The precedence effect in sound localization: Distinct roles for interaural time and level differences suggested by behavioral, modeling and acoustic data

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Psychophysical studies of precedence effects for ITD and ILD

-The precedence effect (localization based on "early-arriving" cues) facilitates accurate sound localization in normal listening environments (e.g., Wallach et al., 1949) -Fusion of "leading" and "lagging" information (quantified by the echo threshold) depends on the recent stimulus history (e.g., Keen & Freyman, 2009)

Purpose: To assess "fusion" and "lateralization" aspects of the precedence effect for "lead-lag" click pairs or trains of such pairs carrying either interaural time or level differences (ITD or ILD).

Methods





Acknowledgements

This work was supported by the National Institute on Deafness and Other Communication Disorders (F31 DC010543, R03 DC009482, and R01 DC011548). Julie Stecker, Anna Mamiya and Jackie Bibee assisted with data collection.

-Binaural cues may be differentially utile in echoic environments (cf. Rakerd & Hartmann, 1985); can be studied independently by isolating cues under headphones



R-L Retest ITD

References

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Contributions of auditory-nerve adaptation to precedence for ITD and ILD

-Peripheral contributions to precedence effect for ITD have been argued for delays shorter than ~3 ms (see Tollin & Henning, 1999; Hartung & Trahiotis, 2001)

-Could power-law adaptation in the auditory nerve (Zilany et al., 2009) account for precedence at longer delays (e.g. 5-12 ms), or the effects of repeated exposure?

Below: Zilany et al. (2009) AN model used as front end for models of effective internal ITD and ILD of "Baseline" and "Buildup" precedence stimuli used in psychophysical investigations (at left).



Finally, ITD and ILD models were tested using a recording of a balloon popped inside an IAC sound booth 90° to the right of a binaural manikin.

The mean IACC exhibits a single peak at $+670 \mu s$, the veridical ITD carried by the signal onset.

The R/L spike ratio is centered near 0 dB, reflecting spurious post-onset ILD (i.e., weak "precedence").



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