Head movements and sound localization

by

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Declaration

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

Signature

To Georgina
Thank you

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Abstract

Most research on auditory localization has been conducted with listeners motionless. Nine experiments were conducted to investigate whether and how head motion assists sound localization. In three preliminary experiments, fairly unconstrained responding was made possible by using a partial spherical screen to obscure sources in the left lateral horizontal plane (HP) and the upper-left lateral vertical plane (LVP). The signal was 2-kHz low-pass noise, which thus offered no high-frequency pinna-based spectral cues. As expected, listeners were unable to localize the low-pass noise if they remained motionless throughout the duration of the signal. With a 3-s signal, it was observed that listeners achieved much greater accuracy in terms of front-back discrimination and elevation judgement, if they were permitted to move naturally or if they employed head rotation, about a vertical axis. Following these preliminary experiments, the test equipment was upgraded, so that all regions of auditory space were equally likely to contain sound sources. A fourth experiment, employing these conditions, used sources throughout the left LVP and left HP, and showed that natural head

movement, and 45° of head rotation, during a 3-s signal, produced significantly more accurate responding in terms of front-back discrimination, elevation judgement and horizontal judgement, compared with motionless listening. With a 0.5-s signal, rotation of the head produced a virtual elimination of front-back confusion, while natural movement was no different to motionless listening. The fifth experiment tested front-back discrimination of 2-s signals with small amounts of head movement. Results showed that head rotation of as little as 8° substantially reduced front-back confusion for 2-kHz low-pass noise and a 500 Hz pure tone. The sixth experiment revealed that head rotation allowed much greater accuracy in elevation judgements of low-pass and broadband noise sources in the upper median vertical plane. Disruption of pinna cues prevented listeners from localizing the broadband signals while motionless, but with rotation, localization was proficient. In the seventh experiment, listeners were tested with sources positioned throughout the MVP and left LVP. This revealed that head rotation assists localization of sources more greatly in the front MVP than for other regions. The eighth experiment employed a guided rotation procedure to allow some control over the velocity of the head rotation. This revealed that the faster a listener rotates the head the greater the ability to distinguish between front and back positions. Front-back errors were seen to be virtually eliminated with signals of as little as 150 ms in duration. The ninth experiment employing the same procedure showed that elevation judgement was assisted with signals of as little as 200 ms. Some remarks are made, in

conclusion, about the functions and bases for sound localization in everyday listening conditions.