AGE-RELATED CHANGES IN CAR-DRIVING

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1. INTRODUCTION

Auditory warnings pervade all aspects of car-driving activity. Ninety-one percent of exposure to music occurs during transportation (Sloboda, O'Neill and Ivaldi, 2001). Usually warning sounds call for immediate attention in order to prevent serious mishap (Stanton and Edworthy, 1999). Moreover, it has been found that music tempo consistently affects perceived car-speed estimates. Thus, the tempo of background music affects the frequency of virtual- (Brodsky, 2002) and possibly, real-traffic violations. Without any doubt, car-driving performance depends on ability of a driver to hear warning sounds such as car-horns and emergency siren.

It is known that hearing changes with age with a reduction in the ability to hear high frequency sound components. Thus, when it comes to a decision based on hearing, the elderly will rely on less information than younger adults (Botwinick, 1985). Moreover, cognitive decisions during very complex tasks such as car driving depends on the ability to integrate inputs across many modalities. Thus, car-driving performance depends on the ability to process and integrate information from the various sensory systems and incorporate this information into appropriate decisions. The decision depends on driver's ability to attend to auditory warning sounds (Ison, Virag, and Allen, 2002).

Canada's population is quickly "graying"; a greater percentage of population is becoming more than 65 years old. It is expected that by 2045 year Canada will experience a dramatic increase of older drivers (above 65 years old) relatively to that in 1998 (Caird, 2001).

The present study attempted to explore driving performance as a function of age, type of warning sound, and listening condition. It was hypothesized that:

4. The elderly need higher intensity warning sounds than younger adults in order to prevent serious mishap.
5. The presence of background music (easy listening) should increase the detection threshold of a warning sound in both age groups of drivers.

2. METHOD

2.1. Participants

Twenty-eight older adults (64-85 years old) and twenty-four young, untrained students (21-32 years old) served as participants. All participants had normal hearing (15 dB or better for audiometric frequencies from 500 Hz to 8kHz).

Older participants were paid $10.00 Cdn per hour for their participation. Younger participants obtained a bonus credit towards a chosen course for their participation.

2.2 Stimuli

Stimuli included two spectrally different auditory warning sounds (targets) presented simultaneously with "easy-listening" music and road noise or with the road noise alone. Auditory warning signals had duration of 600 ms (car-horn) or 2500 ms (emergency siren) and intensity level (initially) of 80 dB SPL. Intensity level of the warning sounds subsequently followed an adaptive procedure (3 correct down and 1 incorrect up) to determine the threshold value. The intensity level of noise road alone and road noise mixed with music was always presented to participants at 67 dB SPL Music included three motives from "Cat Tantzu", "Chaos Opera" and "Abyss Project". The intensity level along the duration of three musical motives and road noise was maintained (as much as possible) constant.

2.3 Procedure

Participants were tested individually in an anechoic chamber. Sound was presented binaurally via headphones of flat frequency characteristics. At the very beginning of the each experiment, participants were presented with a practice session until full understanding of the task was achieved. Emergency signals (car horn and emergency siren) were initially provided to the participants at the maximal level of 80 dB SPL by Tucker-Davis Instruments' hardware and software. During the experiment, delivery of the intensity level of stimuli was controlled by Tucker-Davis Instruments' hardware and software as well as customized software.

Participants' answers were collected by a PC computer HP VECTRA.

An experimental session began with a single-track adaptive procedure to determine the 79.4% detection threshold of a target sound in road noise alone. Next, a single-track adaptive procedure to determine the 79.4% detection threshold of a target sound in road noise mixed with the easy listening music was administered. Participants were able to pause and relax anytime during the experiment.

3. RESULTS

Results obtained during experiments were first examined separately, and subsequent analyses of relationships between the experiments were then performed.

Figure 1 shows the results of the study for each age group and listening conditions. In order to obtain these results, a 2 (age group) x 4 (sound listening conditions) repeated measures ANCOVA, using the audiometric averages as a covariate was performed on the threshold values. There was a significant main effect for the age group, $F(1,45)=12.31$ at $p=0.001$ and for the condition, $F(3,135)=100.75$ at $p<0.001$. However, there was no significant interaction between the age group and the target type, $F<1.0$.

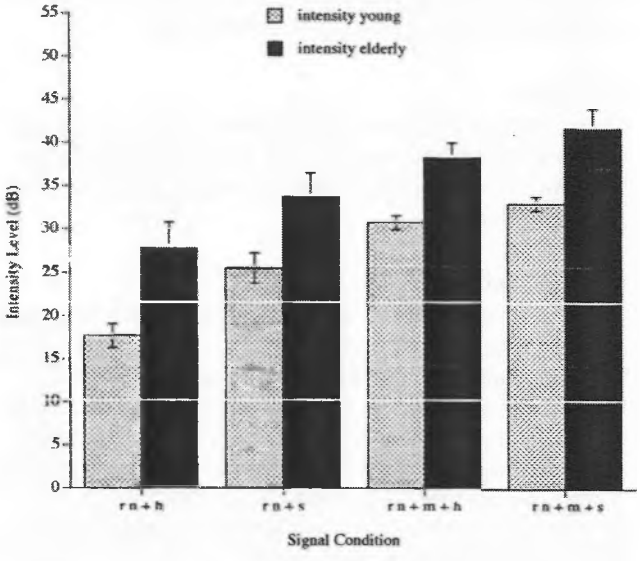

Figure 1. Means and standard deviations of warning sound detection thresholds for both age groups and type of stimuli and four listening conditions.

Thresholds for the various target sounds and conditions revealed the same pattern for both age groups. Elderly drivers demonstrated the large variability (see Figure 1.). Indeed, some of the elderly drivers performed equal to the young listeners, and some of the young listeners had thresholds that were as high as those of some the elderly drivers.

4. DISCUSSION

The hypotheses of the study were supported: Older adults required a higher intensity level of warning signals in all conditions compared to younger drivers. This finding supports other studies showing that the elderly have poorer hearing than young listeners.

Moreover, thresholds for 2 types of signals revealed the same pattern for both age groups and thresholds were higher when listening to music and road noise compared to road noise alone. The same pattern of auditory warning sounds' thresholds processed by both age groups of listeners supports results Ison et al. (2002).

Differences in detection thresholds between car-horns and emergency sirens could be due to the similarity of acoustical aspects of the emergency siren to music and thus, could cause difficulties in detection of the emergency siren when listening to music. Spectral characteristics (noise-type) of car-horn were significantly different from musical motives.

In conclusion, by using changing distracters over time this study suggest that informational masking has a greater impact on the elderly when performing tasks such as driving. These findings of the study indicate the importance of being able to clearly hear the outside environment.

5. REFERENCES

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