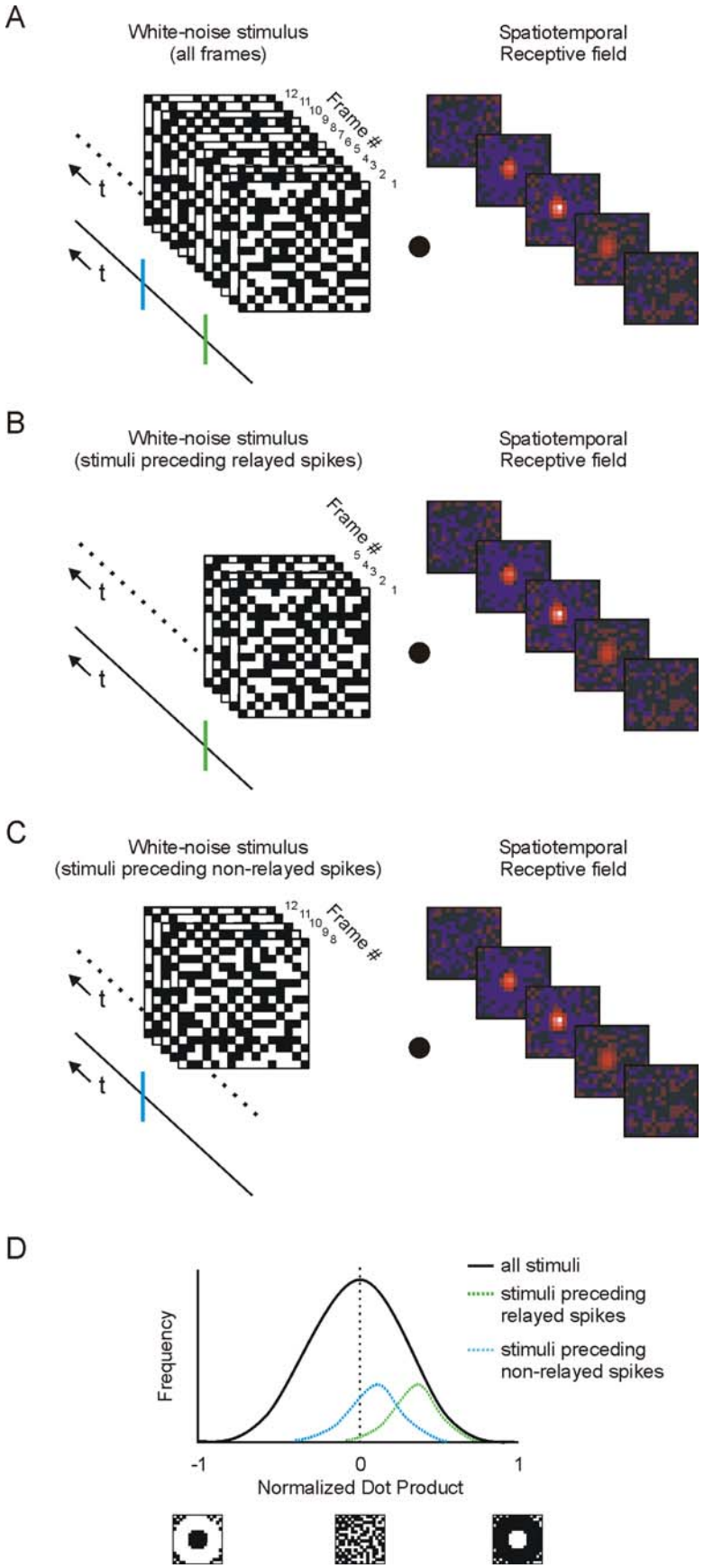
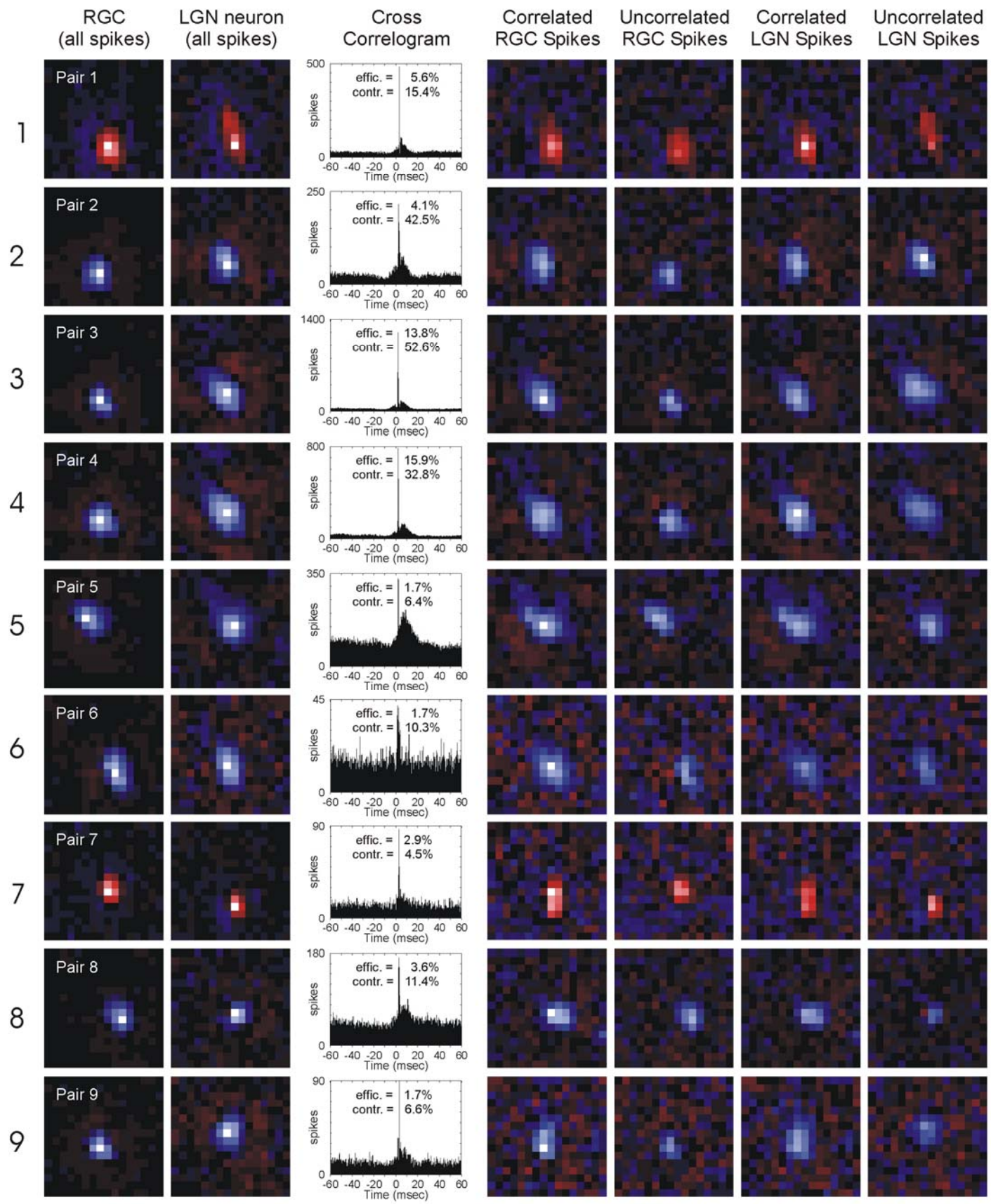
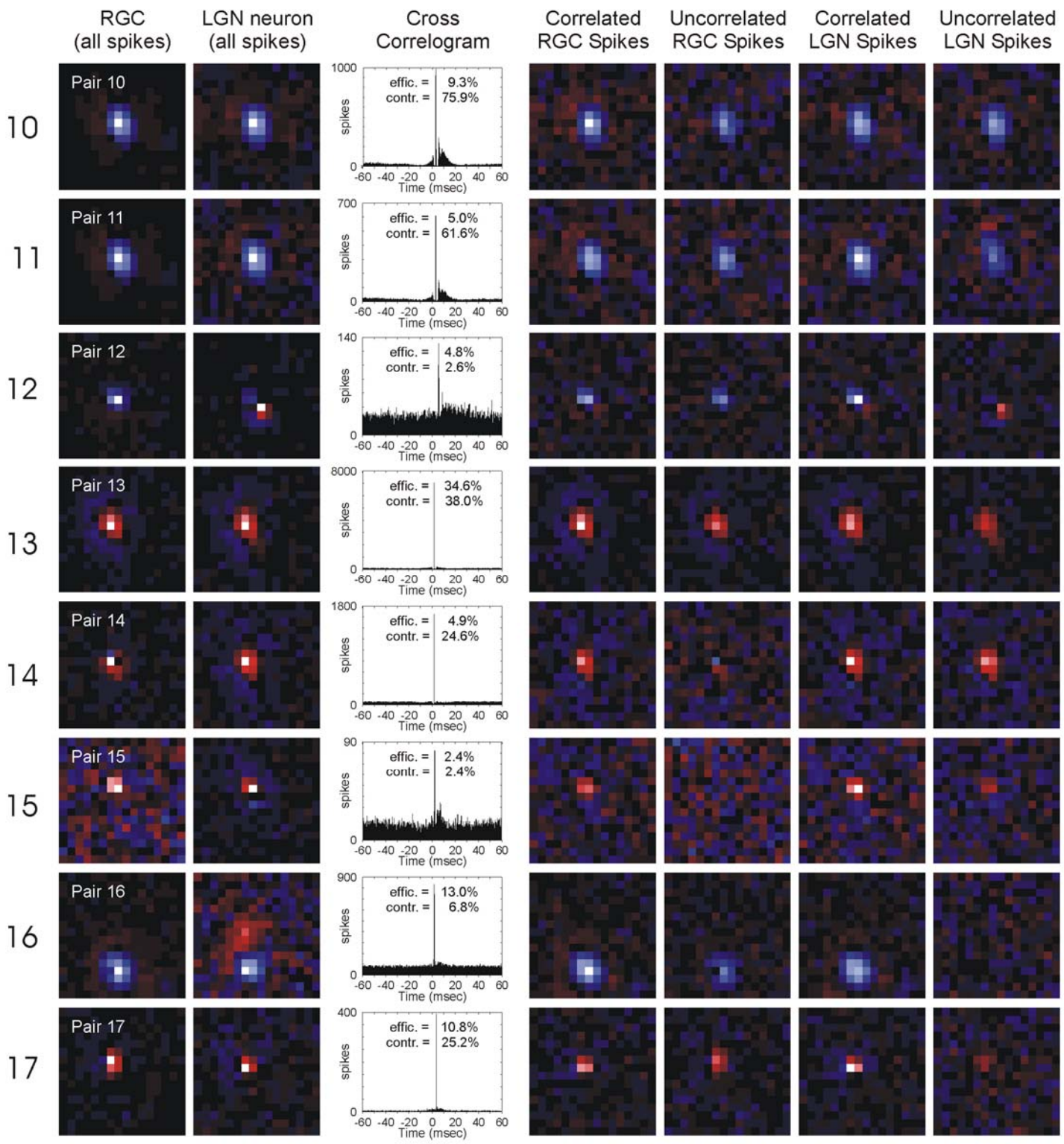
Supplemental Figure 1. Diagram illustrating the method for determining the relationship between stimuli that preceded relayed and non-relayed retinal spikes. A normalized dot product (NDP) was used to quantify the degree of similarity between frames in the white-noise stimulus and the fitted spatiotemporal receptive field (STRF) map of a given neuron (see Experimental Procedures). **A.** When calculating the NDP between all frames of the visual stimulus (32,767 frames; not just the frames that precede spikes) and a cell's fitted STRF map, the resulting distribution of NDP values is centered at zero (as in panel **D**, solid line), where positive values indicate an increasing similarity between the stimulus frames and the STRF map and negative values indicate an increasing mismatch between stimulus frames and the STRF map (e.g. black pixels over an "on" subregion). The NDP can also be calculated using just the stimulus frames that preceded relayed retinal spikes (as in **B**, green spike) or just the frames the preceded non-relayed spikes (as in **C**, blue spike). As shown in Figure **5A** and illustrated in panel **D**, the distribution of NDP values for relayed spikes is centered at more positive values than the distribution of NDP values for non-relayed spikes, indicating that relayed spikes are more likely than non-relayed spikes to be evoked by stimuli that match the cell's STRF map.


A
White-noise stimulus
(all frames)
Spatiotemporal
Receptive field
Frame #
12 11 10 9 8 7 6 5 4 3 2 1
t
t
B
White-noise stimulus
(stimuli preceding relayed spikes)
Spatiotemporal
Receptive field
Frame #
5 4 3 2 1
t
t
C
White-noise stimulus
(stimuli preceding non-relayed spikes)
Spatiotemporal
Receptive field
Frame #
12 11 10 9 8
t
t
D
all stimuli
stimuli preceding
relayed spikes
stimuli preceding
non-relayed spikes
Frequency
-1
0
1
Normalized Dot Product

Supplemental Figure 2. Receptive field maps and cross-correlograms for the 17 pairs of monosynaptically-connected retinal ganglion cells (RGCs) and LGN neurons included in this study. For each pair of neurons, the first panel in the row shows the white-noise RF map for the RGC using all of the RGC's spikes (for all RF maps: on responses indicated in red, off responses indicated in blue, pixel brightness indicates strength of response, the frame shown is taken from the full spatiotemporal RF at the latency for maximum response). The second panel shows the white-noise RF map for the connected LGN neuron. The third panel shows the cross-correlogram generated from the spike trains of the 2 neurons. Also shown in this panel are the efficacy and contribution values, where efficacy is equal to the percentage of RGC spikes that evoked a geniculate response ("relayed") and contribution is the percentage of LGN spikes evoked by the RGC. The fourth and fifth panels show the white-noise RF maps made from the retinal spikes that evoked and failed to evoke an LGN spike, respectively. The sixth and seventh panels show the white-noise RF maps made from the LGN spikes that were evoked and not evoked by the recorded RGC, respectively. Each of the RF maps in panels 4-7 was made using a spike-count matched data set (see Methods). As a result, pixel brightness indicates the relative strength of the RF map across the 4 maps. Because of the latency in the spike times of correlated RGC and LGN cell spikes (~2-4 msec), the RF maps in panels 4 and 6 are slightly different. Important points to note: (1) none of the contribution values for these 17 pairs of neurons approached 100%, indicating that none of the LGN neurons in this study generated spikes that could be fully accounted for by a single RGC, (2) as shown in Figure 2, the RF maps made from the correlated RGC spikes (relayed) are stronger than those made from uncorrelated RGC spikes (non-relayed), and (3) many of the RF maps made from LGN spikes not evoked by the recorded RGC have a structure indicating the RF properties of other inputs.

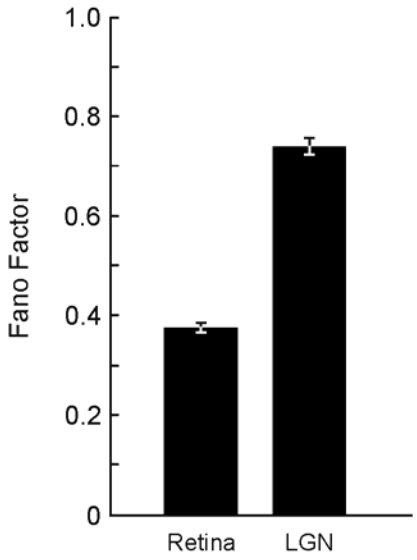


Supplemental Figure 2 – Part 1



Supplemental Figure 2 – Part 2

Supplemental Figure 3. Fano Factor values for 17 pairs of simultaneously recorded retinal ganglion cells (RGCs) and LGN neurons. Consistent with results from Kara et al. (2000), Fano Factor values for RGCs are significantly less than those of LGN neurons ($p<0.01$, Wilcoxin signed-rank test). Fano Factors (variance spike count/mean spike count) were calculated from responses to multiple presentations of a 10-second clip of the white-noise stimulus using a 50 msec window and a 25 msec step size.



Supplemental Figure 3