 dB SNR compared to young adults. This difference was observed even after accounting for the cognitive decline seen in the older age. Many studies have reported the cognitive decline with the aging (9-10).

However, our study indicates that with the advance in aging there are reduced sensory processing abilities that may contribute to decrease speech perception abilities in elderly individuals. It is also been reported that elderly individuals have poor temporal processing Language in India www.languageinindia.com

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abilities compared to young adults. We hypothesize that reduced temporal processing abilities in older individuals might have contributed to poor speech understanding abilities in elderly individuals.

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