

Neuromagnetic activation in the human auditory cortex reflects auditory perceptual asymmetry

A. Kult^{1,3}, D. Pressnitzer², S. Supek³, A. Rupp¹

¹ Department of Neurology, University of Heidelberg, Germany

² Ircam-CNRS, Paris, France

³ Department of Physics, Faculty of Science, University of Zagreb, Croatia

Temporal asymmetry is a fundamental property of human speech. Understanding its representation in the auditory cortex is a crucial step towards our understanding of brain mechanisms underlying speech processing. When an amplitude modulator that is asymmetric in time is applied to a sinusoidal tone, the direction of the asymmetry affects the timbre of the sound. A sinusoid modulated by decaying exponential results in a "damped sinusoid" which has a dominant drumming percept. If the modulator is reversed in time to produce a "ramped sinusoid", the percept is more tonal [1]. The present study was carried out to investigate the relation of the perceived properties of asymmetry and their neuromagnetic representation in the auditory cortex. Transient and steady-state auditory evoked fields (AEFs) to ramped and damped sounds with five different half-life times, i.e. 0.5, 1, 4, 16 and 32 ms (Fig. 1), were acquired in 10 normal hearing subjects using Neuromag-122 whole-head MEG gradiometer system. Perceptual data were obtained with a paired-comparison technique to derive a relative scale of the salience of the carrier quality for each stimulus. Spatio-temporal dipole modeling of transient (Fig 2. a) and steady-state responses showed that the salience of the carrier correlated with the N100m activity (Fig. 2. b) whose amplitude asymmetry mirror the perceptual scales (Fig. 2c), with a maximum at a 4-ms half-life time. This asymmetry had been observed in single neurons [2,3] but our results represent the first neurophysiological ensemble correlate of the phenomenon.

[1] Patterson RD, J Acoust Soc Am, 1994a, 96: 1409-1418

[2] Pressnitzer D et al., Hearing Research, 2000, 149, 155-166

[3] Neuert et al., Hearing Research, 2001, 159: 36-52

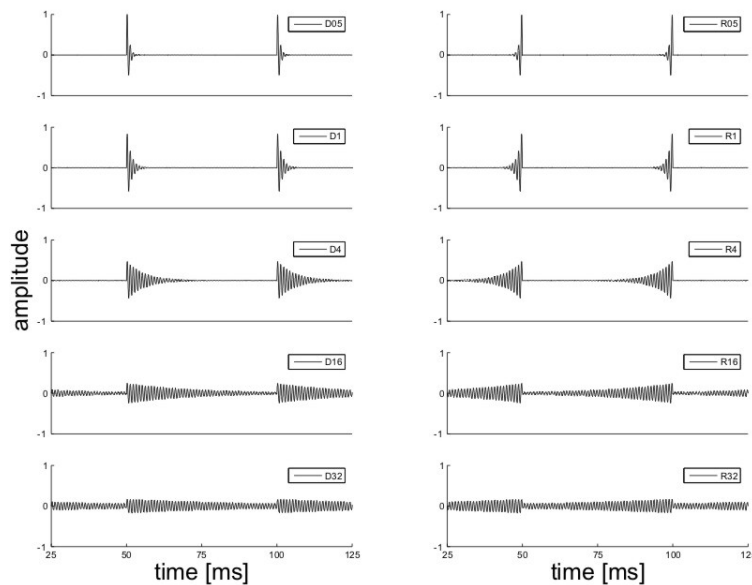


Figure 1. Waveforms of damped and ramped tones. Damped sinusoids (D) are in the left column, ramped sinusoids (R) in the right column. The half-lives used in the experiment are displayed: 0.5, 1, 4, 16 and 32 ms, as identified by a top-right insert on the each panel.

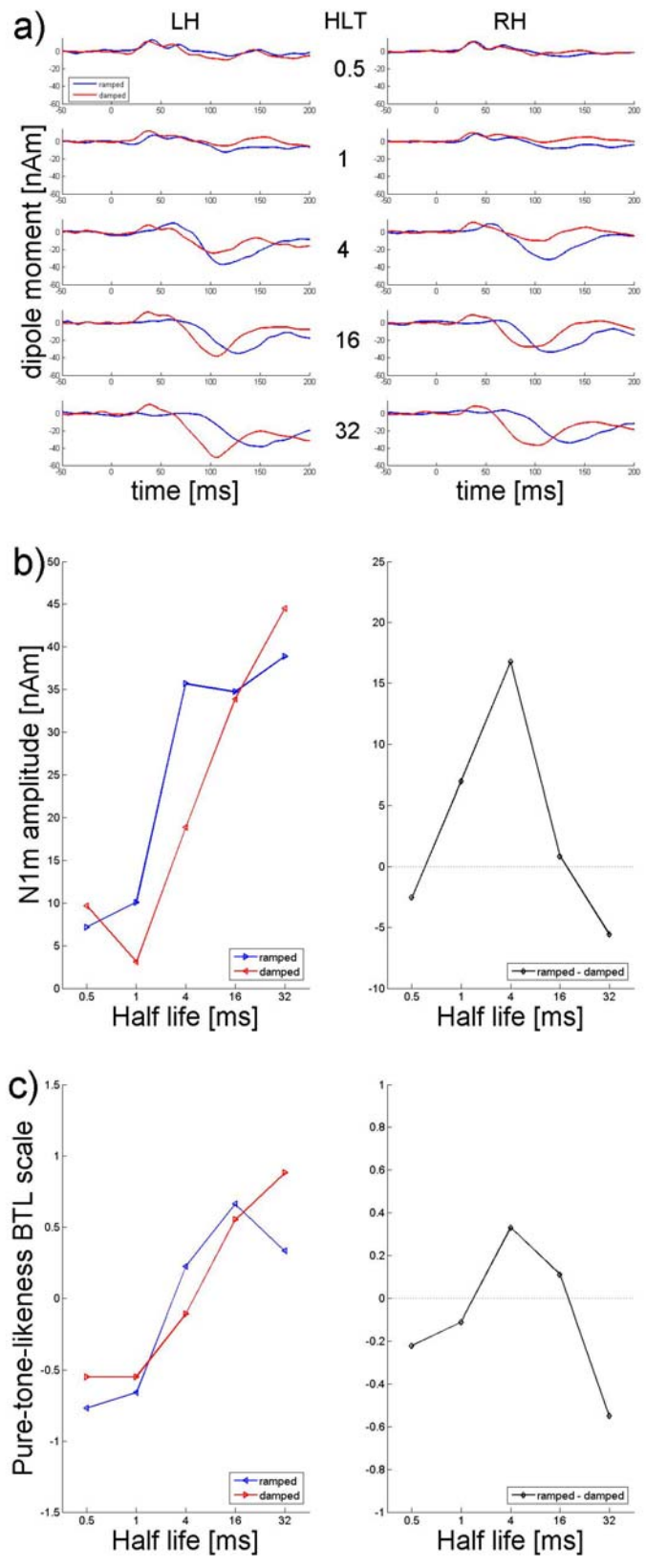


Figure 2. a) N1m source waveforms of a single subject for a transient stimulation. b) Mean N1m amplitude averaged over both hemispheres. c) Perceptual data obtained with a paired comparison technique.