

A Model of the Reference Frame of the Ventriloquism Aftereffect Considering Saccade Adaptation

Background: The ventriloquism aftereffect (VAE), observed as a shift in the perceived locations of sounds after audio-visual stimulation, requires reference frame (RF) alignment since hearing and vision encode space in different frames (head-centered vs. eye-centered). Previous experimental studies observed inconsistent results: a mixture of head-centered and eye-centered RFs for the VAE induced in the central region vs. a predominantly head-centered RF for the VAE induced in the periphery on one side, and for the aligning audiovisual calibration on the other side. A previous model proposed to describe these data required different parameter fits to predict the central vs. peripheral aftereffect data as well as the AV-aligned data. Here, a new version of the model is introduced to provide a unified prediction of all data sets considering that saccade responses, used to measure VAE, are also adapted.

Methods: VAE was measured using eye-tracked saccades to the perceived locations of sound (i.e., “auditory saccades”) presented via loudspeakers. The model has two components: an auditory space representation component and a saccade-representation component. The former is adapted by ventriloquism signals in the head-centered RF. The later one characterizes adaptation in auditory saccade responses in eye-centered RF.

Results: The updated version of the model provides a unified prediction of all the data, even if only head-centered RF is considered in the auditory space representation, while proposing that there are a priori biases in the auditory saccades and that the auditory saccades also undergo ventriloquism adaptation.

Conclusion: The results suggest that purely head-centered RF is used for adaptation of auditory spatial representation in the ventriloquism aftereffect, and that the apparently mixed eye-and-head centered RF observed experimentally is most probably due to saccade-related biases that are eye-centered.