ARE MUSICIANS LISTENING TO SOUNDS IN A DIFFERENT WAY THAN NON-MUSICIANS?

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1.0 INTRODUCTION

People are subjected to many sounds entering the auditory system. Sounds may convey important information (targets) or may serve to distract a listener. Distracting sounds carrying irrelevant information can occur simultaneously or in a sequence with a target sound. In the first case, the distracter is mostly spectrally masking the target and in the second case, a temporal-like masking can occur - of which one phenomenon is the so-called Attentional Blink (AB). In order to explore both types of masking, two experiments were performed which tested musicians and compared their performance to that of non-musicians.

2.0 EXPERIMENT 1

Attention is deployed across time to regulate the ongoing flow of information arriving at the senses. Experimentally, the temporal nature of attention can be studied with rapid serial presentation techniques (RSVP, RAP). In these procedures, a series of stimuli (letters, pictures, tones, etc) are presented in rapid succession at the same location., and participants must identify 1 or 2 pre-specified targets. Numerous studies (e.g., 2, 3, 8) using these procedures have found that having to attend to the first target impairs the ability to identify a second target (probe) for ~ 500 ms - a phenomenon known as the *attentional blink* (AB).

The AB is influenced by a number of factors including stimulus complexity, task difficulty, and learning strategies (5, 6, 12). Furthermore, aging and attention deficits (e.g.. ADHD) have been found to increase the magnitude of the AB (4, 9). Recently, in a preliminary study we (2) demonstrated that the magnitude of the auditory AB was *attenuated* among the congenitally blind, a finding that partly provided the impetus and rationale for the present study. Here, we examined whether the auditory AB would be attenuated in a group of musicians. Specifically, we hypothesized that because musicians have extensive experience with tones, the magnitude of the auditory AB should be attenuated, but not for the visual AB.

2.1 Method

Participants: Participants (19-39 yrs) were 17 university students who participated in the study for course credit. Musicians (n=8) had at least 7 years formal musical training.

Procedure and Stimuli: After training, participants were presented with 168 Rapid Auditory Presentation (RAP) streams (11 tones/sec) consisting of 25 equally loud tones ranging from 1000 to 2490 Hz. All tones were 85 ms in duration, separated by a silent 5 ms interstimulus interval. Targets to be named were 1500 (low) and 2500 (high) Hz tones increased in intensity by approximately 10 dB SPL above stream items. In the visual task, participants were presented with 168 Rapid Serial Visual Presentation streams (11 lines/sec) consisting of 25 sequentially-presented lines at orientations of degrees ranging from 30 to 150. Lines were 15 ms in duration, separated by a blank interval of 75 ms. Targets to be named were thicker lines of 45 (right), 90 (vertical), and 135 (left) degrees. In both tasks, 2 targets were present on 1/2 of the trials, balanced across SOAs of 90, 180, 270, 360, 450, 540, and 630 ms.

2.2 Results

Musicians had an attenuated auditory AB compared to non-musicians and the magnitude of the auditory AB was significantly reduced for this group (p's $< .05$). Unexpectedly, musicians also had an attenuated *visual AB*, except for the briefest interval of 90 ms (ABs not shown). The magnitude of the visual AB was also significantly reduced for musicians (p's $< .05$). Auditory and visual AB magnitudes are shown in Figure 1.

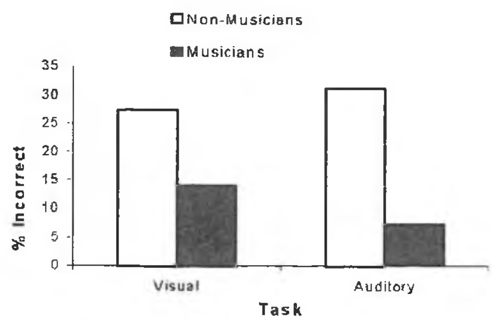

Figure 1. Visual and Auditory AB Magnitudes in Musicians and Non-musicians

2.3 Discussion

The hypothesis that musicians would demonstrate an attenuated auditory AB was supported. These preliminary data suggest that the auditory AB (i.e. auditory attention) is influenced by stimulus familiarity/learning. The demonstration of an attenuated visual AB was not anticipated, but suggests the presence of cross-modal enhancement, consistent with emerging findings from other investigations (11). Thus, there is more than just stimulus familiarity influencing the AB in musicians and, although the mechanisms responsible for these enhancements are not clear at present, enhanced attentional abilities may be one potential mechanism.

3.0 EXPERIMENT 2

This experiment was inspired by several lines of previous research. One study (1) showed that the detection of a pure-tone in noise was poorer in the presence of a second tone burst whose frequency and level varied randomly. Another study (10) demonstrated that the presence of a low intensity distracter increased detection threshold of target independently of listeners' age. Finally, it has also been shown that when the frequency content of a multitone masker (distracter) changes, detection of the target deteriorates (7). In the current study, we examined whether musicians would be better able to attend to a target sound compared to non-musicians in the presence of simultaneous distracters.

3.1 Method

Participants: Non-musicians were 24 students (21-32 yrs) who participated in the study for course credit. Musicians were 20 members 19-50 yrs) of the Calgary Philharmonic Orchestra, recruited from the Department of Music at the U of C, and had at least 7 years formal musical training. All participants had normal hearing (15 dB HL or better for all audiometric frequencies).

Stimuli: The target was a 1-kHz, 200-ms tone burst. The four tonal distracters were 350 ms in duration and 6 dB SL. In addition a continuous band-pass white noise (300Hz-1800Hz) was presented at a total intensity level of 60 dB SPL.

Procedure: Participants were tested individually in an anechoic chamber. A four-track interleaved adaptive procedure (3-up, 1-down) was used to determine the 79.4% threshold for the 1 kHz target in the presence of each of the four, randomly selected distracters.

3.2 Results

When detecting a 1 kHz target (important) sound in the presence of four uncertain tonal distracters (irrelevant sounds), musicians who played "soft" instruments (violin, viola, piccolo, flute, soprano, tenor) were able to detect the target sound significantly better than non-musicians and musicians who were playing "bold" instruments (tuba, double bass and band's players). These results are presented in Figure 2.

3.3 Discussion

Musicians playing low intensity instruments relative to other instruments, had lower thresholds for the detection of targets in the presence of simultaneous distracters. We speculate that these musicians may have developed a strategy for focusing on important sounds and are thus better able to reject irrelevant stimuli.

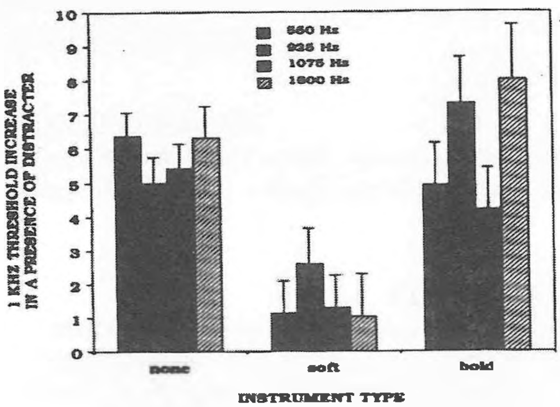

Figure 2. Means and standard deviations for music exposure groups (none, soft, and bold). See text for terms/explanation.

4.0 GENERAL DISCUSSION

Each of these experiments demonstrated that "soft-instrument" musicians were better able to focus on relevant targets and ignore distracters; consequently, it appears that they are less susceptible to the effects of masking. Both simultaneous and temporal masking may be part of a more general phenomenon known as informational masking, which are mediated by learning and attentional processes. If so, then musician's enhanced attentional abilities appear to generalize to other tasks, both within a sensory modality and across modalities.

5.0 REFERENCES

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