

Does temporal weighting of interaural level differences include both onset- and offset-specific effects?

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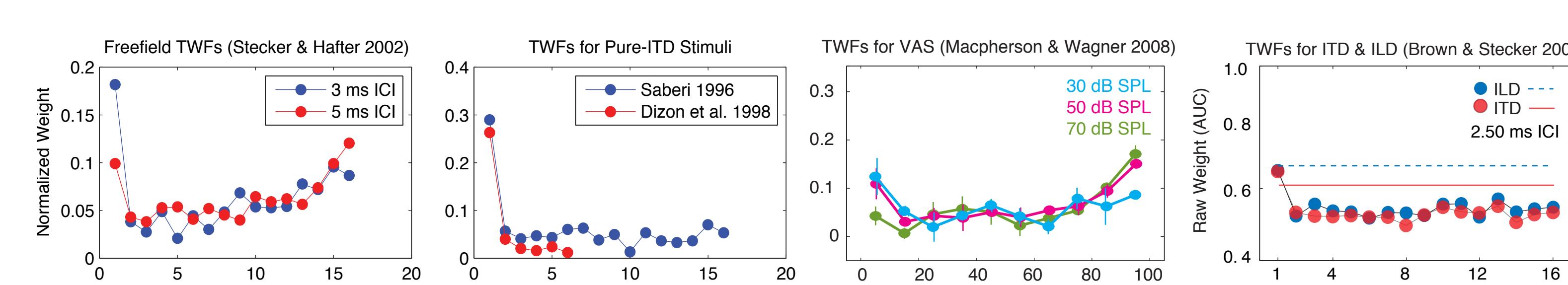


Background

Onset dominance in binaural processing of high-rate stimuli

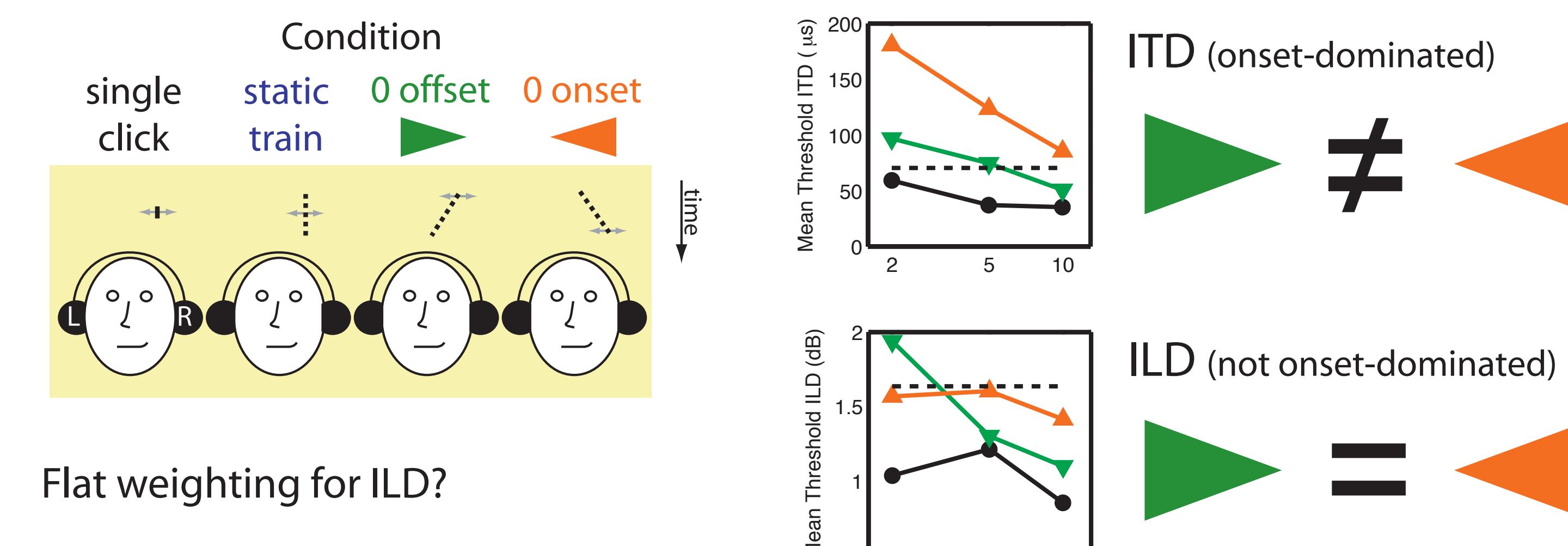
Reduced sensitivity to ongoing envelope interaural time (ITD) and level (ILD) at high rates; shift to onset strategy (Hafter & Dye 1983, Hafter et al. 1983, 1990).

Onset strategy reflected in temporal weighting functions for ITD, ILD (Saberi 1996, Dizon et al. 1998, van Hoesel 2008, Brown & Stecker 2009), freefield azimuth (Stecker & Hafter 2002), virtual elevation (Macpherson & Wagner 2008).



Dynamic ITD discrimination requires onset cue; ILD discrimination does not

Removal of onset cue impairs envelope ITD discrimination but not ILD discrimination (Stecker 2007).



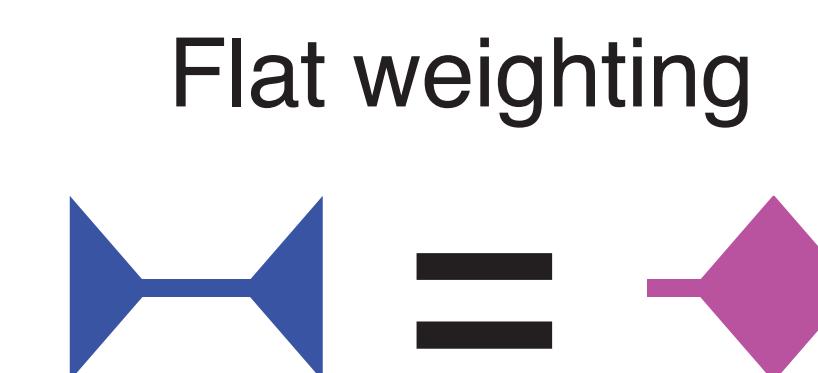
Flat weighting for ILD?

Onset/offset equivalence?

"U-shaped" temporal TWFs? (Zurek, 1980, Akeroyd & Bernstein 2001, Stecker & Hafter 2009)

Question

Does onset/offset equivalence for ILD reflect flat or U-shaped weighting?



Measure discrimination of dynamic ILD at endpoints or middle of click train.



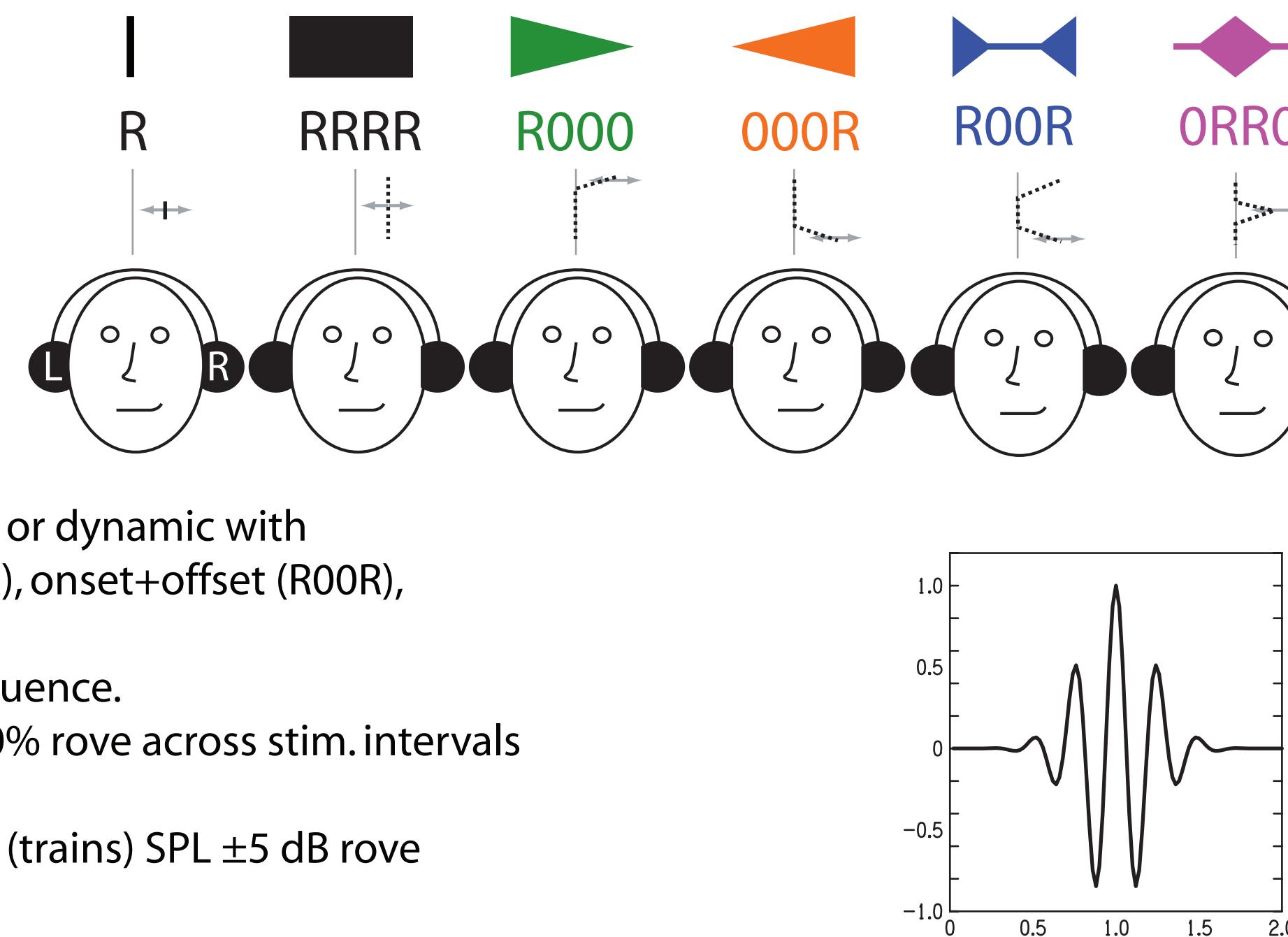
Methods

Seven normal-hearing human subjects (age 20-38, 5 naive)

Gaussian impulses ("clicks")
4 kHz carrier frequency
2ms nominal duration (BW ~900 Hz)

Single dichotic clicks or 16-click trains

Fixed 0 dB ILD reference
Right-favoring target ILD: static (R, RRRR) or dynamic with peak ILD at onset (R000), offset (000R), onset+offset (R00R), or middle (ORRO) of train.
Dynamic ILD linear in dB over 4-click sequence.
Inter-click interval (ICI) = {2, 5, 10 ms} ± 10% rove across stim. intervals
aka pulse rate = {500, 200, 100 pps}
Stimulus level: 65 dB (single) or 71-74 dB (trains) SPL ± 5 dB rove



Task: 2I2AFC, target in interval 2 or 3 (-XX-)
2 down / 1 up adaptive procedure (waste 4 reversals @ 2 dB, average 8 reversals @ 0.5 dB)

Results

Mean Data

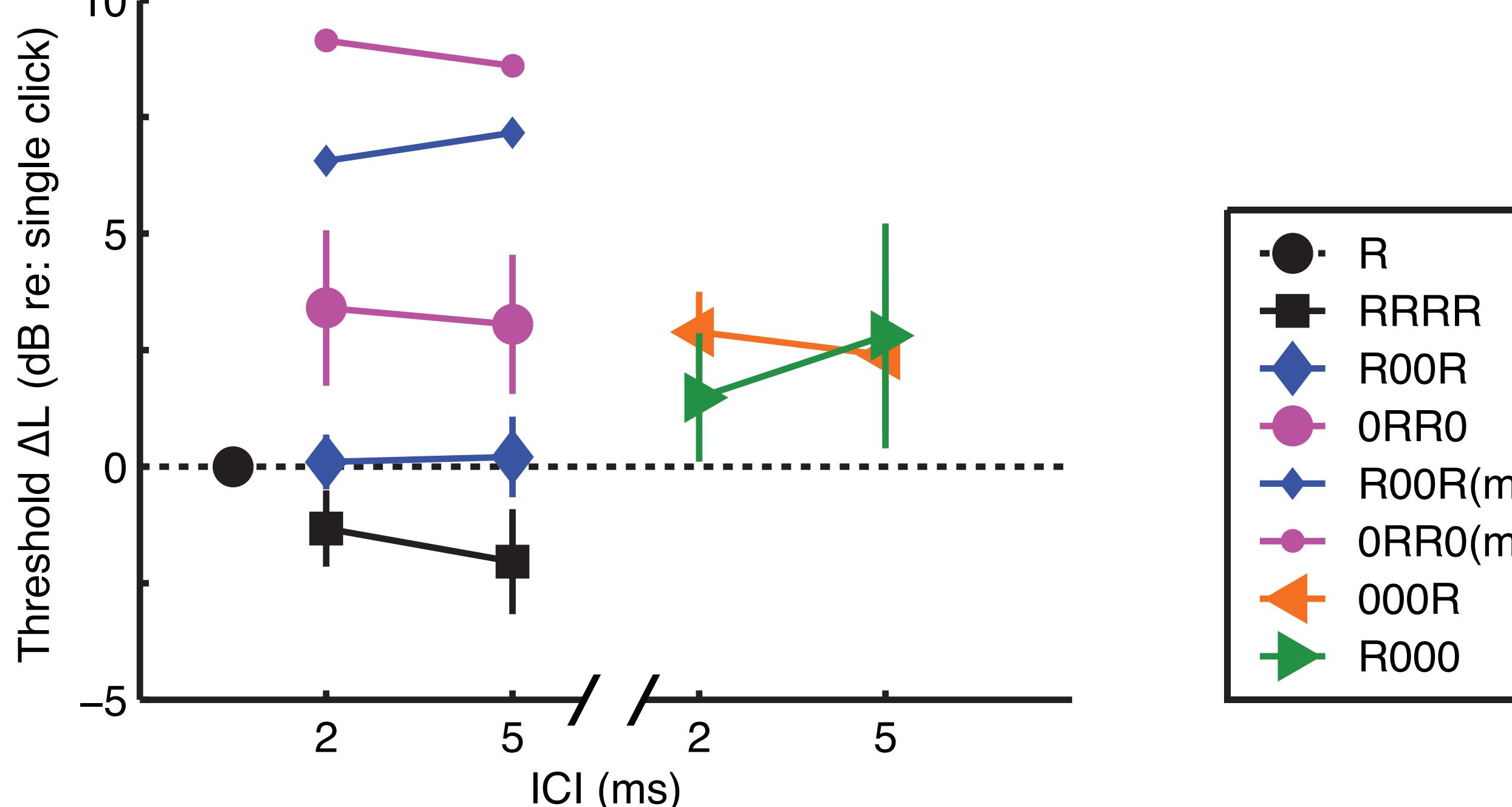


Figure (above) plots threshold peak ILD (see Methods) relative to single-click threshold ILD, averaged across subjects. Threshold ILD is plotted against ICI for static ILD (RRRR, black squares), onset ILD (R000, green triangles), offset ILD (000R, red triangles), onset+offset ILD (R00R, blue diamonds), and mid-train ILD (ORRO, purple horseshoes). Error bars plot 95% confidence intervals across subjects. Smaller symbols plot thresholds recorded with monotic stimulation (monaural control).

- 1) ILD discrimination is impaired for middle clicks compared to endpoint clicks
- 2) Endpoint ILD discrimination is worse than static ILD discrimination
- 3) Onset and offset ILD discrimination are similar, and worse than single-click

Results continued

Individual Data

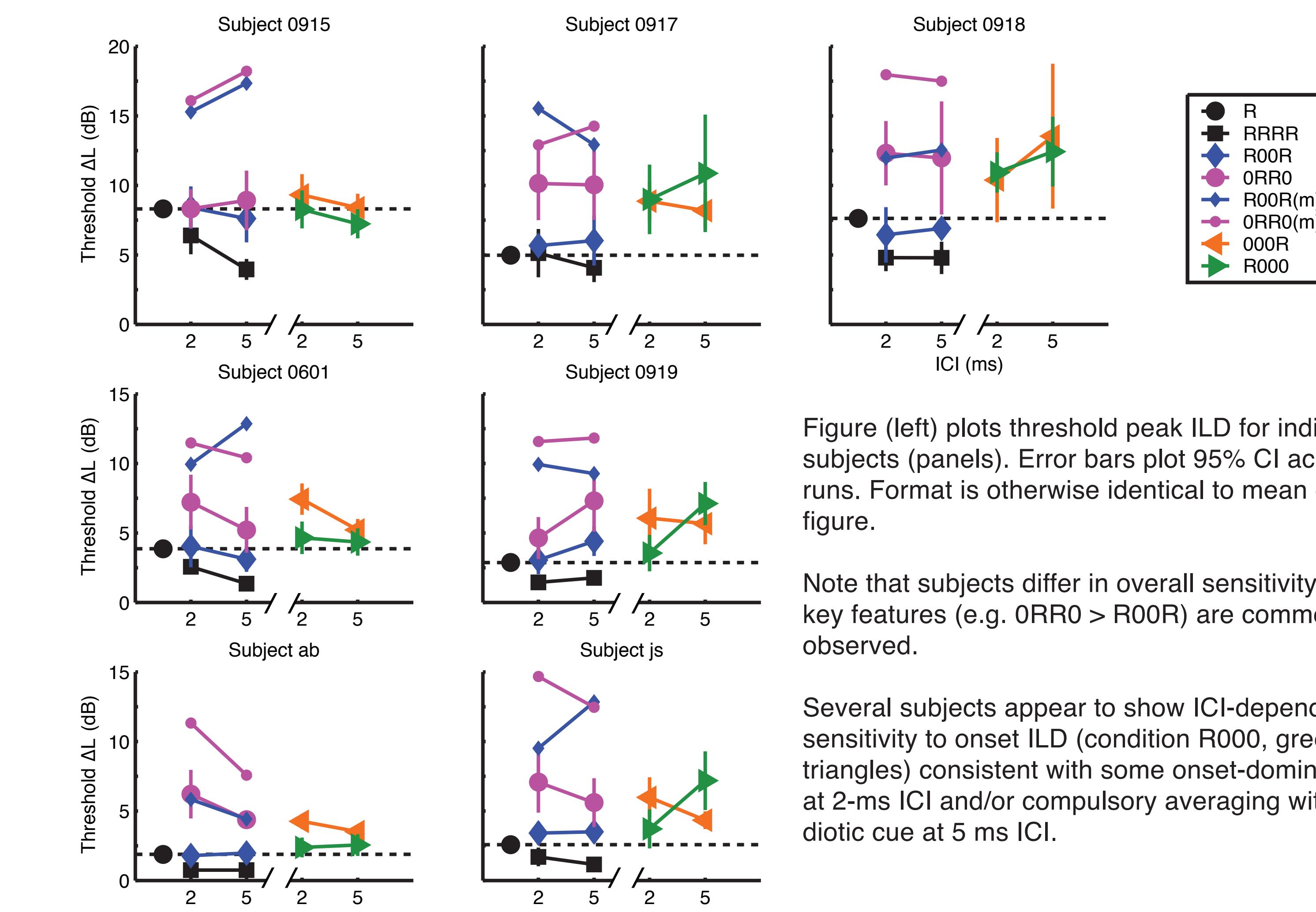


Figure (left) plots threshold peak ILD for individual subjects (panels). Error bars plot 95% CI across runs. Format is otherwise identical to mean data figure.

Note that subjects differ in overall sensitivity, but key features (e.g. ORRO > R00R) are commonly observed.

Several subjects appear to show ICI-dependent sensitivity to onset ILD (condition R000, green triangles) consistent with some onset-dominance at 2-ms ICI and/or compulsory averaging with diotic cue at 5 ms ICI.

Conclusions

U-shaped weighting



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- 1) Advantage of R00R over ORRO consistent with sensitivity to both onset and offset ILD, insensitivity to mid-train ILD.
- 2) Possible ICI-dependent onset dominance (R000 vs 000R). Differs from Stecker (2007) result but consistent with TWF studies (van Hoesel 2008, Brown & Stecker 2009).
- 3) Discrimination may have been hindered by 0 dB ILD present on most clicks. Suggests some compulsory averaging (temporal integration), inability to independently access informative clicks.

Acknowledgements

Julie Stecker, Anna Mamiya, and Jennifer Ostreicher provided assistance with subject recruitment, data collection, and preliminary analyses.

This research was funded by NIDCD R03-DC009482 (GCS), T32-DC000033 (ADB).

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