Shape congruence modulates dynamic visuo-haptic interactions

Haeji Shin, Yuna Kwak, & Chai-Youn Kim
School of Psychology, Korea University

When two dissimilar images are presented to the corresponding retinal positions of the two eyes, perception alternates between the two images (Blake & Logothetis, 2002). Dubbed binocular rivalry (BR), this paradigm provides a window into inferential visual processing. Recent experiments using multisensory stimuli found that tactile information boosts the dominance of the congruent visual stimulus (Lunghi et al., 2010; Suzuki et al., 2019). The present study examines whether dynamic haptic exploration of 3D shape objects boosts the perception of congruent visual shape stimuli during BR. 3D spiky and round shapes were created with a parametric shape model (Gielis, 2003). The coordinates for the neutral shape were acquired through linear interpolation of round and spiky shape coordinates (Kwak et al., VSS 2018). Visual and haptic stimuli were each created by 3D rendering and 3D printing the shape models. Participants viewed a pair of rotating round and spiky shapes as rival targets while exploring haptic objects with their left hand. They used their right hand to track perceptual dominance via computer key press. There were four haptic conditions - three exploring round, spiky, and neutral shape objects and one with no haptic stimulation (visual-only). Visual dominance durations for each condition were normalized with the mean duration of visual-only trials to account for individual differences. Analyses showed significant differences in the normalized dominance durations of both round and spiky visual targets when exploring haptic stimuli of different shapes. Specifically, haptic exploration of an object was associated with increased dominance of the corresponding visual target for both round and spiky shape during BR. With these results based on stimuli parametrically modulated in a single shape dimension of curvature, we suggest that shape congruence between visual and haptic modalities boosts the dominance of the corresponding visual target.

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