# ERROR PATTERNS IN SOUND LOCALIZATION BY YOUNG NORMAL HEARING-LISTENERS

**Sharon M. Abel*, Angela Consoli*, Christian Giguère** and Blake Papsin***

Dept. of Otolaryngology, University of Toronto*,
and Prog. d'audiologie et d'orthophonie, Université d'Ottawa**

## 1.0 INTRODUCTION

The ability to localize warning signals, human voices and other sounds in space is an important component of communication. Spatial acuity improves over the first 18 months, and declines later in life.[1] These changes likely reflect early maturation of structures in the ear and brain and later peripheral hearing loss and/or central degeneration. Accurate identification of spatial sound sources depends on the encoding of interaural differences in the intensity and time of arrival of the sound at the two ears and spectro-temporal information contributed by the pinna of the ear. An experiment in progress is investigating life cycle changes in the use of these cues. Horizontal sound source identification is being studied in normal-hearing human subjects aged 10 to 79 years, in an acoustic environment which models real-world listening.

## 2.0 METHODS AND MATERIALS

### 2.1 Subjects

One group of sixteen subjects, aged 20-29 years has been tested thus far. All were screened for hearing loss in the region of 0.5-4 kHz. Within subject, pure-tone hearing thresholds in each ear were in the normal range. Differences between ears were no greater than 7 dB.

### 2.2 Apparatus

Subjects were tested individually in a semi-reverberant sound proof chamber. The chamber and the stimulus generating and loudspeaker systems have been previously described.[2] Subjects responded using a laptop response box with set of microswitches in the same configuration as the loudspeakers used to present the stimulus.

### 2.3 Procedure

The subject's task was to identify the direction of a 300-ms sound (1/3 octave noise band centred at 0.5 or 4 kHz or broadband noise) randomly emanating from a set of four or eight loudspeakers surrounding her/him, at a distance of 1 m. For the 4-speaker array, speakers were placed either close to the midline or the interaural axis, in each quadrant. For the 8-speaker array, the separation between pairs of speakers placed within quadrant was varied (15, 30, 45 or 60 deg).

One block of trials, comprising 16 random presentations of the stimulus through each speaker in the array, was given for each of the eighteen listening conditions. A trial began with a 0.5-s warning light on the response box, followed by a 0.5-s delay, and then the presentation of the stimulus. The warning light was the subject's cue to keep the head steady and fixate a straight-ahead visual target attached to the wall of the booth. A maximum of 7 s was given for choice of the response key corresponding to the speaker that had emitted the stimulus. No feedback was given about the correctness of the judgements.

## 3.0 RESULTS AND DISCUSSION

For all six speaker arrays, accuracy was higher for the broadband than the 1/3 octave band stimulus, and for the higher of the two 1/3 octave band centre frequencies. Neither interaural vs midline positioning for the 4-speaker array nor the separation between speakers for the 8-speaker array affected overall percent correct. A comparison of quadrant accuracy scores indicated a frontal superiority, regardless of frequency, for the 4-speaker midline array and the 8-speaker array with 15 deg separation of speaker pairs which were located close to the midline, and a left frontal superiority at 500 Hz for the 8-speaker array with 30 deg and 45 deg separations.

An analysis of midline front/back (15 deg vs. 165 deg) and interaural front/back (75 deg vs. 105 deg.) reversal errors showed a higher predominance of mirror image confusions on the right side of space, particularly for the 500 Hz stimulus. In the midline, front-to-back errors were relatively more common than back-to-front errors. The opposite trend was evident for speakers placed in front of and behind the ear.

Differences in accuracy favouring speakers on the left side of space have not been previously documented in any detail. A possible explanation of the result is right hemisphere superiority for spatial resolution.[3]

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**References**

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