Supplementary Methods

Eye movements:

Eye movements were monitored outside of the scanner using an identical stimulus display and a standard pupilometry eye tracking system (ISCAN Co, Burlington, Massachusetts). Mean horizontal and vertical eye-positions during stimulus presentation intervals were compared between the two conditions (same and different). Eye blink artifacts were removed from all eye position traces before statistical analysis. No statistical difference in mean horizontal or vertical eye position was found (t-test, $P>0.05$) excluding the possibility that eye position systematically varied with condition. This demonstrates that there was no difference in the location of the stimulus on the retina between conditions and no difference in the effective retinal velocity of the moving dot stimulus between conditions.

Color experiment:

In the color experiment, subjects were given a two-interval, forced-choice discrimination task at luminance threshold . They were instructed to attend to the red or green field of dots (the target field) on the attended side in alternating blocks. The color of the ignored field of dots did not change during each scan. Each four-minute fMRI scan consisted of six 40-s cycles in which attention alternated between the 'same' condition, in which the color of the ignored stimulus matched the target field, and the 'different' condition, in which the color of the ignored stimulus was different from that of the target field. During each trial, all stimuli were simultaneously presented for two sequential intervals (trial structure same as in first experiment). A threshold-level luminance intensity change occurred between the two intervals for each field of dots on every trial. Subjects indicated with a key press whether the target dots were brighter during the first or second interval (this was independently randomized for each field of dots). The baseline luminance was independently jittered across trials in all fields of dots, so that the non-target fields could not be used for comparison. Again, the optimal task strategy was to maintain attention on the target field of dots while ignoring the two non-target fields. Stimulus presentation, training, eye monitoring, fMRI and data analysis were done as in the first experiment. No difference in mean eye position was found between 'same' and 'different' conditions (t-test, $P > 0.05$).

Divided attention experiment:

In separate psychophysical trials, we verified that task performance was impaired when subjects were instructed to divide attention across both left and right stimuli. These trials were conducted outside of the MRI scanner

using an identical visual display. All three subjects of the original feature-based attention to motion fMRI experiment participated. The stimulus was as previously described (**Fig. 1a**): a circular aperture with overlapping fields of upward and downward moving random dots was presented on one side of fixation (the overlapping fields stimulus) and a single field of dots moving either up or down was presented on the other side (the single field stimulus). As in the original experiment, subjects attended the two directions of motion on the overlapping side in alternating blocks. However, when the attended direction matched the direction of the single field stimulus, subjects were instructed to also perform the speed discrimination task on the single field stimulus and enter two responses (dual task). Thus, subjects alternated between conditions during which attention was spatially focused on the overlapping field stimulus and divided across both stimuli. As described in the main text, all three fields of dots independently changed speeds every trial so that no change in the stimulus was required to accommodate these divided attention trials. Each subject's previously determined increment threshold was used here for each field of dots. These trials were counterbalanced for side (left/right) and for the direction of motion of the single field stimulus.

We compared task performance on the overlapping fields stimulus during the two conditions. As expected, performance was significantly impaired when in the divided attention trials (mean performance = 74.7% correct) compared to focused attention trials (mean performance = 85.8% correct, $P < 0.05$ for each of three subjects, 576 trials per subject). These results are consistent with many previous studies that show, using a variety of stimuli, impaired performance on a divided attention task compared to focused attention[1,9].