

Supplementary Material

Perceived Depth in Non-Transitive Stereo Displays

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Section 1

Figure S1: Response probabilities for Transitive displays, Experiment 1.

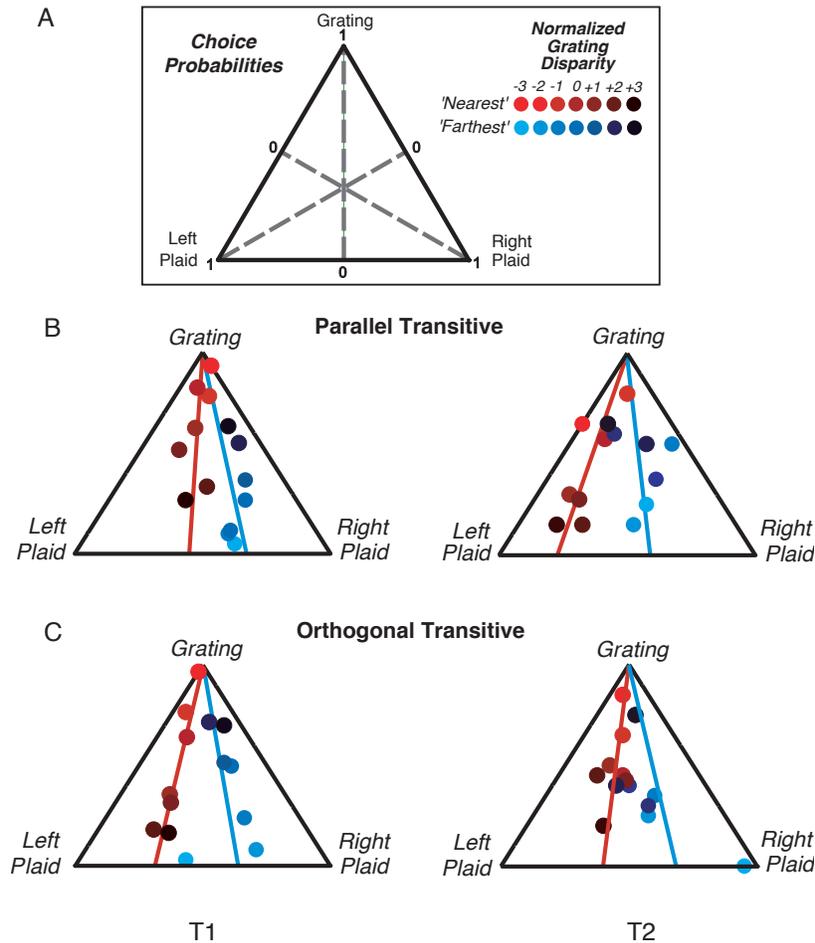


Figure S1. 'Nearest' and 'Farthest' probabilities for Transitive displays of Experiment 1. (A) Conventions for plotting probabilities of 'Nearest' and 'Farthest' judgments of a grating and two plaids, similar to Figure 5A of the main text. (B) 'Nearest' and 'Farthest' probabilities for judgments of Parallel Transitive displays by each of two observers, T1 and T2. Plot coordinates designate stimulus positions. Red and blue lines are best-fitting linear functions for 'Nearest' and 'Farthest' judgments, respectively, constrained to pass through the upper vertex. (C) 'Nearest' and 'Farthest' probabilities for judgments of Orthogonal Transitive displays, plotted as in (B).

Section 2

Plaid-plaid depth judgments.

Plaids with equal horizontal disparities appear at equal depths (Farell *et al.*, 2010), provided one plaid does not have a near-vertical disparity. To determine whether this rule applies when 1-D stimuli are also present, we collected depth judgments for a pair of plaids using a modified version of the 3-stimulus control displays of Experiment 2. These displays contained one plaid with a fixed disparity (equivalent to a phase angle of 20°) and another with a variable disparity. A grating with fixed disparity (10° of phase) occupied the position between the plaids, in the center of the display. The two plaids had orthogonal disparity directions ($+45^\circ$ and -45°) and the grating was oriented at 45° or 135° . The plaids occupied one or the other diagonals, as in the control conditions of Experiment 2. Across trials with a block, the only variation was in the disparity magnitude of one plaid, and the absolute phases of all stimulus components. Observers judged the relative depth of the two plaids and treated the grating as irrelevant. Two of the observers from Experiment 2 served here. The remaining methodological details followed those of that experiment.

PSEs for the two plaids, along with comparison data from Figure 9 of the main text, are shown in Figure S2 for the two observers. A perceptual depth match occurred when the plaids had equal disparity magnitudes (equivalent to a 20° phase disparity) and therefore equal horizontal disparities. This result replicates measurements taken from displays consisting solely of a pair of plaids (Farell *et al.*, 2010), showing that the presence of a 1-D stimulus does not change the dependence of the perceived depth of 2-D stimuli on horizontal disparities.

Plaids with orthogonal disparity directions constitute one subset of stimuli contained within Non-Transitive displays. We can compare the PSEs for this subset with the PSEs for the other subsets present in these displays—a grating and a pair of plaids, in one case all with parallel disparity directions and in the other case with orthogonal disparity directions between the grating and the plaids. Taking the data for these conditions from the ordinate of Figure 9, we find that in one case observers T3 and T4 judged the grating as appearing at the same depth as the plaid when its phase disparity was about 20° (Grating/Plaid Parallel in Fig. S2) and at the same depth as the other plaid when its phase disparity was, on average, 7.25° (Grating/Plaid Orthogonal in Fig. S2). Yet as we have seen, the plaids themselves appear in the same depth plane when they have equal disparity magnitudes (Plaid/Plaid Orthogonal in Fig. S2), confirming the inconsistency among the perceived depths given by the subsets of the displayed disparity values.

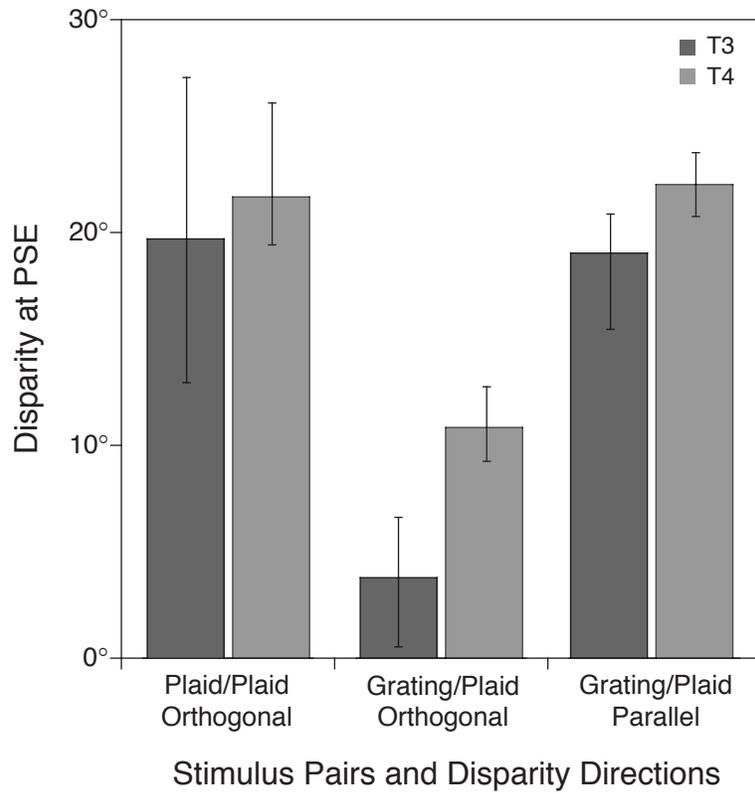


Figure S2. PSEs for a pair of plaids with orthogonal disparity directions, compared with PSEs for grating-plaid pairs. Data are from two observers, shown separately. See text above for details. Error bars are 95% confidence intervals.

Section 3

Effect of substituting a plaid for the grating

Observers in Experiments 2 and 3 were instructed to judge the relative depth of a 1-D stimulus and a subset of the 2-D stimuli present in the display. The remaining 2-D stimuli were irrelevant, yet their disparities influenced observers' depth judgments as much as the disparities of the relevant stimuli did. The failure to exclude irrelevant plaids might be due to a property of task computation or to a performance limitation. In the former case, it reflects a global processing step in the calculation of stereo-depth between 1-D and 2-D stimuli. In the latter case, it reflects a failure of perceptual mechanisms to discriminate relevant and irrelevant stimuli or a failure of attentional mechanisms to differentially process them.

If the equivalence of relevant and irrelevant plaids was a by-product of the computation of stereo-depth between 1-D and 2-D stimuli, then eliminating the 1-D stimulus by substituting a plaid for the grating should change the computation and the relevant-irrelevant balance.

However, if a performance limitation made relevant and irrelevant plaids indistinguishable, then the results should not change, since these plaids are unaffected by the dimensionality of the target stimulus.

The perceived depth between 2-D stimuli varies with their relative horizontal disparities (Farell et al., 2010). The plaids in the displays used in Experiment 2 all have the same horizontal disparities regardless of their disparity directions and those in Experiment 3 vary by no more than a factor of $\sqrt{2}$. A larger difference would facilitate a comparison of grating and plaid target stimuli. Therefore, we modified the displays of Experiment 2 by giving either the relevant or the

irrelevant subsets of plaids a 10° phase disparity and the other subset a 20° phase disparity. As in Experiment 2, both the relevant and irrelevant plaids could have disparity directions of $+45^\circ$ or -45° . Thus, their disparities were either parallel or orthogonal. The central grating or plaid could also have a disparity direction of either $+45^\circ$ or -45° . We carried out the same task as in Experiment 2, comparing depth judgments of a central grating and a central plaid relative to the relevant subset of flanking plaids.

Figure S3 shows PSEs for the central grating and plaid for observer T4, who served in Experiment 2; a second observer from that experiment (T3) produced similar results. These PSEs are plotted as a function of the sum of the disparity magnitudes of all the flanking plaids, relevant and irrelevant, that have the same disparity direction as the central stimulus. The possible values are 0° , 20° , 40° , and 60° of phase. The PSE for a grating should increase linearly with this sum, as they in fact do. This is because all parallel plaid disparities, whether relevant or irrelevant, contribute to the average projected disparity value. By contrast, the perceived depth between plaids depends only on horizontal disparity, which means it is independent of disparity direction in the displays used here. If in this case attention restricted processing to relevant stimuli, then PSEs should be flat in Figure S3. That's what we see for the plaid PSEs. The linear fits to the grating and plaid data differ significantly, $t(4) = 5.16$, $p < 0.01$. Thus, performance limitations do not prevent the selection of subsets of plaids. Instead, the ability to selectively attend to relevant disparities depends on the dimensionality of the stimuli whose depth is being judged.

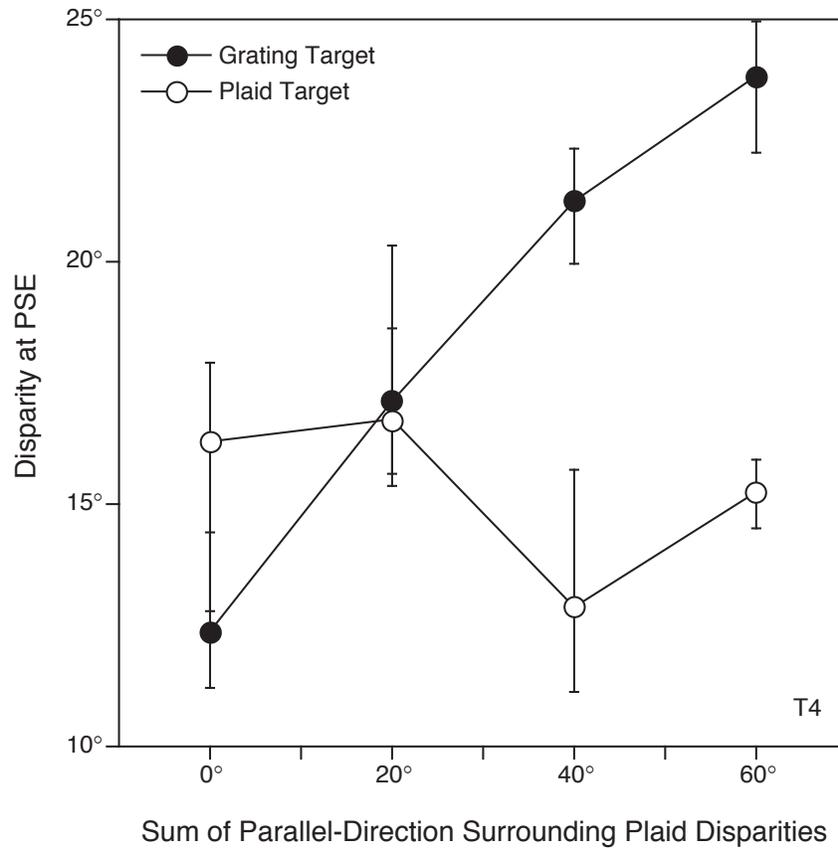


Figure S3. PSEs for central target grating and plaid as a function of the sum of surrounding plaid disparities with a direction parallel to the target disparity. Details are contained in the text above. Data for observer T4. Error bars are 95% confidence intervals.

Reference

Farell, B., Chai, Y.-C. & Fernandez, J. M. (2010). The horizontal disparity direction vs. the stimulus disparity direction in the perception of the depth of two-dimensional patterns. *Journal of Vision*, *10*, 25, 1–15.