To the Editor:

Mitchell et al report improvement in stereoacuity thresholds in 5–14-year-old amblyopic children following the “minimal occlusion therapy” regimen. This finding, if valid, is an important one since it would lend support to the hypothesis that the sensitive period for binocular vision in humans extends into this age range. Clinical evidence based on data from early surgery for esotropia has suggested an upper limit of only about 2 years of age on human stereo system plasticity, although indirect evidence suggests the possibility of some degree of such plasticity as late as 5 years of age. The question in the present case is whether the reported improvements in stereoacuity are due to anything beyond what the authors themselves refer to as “practice effects as well as general familiarity with the testing procedures” in the posttreatment test session.

The findings here appear to have largely been based on threshold on the Titmus test, since that was the only stereotest given to all subjects pre- and posttreatment. The Titmus test provides monocular cues, in the sense of providing targets apparent to monocular as well as stereoscopic vision—cues that are missing from random element stereograms. The presence of such cues has been found to aid achievement of stereopsis in patients unable to achieve it on a purely random element test, presumably by providing aids to vergence alignment. Unfortunately, the design of the Titmus test is such that these cues may also be used to achieve nonstereoscopic artificial thresholds on the test. Our work indicates that any thresholds worse than 100" of arc are unreliable in patients, and studies of normals in which one eye was blurred to 20/200 vision found that thresholds of 140" or averaging 160" could be achieved. Monocular cues on the Wirt test, similar to the Titmus circles, have been found to provide artificial thresholds as fine as 25".

The authors state that "there did not appear to be any real evidence of spuriously good Titmus scores" due to monocular cues, but no control conditions—such as inverting the test or determination of threshold with one eye occluded—are reported to substantiate this statement. If the 100" criteria of our clinical study is picked as a breakpoint, then, question would be raised about patients showing a stereoacuity improvement to any Titmus test threshold worse than that figure. According to the authors' Figure 1, half the patients (17 of 33), in fact, showed improvement only to levels worse than 100".

More definitive demonstration of stereoacuity improvement would be provided if the authors could clarify two points about the study:

(1) The random element stereogram is a reliable measure of stereo function in patients such as tested here, with the exception of question about the Frisby test. The authors report that two such stereograms, the Frisby and TNO tests, were administered to about a third (24) of the children in the study. No pre- and posttreatment comparative data, such as that provided for the Titmus test in their Figure 1, is provided for the random element tests, however. Demonstration of improvement on these tests, particularly a change from "not demonstrable (ND)" stereopsis to achievement of stereoacuity at some threshold on the TNO test, would be convincing evidence of improvement.

(2) Further evidence of actual stereoacuity improvement would be provided if correlated visual acuity improvement could be demonstrated. Stereoacuity has been found to be reduced proportional to unilateral visual acuity decrement. Thus, true improvement in the amblyopic subjects' stereoacuity threshold might be expected to be accompanied by proportionally improved visual acuity in the amblyopic eye. In their earlier report on the patients detailed in the present paper, the authors indicated that posttreatment visual acuity improvement was found. No correlation statistics on the relationship between stereoacuity and visual acuity improvement was found, however, especially for the random element stereotests.
To the Editor:

Simons' has raised a number of points concerning the improvement in the scores of amblyopic children on the Titmus stereotest that we report following minimal occlusion therapy. He refers to certain well-known limitations of this test and questions whether the improvement in the Titmus scores represents anything more than just the effects of practise on this particular test. Simons argues that the demonstration of improvement on random element stereotests would be more compelling, a point with which we take issue since it ignores one of the major conclusions of our paper. While the Titmus test was the only stereotest administered to all children both before and after treatment, a comparable degree of improvement was also observed on those children on whom other tests were administered, including the random element TNO test.

Either the Frisby or the TNO test was administered to 24 of the patients both before and after the treatment regimen. Of the 15 children examined on the Frisby test, 11 showed better scores following treatment. The scores of 7 of the 11 children that improved did so by more than a factor of two, a proportion (63.6%) that agrees closely with the proportion that showed comparable improvement on the Titmus test. Of the 32 children whose scores improved on the latter test following treatment, 22 (68.7%) did so by this amount. In addition to the 15 children tested with the Frisby test both before and after treatment, the scores of a further nine children that were tested only on completion of the six treatment sessions agreed closely with those obtained on the Titmus test at the same time, a point that was made explicit in Figure 2 of our paper.

Simons' refers to the monocular cues inherent in the Titmus test and although we cannot be completely certain that they were not exploited by our subjects, the control tests that we performed on each child suggest that they were not. Both the control conditions mentioned by Simons were employed; the use of monocular cues was checked by performing the test with one eye covered and/or by inverting the plates. Although monocular cues are less evident on the Frisby test, comparable control tests were also performed when this test was administered. Apart from these considerations, the close agreement of the final stereovisual scores on the Titmus and Frisby tests (Fig. 2 of our paper) suggests very strongly that the improvement observed in the scores on the former test represent a true improvement of stereovisual acuity. This point is reinforced by the results obtained from those children on whom the TNO test was administered.

The TNO test was administered before and after treatment to 17 of the children. The scores of eight of these children improved following treatment; in six the improvement in stereovisual acuity was by more than a factor of two. The proportion of subjects that exhibited such substantial improvement on the TNO test was, thus, comparable to the proportion of children that showed a similar degree of improvement on the other tests of stereopsis. In fact, five of the six subjects whose

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References