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# When mechanical engineering inspired from physiology improves postural-related somatosensory processes

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## Abstract

Although in the standing position, stimulation comes from the relative movement between the feet and the supporting surface, most of the investigations have ignored this mechanical contact behavior. Mechanical friction between the foot skin and the contact surface induces vibrations that stimulate receptors of the plantar skin (i.e., mechanoreceptors). We hypothesized that a biomimetic surface inspired by the characteristics of the mechanoreceptors and skin dermatoglyphs (i.e., biomimetic) would potentiate early cortical processes associated with somatosensory inputs involved in balance control.

We recorded by EEG and measured the amplitude of the somatosensory potential (i.e. SEP) evoked by the production of the contact force during unexpected supporting surface translation, and the amplitude of the induced vibrations with an accelerometer glued to the first right toe. 25 participants stood with their eyes closed on a biomimetic or smooth surface and underwent a low acceleration supporting surface translation.

The amplitude of the SEP was greater and the P1 latency shorter when standing on the biomimetic surface. Power spectral density (PSD) analysis of the accelerometer signal showed a different vibration signature on the biomimetic surface with greater power at 215Hz and the presence of a peak at 310Hz.

It would appear that the biomimetic surface amplifies tactile information by bringing out a characteristic vibratory profile dominated by frequencies within the optimal sensitivity range of specific mechanoreceptors. These observations provide neurophysiological evidence that the transmission of somesthetic afferents can be potentiated when the mechanical behavior of contact with the skin allows the amplification of subcutaneous vibrations.

**Keywords:** plantar sole afferents, biomimetic surface, balance, EEG, somatosensory evoked potentials (SEP)

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