Supplementary Materials

Figure S1 summarizes the main features of subjects' saccadic eye movements from the reloading station to the target. Subjects' saccades began on average 6.9 msec. before the hand in the 'near' condition and 10.8 msec. after the hand in the 'far' condition. As seen by the size of the error bars in figure S1a, which shows the standard deviation of the eye-hand delay, the relative timing of eye and hand movements varied widely across trials, with an average standard deviation of 74.7 msec. in the 'near' condition and 72.3 msec. in the 'far' condition. Figure S1b shows average saccade durations for each subject. The mean saccade duration across subjects was 60.8 msec. in the 'near' condition and 96.9 msec. in the 'far' condition. Realistically, given the conservative threshold used to estimate saccade end-times, these estimates are negatively biased by approximately 8–12 msec. as discussed in the main text under Data Analysis: Eye Movements. Saccade durations varied from trial to trial, with average standard deviations of 6.1 msec. in the 'near' condition and 10.9 msec. in the 'far' condition.
Supplementary Figure S1. (a) The relative delay between the beginning of saccades (T_{eye}) and the beginning of hand movements (T_{finger}). Error bars show the standard deviations of the relative delays across trials (not the standard errors of the means). (b) Mean saccade durations for each subject. As in (a), error bars show the standard deviations of each subject's saccade durations.

Figure S2 shows the main features of subjects' hand movement kinematics. Figures S2a and S2b show samples of one subject's finger endpoint trajectories in the 'near' and 'far conditions respectively. The trajectories are represented in a coordinate frame aligned with the path from the reloading station to the target (only no-perturbation trials are shown). Figure S2b shows plots of the tangential velocity for the same movements. Figure S3 shows the same velocity profiles in normalized time units, where the time axis represents the proportion of movement time from the reloading station to the target. The dotted lines in figure S3 show the point in the trajectories of hand movements used to calculate the planning weights to memory in the main text, as this is a very conservative es-
timate with little to no influence of online control. The dashed lines show the point in the trajectories used to estimate the relative influence of visual short-term memory on hand movement planning on a subject-by-subject basis in figure S4. As seen in S3, this point occurred near the time of peak velocity, but slightly later on most trials. This pattern was consistent across subjects. The mean duration of subjects hand movements was 642 msec. in the near condition and 804 msec. in the far condition. Movement duration varied from trial to trial within each subject with an average standard deviation within each subject across of 105 msec. in the near condition and 128 msec. in the far condition.
**Supplementary Figure S2.** Hand movement kinematics as represented by the motion of one subject’s fingertip on multiple trials (all with no target perturbation). (a,c) Fingertip trajectories projected onto the tabletop and represented in a coordinate frame aligned with the axis from the reloading station to the target. (b,d) The tangential velocity of the fingertip from the beginning to the end of the movement, as measured by the times that the fingertip broke contact with the contact plate at the reloading station and made contact with the contact plate at the target.
**Supplementary Figure S3.** The same velocity profiles from figure 6 re-plotted in normalized time coordinates. The time axis for each movement was scaled by the movement duration and multiplied by 100.

As shown in figure 5 in the text, there is a trade-off between minimizing the effect of online control (time points later in the movement have had more opportunity for correction from online control) and minimizing the standard error in weight estimates (as each movement begins in roughly the same location). We selected the 50% time frame as the point at which to examine the subject-by-subjects’ weights given to visual short-term memory for planning the finger movement, as this time point allows for low standard error in the weight estimates, but is still conservative in minimizing the effects of online control. In the 'near' condition, this corresponded to a point in time 321 msec. after movement onset and 154 msec. after the end of the flicker, on average. For the 'far' condition, this corresponded to a point in time 402 msec. after movement onset and 235 msec. after
the end of the flicker, on average. When the overall analysis was conducted using the 50% mark instead of 35% as in the text, all ANOVA results remained the same.

Furthermore, any effect of online control would under-estimate the weight to memory for hand movements, and yet we still see that nearly every subject gives a stronger weight to memory for hand movements over eye movements for both the near and the far condition. Also, there would be more opportunity for online control to effect hand movements at the halfway point for far conditions over near conditions, yet we still see a stronger influence to memory in the far condition over the near.
Supplementary Figure S4. The relative influence of short term memory on subjects finger positions 50% of the way through a movement and eye positions just before the ends of saccades for the 'near' condition (a) and the 'far' condition. This 50% mark is still a conservative estimate to minimize effects of online control, but by this point in the movement, error bars are small enough to examine effects subject-by-subject. (b). Error bars for each subject were computed by fitting the regression model to re-sampled trials and computing the standard deviation of the resulting weights to the remembered (pre-perturbation) target position.