Notes and Comment

Binocular rivalry and perceptual inference

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Dissimilar monocular inputs seem to confuse the binocular visual system; in effect, there is disagreement between the two eyes about the nature of the stimulus occupying a particular region in visual space. Apparently the brain resolves this conflict by considering each alternative successively and repetitively, such that one eye's view is dominant for a few seconds, only to become suppressed in favor of the other eye's view. Of course, this really just represents a description of the phenomenon, that is, binocular rivalry; it sheds no real light on the process by which dominance and suppression are realized. In recent years, there has been disagreement concerning the nature of this process, some attributing it to inhibitory interactions between cortical neurons (e.g., Abadi, 1976) and others (e.g., Walker, 1978) invoking a more central, cognitive mechanism.

In some sense, binocular rivalry is similar to that category of perceptual phenomena known as ambiguous figures, the most familiar example of which is the Necker cube. An ambiguous figure represents the case in which the same proximal stimulus gives rise to multiple (usually two) percepts which are alternately experienced. These multiple percepts are commonly believed to result from some type of central process—terms such as inference, perceptual organization, and interpretation are frequently used to characterize this process (Gregory, 1970). Consistent with this kind of notion are demonstrations that additional information compatible with just one of the alternative percepts serves to bias the outcome toward that percept. These demonstrations indicate that the context in which an ambiguous stimulus appears plays an important role in determining the percept generated by that stimulus. Now, to what extent does the same rule apply in the case of rivalry? To address this question, I have attempted to create rivalrous stimuli in which one eye's view, but not the other's, was consistent with a perceptual organization implied by both eyes' views. If the rivalry process were akin to that involved in ambiguous figures, this sort of manipulation should

bias the predominance of one eye during rivalry toward the more meaningful percept.

To create this context, I utilized the familiar illusion of subjective contours (Kamzsa, 1976) in the manner shown in Figure 1. First consider the stereogram in the middle part of this figure. Both members of this stereogram contain identical sets of components which induce the impression of a white triangle, the contours of which are perceived as complete. Midway along a subjective contour of one half-image of the stereogram appears a short horizontal line whose orientation

Figure 1. These three pairs of rivalrous half-images may be free-fused by holding the page at about arm's length. Inspect the rivalry between the two short line segments, in particular noting the relative dominance of each. Does any one pair of stereograms seem to favor the horizontal line or the vertical line? The naive observers tested in this laboratory reported that the fluctuations of rivalry were similar for all three pairs.

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is consistent with that of the subjective contour. In the corresponding region of the other half of the stereogram appears a vertical line which rivals the horizontal line of the other. Thus, in terms of the context provided by the illusory triangle, the horizontal line represents the more reasonable percept. Yet, when observers view this stereopair, noting the rivalry between the two orthogonally oriented lines, the horizontal contour enjoys no increase in predominance relative to conditions in which illusory contours are not induced (the bottom pair in Figure 1).

Now, one might argue that in the middle stereogram the short vertical line in the right-hand side of the stereogram detracts from the vividness of the illusory contour and that this, in turn, undermines the effectiveness of the strong context cue implied by the entire stereogram. To confront that argument, I created a third stereogram (top of Figure 1), in which the illusory contour itself would require contributions from both eyes. This was done by removing one inducing component from each side of the stereogram. Despite this maneuver, the illusory contour is still experienced and again exerts no influence on the course of binocular rivalry. Incidentally, the equivalence of rivalry in all three conditions also rules out the possibility that incongruity (which could be ascribed to the half-image containing the vertical line) influences the alternations of rivalry. From an information theory viewpoint, incongruity should have served to enhance

the potency of a stimulus by increasing its information content.

In conclusion, these observations indicate that the fluctuations of binocular rivalry, unlike the reversals in ambiguous figures, are not influenced by the perceptual context in which the rivalrous stimuli appear. Consequently, for modeling the rivalry process, it seems prudent to shy away from using concepts such as perceptual inference which have been invoked to explain ambiguous figures. Instead, it may be more fruitful to think of rivalry as involving a spatially local process that is based on the physical characteristics of the discrepant monocular inputs (Blake & Overton, 1979).

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