
Figures and figure supplements

Brain representations of motion and position in the double-drift illusion

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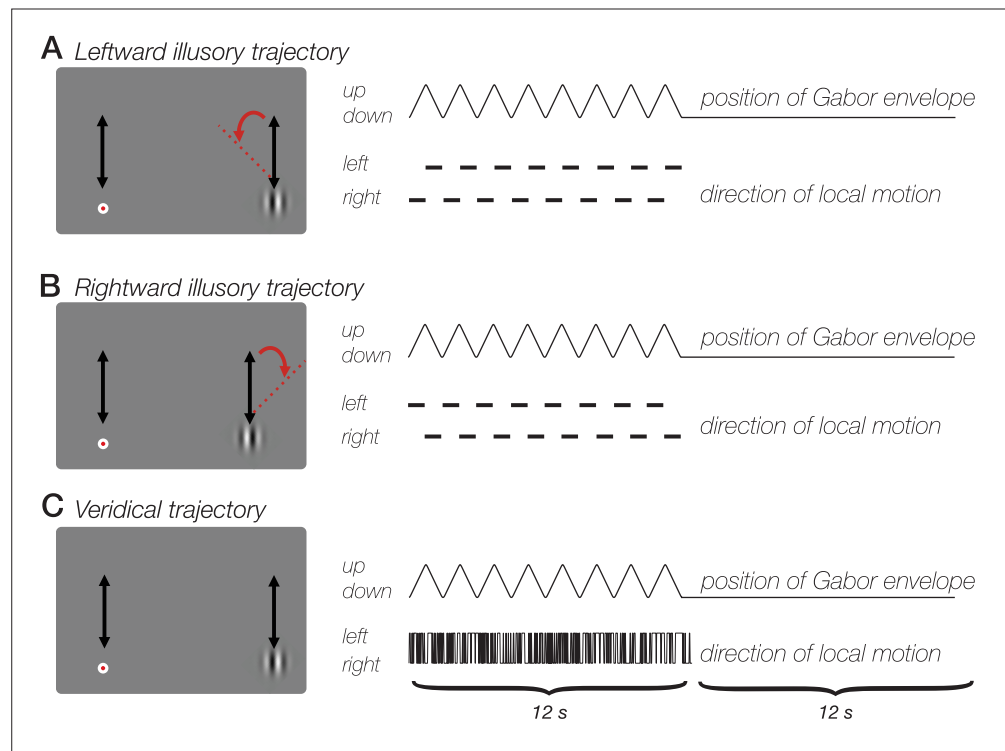


Figure 1. Double-drift illusion during smooth pursuit. **(A)** Leftward drift illusion. Participants made smooth pursuit eye movements, tracking the target as it moved vertically in tandem with a Gabor stimulus. Both the gabor and target moved for 12 seconds. Conjunction of local motion (grating phase drift) and global motion (displacement of the Gaussian envelope) produces an illusion in which the Gabor appears to drift several degrees to the left of its actual trajectory, even when smooth pursuit eye movements stabilize the Gabor on the retina. **(B)** Rightward drift illusion. Conjunction of local and global motion produces illusion of a rightward Gabor trajectory. **(C)** No-illusion control condition. Randomly updated grating phase does not produce illusory stimulus trajectory. All three stimulus conditions contain the same net motion energy and involved the same pursuit eye movements, yet are associated with strongly different percepts.

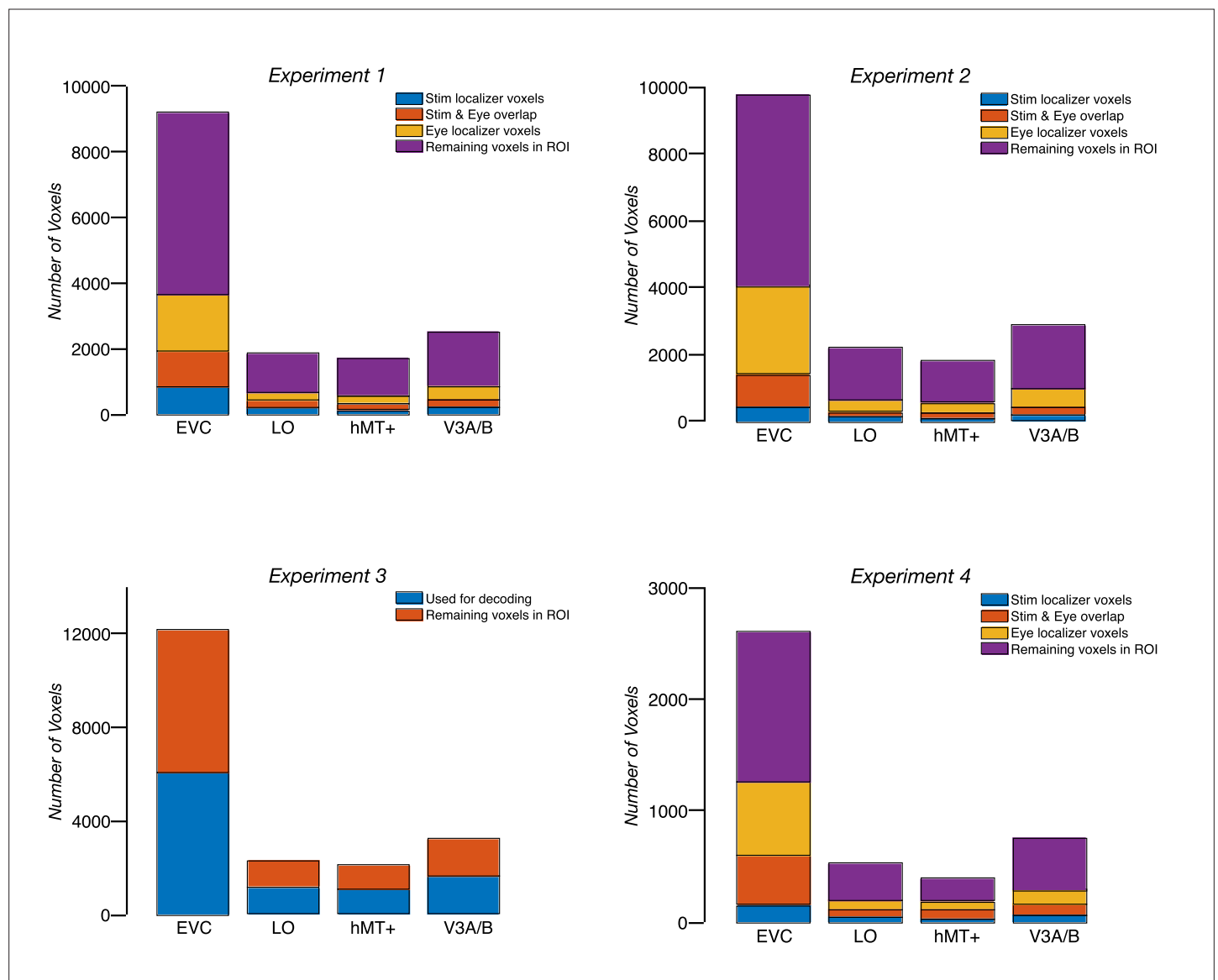


Figure 1—figure supplement 1. Mean number of voxels in each region of interest, for each experiment. For experiments 1, 2, and 4, colored portions of bars represent mean number of voxels identified in Stim (blue) and eye (yellow) localizers, their overlap (orange), and the remaining voxels (purple). For experiment 3, colored portions of bars represent mean number of voxels used for decoding (blue, top 50% voxels ranked by R^2) and those that were not used for decoding (orange).

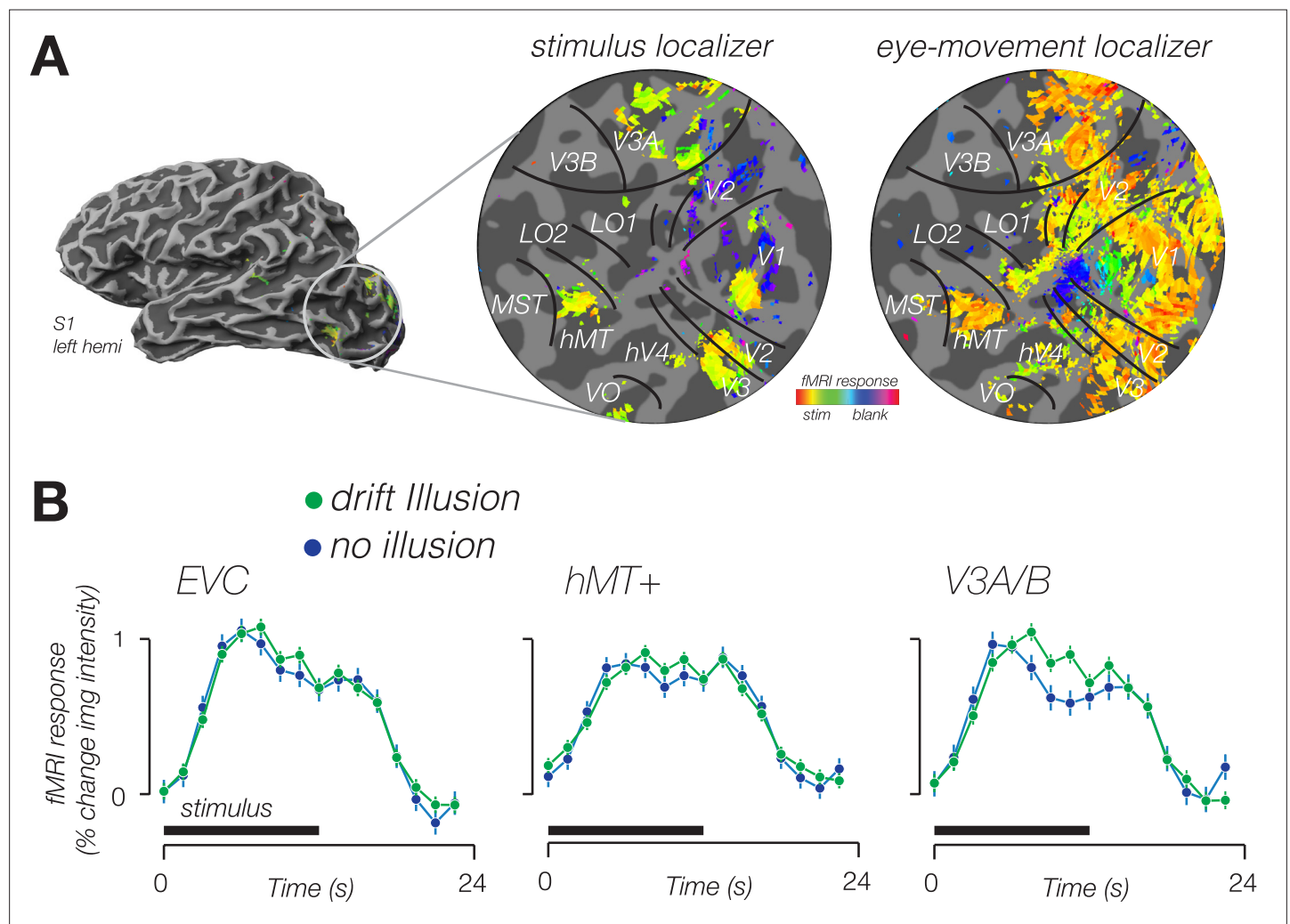


Figure 2. Modulation of fMRI response amplitude during double-drift illusion. **(A)** Stimulus localizer-evoked activity in cortical regions representing stimulus location (center), eye movement localizer-evoked diffuse activity in visual cortex, extending well beyond stimulus representation. Data from a single participant in the stimulus localizer shown on an inflated cortical surface (left) and a flattened patch of the occipital lobe (center). Data from the same subject in the eye-movement localizer shown on the right. Boundaries of retinotopic visual areas identified according to an anatomical template. Color indicates the phase of the response. Yellow hues indicate a response in phase with the onset of the stimulus (center) or onset of smooth pursuit (right). **(B)** Time course of fMRI response from voxels identified in the stimulus localizer, from three cortical areas exhibiting a larger response for the double-drift illusion than during a no-illusion control condition.

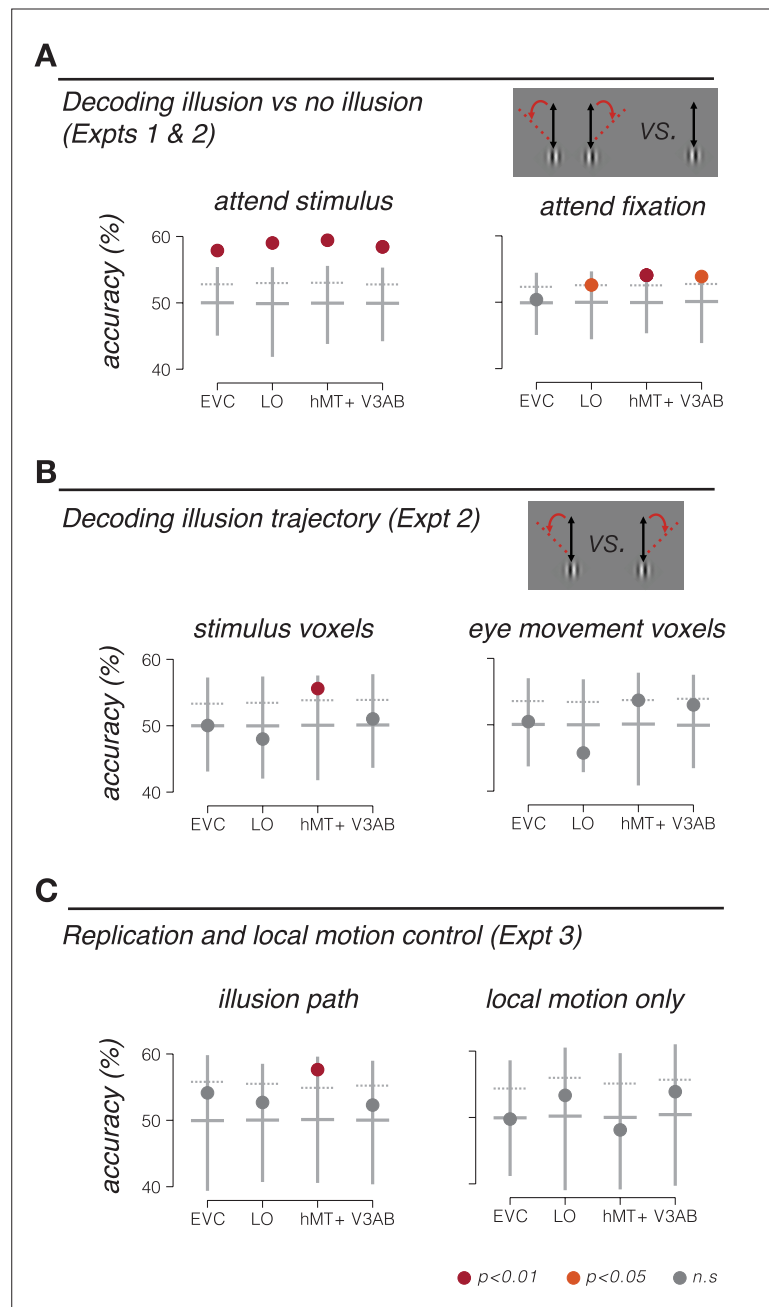


Figure 3. Stimulus location information encoding during double-drift illusion. **(A)** Accuracy of discriminating the double-drift illusion from a control condition that was matched for net motion energy. Participants either attended the peripheral stimulus and reported the presence of the illusion (Expt 1, left), or attended the fovea and reported a luminance decrement at fixation (Expt 2, right). **(B)** Accuracy of discriminating rightward vs. leftward drift illusion paths in Expt 2 (attend fixation) based on fMRI responses in voxels selected to match the retinotopic location of the stimulus (left) and voxels selected based on responses to pursuit eye movements (right). **(C)** Decoding accuracy for independent replication and control experiments (Expt 3). Left, decoding illusory drift paths, replicating results of Expt 2. Right, decoding local-motion only control conditions, which did not produce a drift illusion. Vertical lines extend from minimum to maximum bootstrap decoding accuracy. Horizontal lines denote median bootstrap decoding accuracy. Maroon dot, $p < 0.01$; orange dot, $p < 0.05$; gray dot, nonsignificant ($p > 0.05$).

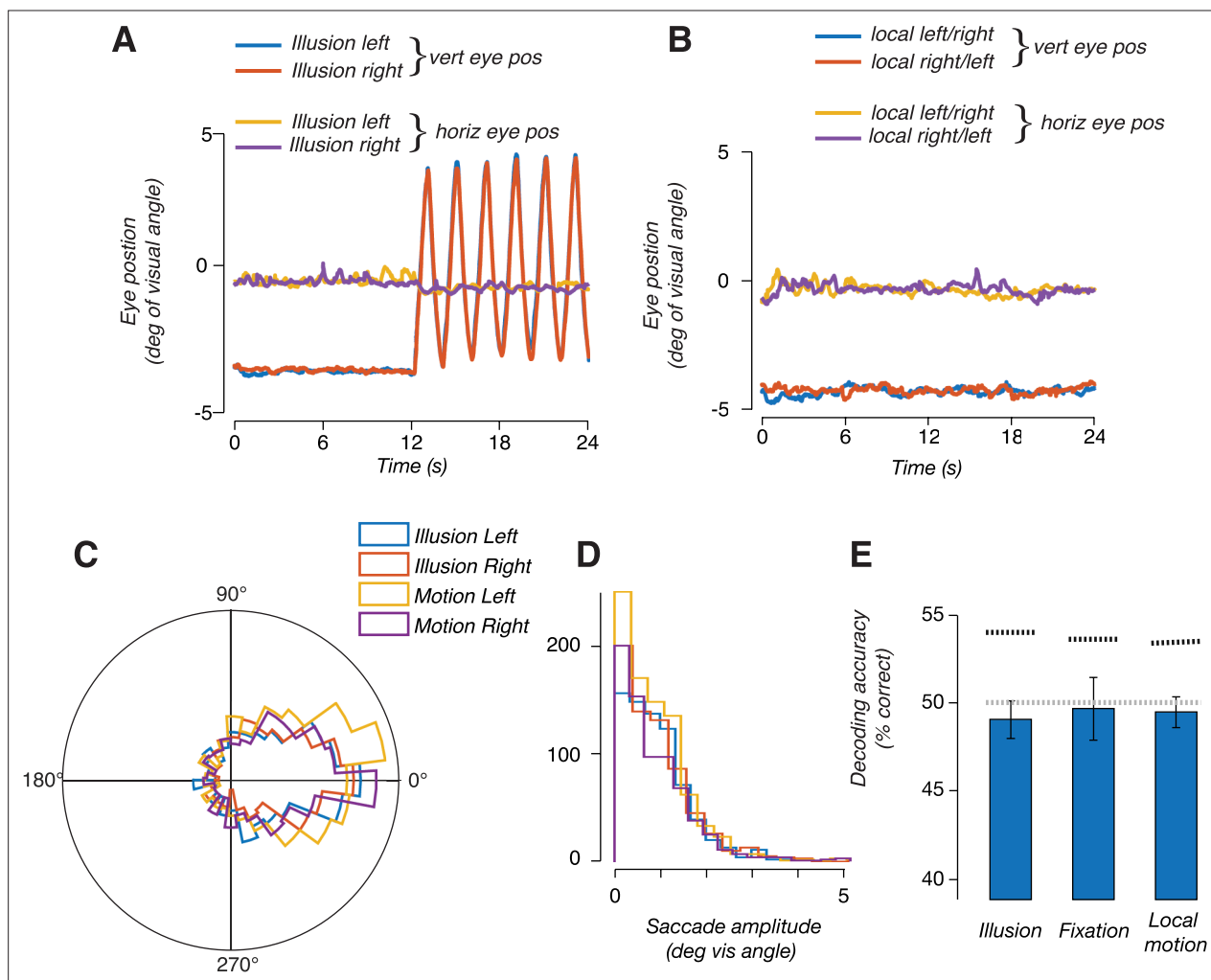


Figure 4. Eye position measurements did not reflect the trajectory of the illusion. **(A)** Eye position measured during blocks of double-drift illusion; one representative subject averaged over all blocks in a scan session. Traces show stable fixation during the first 12 s followed by 12 s of vertical smooth pursuit. Eye position did not differ between leftward and rightward illusion. **(B)** Eye position during blocks of local motion only trials. **(C)** Polar histogram of microsaccades direction during leftward and rightward double-drift illusion and the two motion conditions. **(D)** Histogram of saccade amplitude during the two illusion conditions and the two motion conditions. **(E)** Decoding accuracies, using the horizontal and vertical eye position measurements to train and test a linear classifier to discriminate the direction of local motion. The bar labeled 'illusion' indicates accuracy for decoding trajectory during the illusion; the bar labeled 'fixation' indicates decoding during fixation (when no illusion was perceived); bar labeled 'local motion' indicates decoding during the local-motion only condition (during fixation). Horizontal gray dashed line denotes chance decoding for binary decision (50%). Horizontal black dashed line denotes 95% confidence interval of null distribution estimated using a permutation test.