

Emotion induced by auditory roughness modulates multisensory integration in relation with the body

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ABSTRACT

It has been evidenced that alarming sounds such as human screams comprise an acoustic attribute (amplitude modulation in the 30–150Hz range), which corresponds to the perception of roughness. Roughness seems to be linked to a more intense induction of fear, behavioral gains and a higher activation in cerebral areas involved in fear and danger processing [1]. These observations, however, were made with voice sounds, i.e. particular and meaningful sounds, and the importance of the semantic content for the emotional value conferred to the sounds remains unclear.

In the present study, we hypothesized that if roughness can modulate the emotional effects of simple and meaningless sounds, it should impact the integration of multisensory stimuli related to the coding of the space around body. Indeed, the space immediately surrounding the body is an interface with the external world [2]. Multisensory integration processes are thought to convey the behavioral relevance of events in relation to the body and thus to play a role in the protection of the body [3].

We used a modified version of Canzoneri et al. paradigm [4] to study audio-tactile integration in healthy participants. Participants had to detect a tactile stimulation delivered on their hand while a meaningless simple sound was approaching them from the rear hemifield. The meaningless sound was either a simple harmonic sound ($f_0=500\text{Hz}$) or a rough sound (the same harmonic sound amplitude-modulated at 70Hz). The sounds were processed through binaural rendering so that the virtual sound sources were looming towards participants from the left hemisphere of their rear hemifield.

We found that rough sounds interact with tactile processing from farther distances than non-rough sounds, suggesting that auditory-tactile integration is sensitive to auditory roughness. This finding suggests that roughness, even expressed in a very simple way (simple harmonic sounds and not human screams or natural sounds), modifies the behavioral relevance of auditory events in relation to the body. This confirms our hypothesis: auditory roughness, even apart from semantic content, could be an auditory

attribute efficiently conveying a signal of danger to the central nervous system.

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