analysis would therefore be greater in the case of highly probable words, and the difference in the amounts of processing capacity available for secondary tasks might have resulted in more efficient analysis of the word "tap" when the residual capacity was greater.

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Reply

IN my original article[1], I was concerned to juxtapose two different theories of dichotic listening. One of these is that the ears constitute two channels, only one of which can be fully analysed if items arrive at both simultaneously. The other theory, which I claimed was supported by my results, was that multiple criteria are used in the selection of items for analysis from a common, rapidly decaying auditory store. One criterion, of course, could be the ear at which the item arrived.

Underwood claims that Treisman's attenuation theory[2] could explain my results. The main finding I reported was that under left (shadowed) channel conditions where the subjects were likely to report a contextually more probable right channel item, they failed to obey a tap instruction in a second experiment. Appropriate tapping sometimes occurred, however, when the instruction coincided with a probable left-channel item that was successfully shadowed. I agree with Underwood that the last result calls for some notion of shared processing capacity[3], and I would have developed that point had space permitted. I do not agree, however, that Treisman's theory is capable of explaining why subjects did not respond to "tap" when it coincided with an unexpected item to be shadowed, although they often did tap appropriately while shadowing a high-probability word. A theory which supposes that the unshadowed channel is attenuated must predict a higher probability of tapping during the presentation of the low-probability item for shadowing.

My own view, already expressed, is that items are selected on both spatial and contextual cues, so that if context does not favour one of two coincident items selection for processing will proceed on spatial cues alone, causing the tap instruction to be ignored.

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Feature Detectors and Vernier Acuity

HUMAN subjects can achieve an accuracy in a vernier alignment task of a few seconds of arc visual angle in optimal conditions[1-3]. The inter-cone spacing in the central fovea is several times this magnitude[4], so this performance must be achieved through some spatial information processing in the visual system.

Theories of vernier performance have concentrated on the problem of locating the position of the retinal image of one of the lines (that is, specifying the x coordinate in Fig. 1) to the requisite accuracy. Two explanations have been suggested. The first[2,5] depends on the intensity differences at a receptor created when the retinal image of a line (modified by the optics of the eye[6]) is given a small displacement (the illumination gradient hypothesis). The second theory[7] assumes each receptor, instead of giving a graded signal, only signals whether or not it is illuminated. The requisite accuracy is achieved by averaging over the length of the line to establish a "mean retinal local sign".

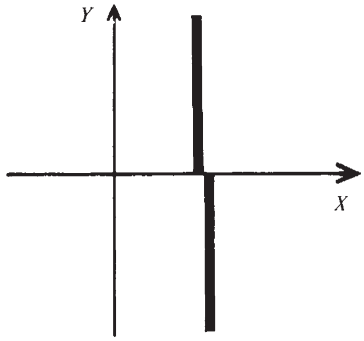

Fig. 1 The vernier acuity task. The subject makes an alignment setting by moving one of the lines along the x axis.

Neither theory is more than indirectly supported by the experimental evidence. The improvement of vernier acuity with target luminance provides some support for the illumination gradient hypothesis[2]; but the maintenance of acuity when the target is blurred[8] is difficult to understand on this basis. The mean local sign hypothesis is supported by studies which find an effect of line length on acuity (ref. 7 and unpublished work of J. A. Foley-Fisher); but the sharp deterioration which is found if a separation is made between the vernier lines[9] is not easily explained by either theory.

An alternative hypothesis is suggested by recent work on the visual system. It has been established physiologically that pattern information is transmitted by neurones in the visual cortex, often termed "feature detectors", which respond specifically to the size and orientation of elements of the stimulus array[10,11]. The existence of similar units in the human visual system is indicated by work which demonstrates that humans possess "channels" selectively activated by stimuli of a particular size and orientation[12-14]. The amount of activation in a channel is determined by the contrast in the stimulus rather than the light intensity. Much current work is concerned with the elucidation of the properties of these channels and relating them to the more traditional areas of perception. Here I suggest an application of this approach to vernier acuity.

In the vernier task subjects on occasion report that they achieve their final alignment by the elimination of a "kink" at the junction of the lines. It seems possible that this might correspond to reduction of activity in a channel, as defined above, the axis of which is at an orientation oblique to the vernier lines. This is clarified in Fig. 2 which shows that the hypothesis is essentially one of contrast discrimination in such a channel. Contrast sensitivity increases as the spatial frequency