

Auditory Temporal Gap Detection

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1. Auditory temporal gap detection is a psychophysical task which measures one aspect of auditory temporal resolution.

- *Eddins, DA, Hall, JW, Grose, JH. (1992) J. Acoust. Soc. Am. 91: 1069-1077.*
- *Moore, BCJ. (2005) An Introduction to the Psychology of Hearing, 5th Edn. NY: Academic Press.*

2. Gap detection may be a useful model for sensory-perceptual mechanisms mediating the perception of stop consonant-vowel syllables.

- *Formby, C, Barker, C, Abbey, H, Raney, JJ. (1993) J. Acoust. Soc. Am., 93: 1023-1027.*

3. Gap detection tasks come in at least two kinds: “within-channel”, and “between-channel.” In the within-channel paradigm, the sounds (usually noises) bounding the gap are spectrally identical, and gap detection thresholds are very low (a few ms). In the between-channel paradigm, the noises bounding the gap are spectrally (or otherwise) different, and gap detection thresholds are up to an order of magnitude higher.

- *Heinz, MG, Goldstein, MH, Formby, C. (1996) Auditory Neurosci., 3: 35-56.*
- *Phillips, DP, Taylor, TL, Hall, SE, Carr, MM, Mossop, JE. (1997) J. Acoust. Soc. Am., 101: 3694-3705.*
- *Formby, C, Gerber, MJ, Sherlock, LP, Magder, LS. (1998) J. Acoust. Soc. Am., 103: 3554-3560.*
- *Hanekom, J, Shannon, RV. (1998) J. Acoust. Soc. Am., 104: 2372-2384.*
- *Grose, JH, Hall, JW, Buss, E, Hatch, D. (2001) J. Acoust. Soc. Am. 109: 1587-1595.*

4. It is thought that the within-channel gap detection task requires the listener to detect a discontinuity in the activity of the perceptual channel activated by the stimulus. In contrast, detecting the gap in a between-channel paradigm may require a relative timing of the activity in the perceptual channels activated by the two different noises bounding the gap. It is the between-channel paradigm which perhaps best models the stop consonant CV syllable.

- *Phillips, DP, Taylor, TL, Hall, SE, Carr, MM, Mossop, JE. (1997) J. Acoust. Soc. Am., 101: 3694-3705.*
- *Taylor, TL, Hall, SE, Boehnke, SE, Phillips, DP. (1999) J. Acoust. Soc. Am., 105: 563-566.*
- *Phillips, DP, Hall, SE. (2000) J. Acoust. Soc. Am., 108: 2957-2963.*

5. Gap detection thresholds for between-channel stimuli that approximate the spectral configuration of a stop consonant CV syllable roughly match the duration of VOTs that define phonetic boundaries. In this regard, Kuhl & Miller suggested that the speech system exploits natural psychophysical discontinuities in the formation of perceptual categories. Perhaps one such discontinuity serving as a viable candidate for a VOT phonetic boundary determinant is therefore between-channel gap threshold for stimulus configurations resembling the CV syllable.
 - *Kuhl, PK, Miller, JD. (1978) J. Acoust. Soc. Am., 63: 905-917.*
 - *Phillips, DP, Smith, JC. (2004) Perception, 33: 371-378.*

6. Between-channel gap thresholds, but not within-channel ones, are highly correlated with perceptual VOT phonetic boundaries in the same listeners.
 - *Elangovan, S, Stuart, A. (2007) Submitted.*

7. In children, performance on within- and between-channel gap detection tasks appear to have different developmental time courses, and different patterns of association with orthographic and phonological reading processes. Performance on between-channel gap detection (and other relative timing) tasks is the better predictor of phonological reading performance.
 - *Walker, KMM, Hall, SE, Klein, RM, Phillips, DP. (2006) Brain Res., 1124: 126-141.*

8. In adults, performance on between- and within-channel gap detection tasks is differentially vulnerable to aging, with between-channel performance deteriorating more rapidly.
 - *Lister, J, Besing, J, Koehnke, J. (2002) J. Acoust. Soc. Am., 111: 2793-2800.*

9. Adult aphasics show greater deficits in between-channel gap detection performance than in within-channel performance.
 - *Stefanatos, GA, Braitman, LE, Madigan, S. (2007) Neuropsychologia, 45: 1127-1133.*

10. Children with learning disabilities may have greater deficits in perceptual tasks requiring relative timing operations (e.g., between-channel gap detection) than tasks that do not, and this may be true both for children with concurrent CAPD diagnosis and for those without it.
 - *Walker, KMM et al (2007) in progress.*

For the Future

Exactly what sensory, perceptual/cognitive operations are engaged in the performance of within- and between-channel versions of the gap detection task?

- *Florentine, M, Buus, S, Geng, W. (1999) J. Acoust. Soc. Am., 106: 3512-3520.*
- *Allen, PD, Virag, TM, Ison, JR. (2002) J. Acoust. Soc. Am., 112: 2967-2974.*
- *Phillips, DP, Hall, SE. (2002) Hearing Res., 174: 133-141.*

Exactly what is the nature of the relationship between auditory temporal processing and language or other cognitive impairment?

- *Ramus, F, Rosen, S, Dakin, SC, et al. (2002) Brain, 126: 841-865.*
- *Rosen, S. (2003) J. Phonetics, 31: 509-527.*
- *McArthur, GM, Bishop, DVM. (2004) Cognitive Neuropsych., 21: 79-94.*

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