the drift is small (less than 1 minute), and is primarily attributable to one subject. Thus, it seems that when there is a conflict between retinal and perceived motion, the retinal information exerts primary control over the pursuit system.

This conclusion is supported by the results of a third experiment, which, unlike the first two, involved suprathreshold motion; we can thus generalize our conclusion to tracking velocities well outside the slow-drift range and well within the normal range of smooth pursuit. The display, slightly altered from the previous experiment, consisted of the target point surrounded by a 6° by 1° rectangular array of six points. The two additional points marked the midline of the rectangle and were aligned with the target. There were three conditions: (i) the frame was stationary and the target moved left or right at 1° per second, which resulted in simple object-relative motion; (ii) the target moved left or right at 1° per second for 1 second while the frame moved 2° per second in the same direction, which resulted in an induced motion of the target in the direction opposite its real motion due to its displacement relative to the frame; and (iii) the target was stationary and the frame moved 2° per second for 1 second, which also frequently produced an induced motion of the target opposite the frame. At the end of each trial, the subject reported whether the target appeared to move left or right, or remain stationary.

The psychophysical data indicate that 98 percent of target motion reports in condition 1 were veridical, while in condition 2, 100 percent of the reports were of induced motion, and in condition 3, 77 percent of the reports were of induced motion. The data on eye movements are consistent with those of the slow-velocity experiments. A comparison between condition 1, in which there was simple object-relative motion, and condition 2, in which an induced motion caused the moving target to appear to be moving in the opposite direction, reveals that the total displacement of the eye is similar (50.11 minutes and 47.47 minutes). The slow-pursuit component of that displacement is, if anything, slightly greater in condition 2 (38.72 minutes as opposed to 32.13 minutes) (6). This is so despite the consistent reports from all observers that the motion of the target was opposite its real motion in this condition. Thus while object-relative displacement determined the direction of the perceived motion, retinal motion determined pursuit.

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Table 1. Mean direction appropriate eye motions and psychophysical reports (experiment 2). In condition 1 the target motion is subject-relative, in condition 2 it is object-relative, and in condition 3 it is induced. In the eye motion data, a + indicates eye motions in the same direction as stimulus motion, and a − indicates eye motion opposite stimulus motion. The numbers are eye movements in minutes of arc. A +6 would indicate a perfect following response in the subject-relative and object-relative conditions, while a 0 would represent perfect fixation in the induced motion condition. In the psychophysical report data, the percentages of veridical reports are given for condition 1 and condition 2, and the percentage of induced reports is given for condition 3. The subjects' mean confidence ratings are on a scale from 1 (indicating certainty) to 3 (indicating a guess).

| Condition | Total eye movement | Slow drift | Psychophysical reports | |
|---|---|---|---|---|
| | | | Correct (%) | Confidence rating |
| 1 | +5.06 | +5.17 | 52 | 2.125 |
| 2 | +4.64 | +4.55 | 99 | 1.08 |
| 3 | − .8 | − .76 | 99 | 1.17 |

Figure 1B illustrates characteristic eye records of one subject in the three conditions. The tendency for the eye to drift in the direction of frame movement in condition 3 in which the target was stationary, which was typical of the eye records of all our observers, is apparent in the sample eye record. This tendency was evident regardless of whether an induced motion of the target was reported. No tendency to pursue the perceived induced motion was noted in any subject who reported induced motion.

Taken together, the results demonstrate that retinal displacement in the absence of perceived motion is an adequate stimulus for pursuit; thus, perceived motion cannot be considered necessary for pursuit. Moreover, in instances in which retinal and perceived motion conflict, pursuit is controlled by retinal and not by perceived motion. This is so both for very slow stimulus motion as well as for stimulus motions well within the range of normal tracking. These data are not incompatible with the view that smooth pursuit movements are predominantly under subcortical control. The findings of other investigators (2, 3) suggest that in the absence of a conflict between retinal and perceived motion, perceived motion may control pursuit, but our data indicate that the power of perceived motion to drive the pursuit system is limited and confined to such nonconflict situations.

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3. T. Cornsweet and H. Crane, J. Opt. Soc. Am. 63, 921 (1973).
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5. This is consistent with earlier reports concerning the ability of the eyes to track very slow motion [A. Yarbus, Eye Movements and Vision (Plenum, New York, 1967)].
6. A consistent difference between the eye records from conditions 1 and 2 is intriguing. In condition 1, where there was simple object-relative motion of the target, there were more saccades evident than in condition 2, where perceived and retinal motion were in conflict (Fig. 1B).
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## The Dodo and the Tambalacoque Tree

I do not dispute that coevolution between plant and animal exists and that the germination of some seeds may be assisted by their passing through the gut of animals. However, that "mutualism" of the famous dodo and Calvaria major (tambalacoque) is an example (1) of coevolution is untenable for the following reasons.

1) Calvaria major grows in the upland rain forest of Mauritius with a rainfall of 2500 to 3800 mm per annum. The dodo according to Dutch sources roamed over the northern plains and the eastern hills in the Grand Port area—that is, in a drier forest—where the Dutch established their first settlement. Thus it is highly improbable that the dodo and the tambalacoque occurred in the same ecological niche. Indeed, extensive excavations in the uplands for reservoirs, drainage canals, and the like have failed to reveal any dodo remains.

2) Some writers have mentioned the small woody seeds found in Mare aux Songes and the possibility that their germination was assisted by the dodo or other birds. But we now know that these seeds are not tambalacoque but belong to another species of lowland tree recently identified as Sideroxylon longifolium.

3) The Forestry Service has for some years been studying and effecting the germination of tambalacoque seeds without avian intervention (2). The germination rate is low but not more so than that of many other indigenous species which have, of recent decades, showed a marked deterioration in reproduction. This deterioration is due to various factors too complex to be discussed in this comment. The main factors have been the depredations caused by monkeys and the invasion by exotic plants.

4) A survey of the climax rain forest of the uplands made in 1941 by Vaughan and Wiehe (3) showed that there was quite a significant population of young tambalacoque plants certainly less than 75 to 100 years old. The dodo became extinct around 1675!

5) The manner in which the tambalacoque seed germinates was described by Hill (4), who demonstrated how the embryo is able to emerge from the hard woody endocarp. This is effected by the swollen embryo breaking off the bottom half of the seed along a well-defined fracture zone.

It is necessary to dispel the tambalacoque-dodo "myth" and recognize the efforts of the Forestry Service of Mauritius to propagate this magnificent tree of the upland plateau.

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**References and Notes**

1. S. Temple, *Science* **197**, 885 (1977).
2. Young *Calvaria major* plants that are 9 months old or more can be seen at the Forest Nursery in Curepipe.
3. R. E. Vaughan and P. O. Wiehe, *J. Ecol.* **19**, 127 (1941).
4. A. W. Hill, *Ann. Bot.* **5**, 587 (1941).

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The plant-animal mutualism that may have existed between the dodo and *Calvaria major* became impossible to prove experimentally after the dodo's extinction. What I pointed out (1) was the possibility that such a relation may have occurred, thus providing an explanation for the extraordinarily poor germination rate in *Calvaria*. I acknowledge the potential for error in historical reconstructions.

I disagree, however, with the conclusion of Owadally (2) that the dodo and *Calvaria* were geographically separated. There have been virtually no bones of dodos or any other animals found in the uplands of Mauritius not because the animals were never there, but because the island's topography does not cause alluvial deposits there. Catchment basins in certain lowland areas accumu-

lated many bones of animals that were washed into these areas from the surrounding uplands. Accounts of early explorers, summarized by Hachisuka (3, p. 85), definitely refer to dodos occurring in the uplands, and Hachisuka makes a point of clarifying the misconception that dodos were strictly coastal birds. Early forestry records from Mauritius (4) indicate that *Calvaria* was found in the lowlands as well as on the upland plateau. Although native forests only occur in the uplands today, one of the surviving *Calvaria* trees is located at an elevation of only 150 m. Thus, the dodo and *Calvaria* may have been sympatric, making a mutualistic relation possible.

Taxonomic authorities on sapotaceous plants of the Indian Ocean region recognize seeds of *Calvaria major*, as well as the smaller seeds of *Sideroxylon longifolium*, from alluvial deposits of the Mare aux Songes marsh (5), but this has little relevance to the question of mutualism. Mutualistic species will not necessarily be fossilized together.

The Mauritius Forestry Service has only recently succeeded in propagating *Calvaria* seeds, and the unmentioned reason for their recent success strengthens the case for mutualism. Success was achieved when the seeds were mechanically abraded before planting (6). A dodo's digestive tract merely abraded the endocarp naturally the same way the staff of the Mauritius Forestry Service

does artificially before the seeds are planted.

The reference Owadally cites (7) is equivocal about the age of the surviving *Calvaria* trees because there is no easy way to accurately date them. Coincidently, Wiehe, the coauthor of the paper Owadally cites, was also my source of the estimated age of over 300 years for the surviving trees. I agree that there were more trees surviving in the 1930's than today, which further supports the notion that *Calvaria major* is a declining species and may have been so since 1681.

I erred in not citing Hill (8). However, Hill does not describe how and under what conditions he induced a seed to germinate. Without these details, his description is of little relevance to the question of mutualism.

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4. N. R. Brouard, *A History of the Woods and Forests of Mauritius* (Government Printer, Mauritius, 1963).
5. F. Friedmann, personal communication.
6. A. M. Gardner, personal communication.
7. R. E. Vaughan and P. O. Wiehe, *J. Ecol.* **19**, 127 (1941).
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# Developmental Dyslexia: Research Methods and Inferences

Witelson (1) has proposed that developmental dyslexia is associated with bilateral hemispheric representation of spatial function that interferes with specialized left hemispheric processing of linguistic information. The data presented, however, may not warrant this conclusion because of (i) inferences drawn from a failure to obtain a significant treatment effect in groups selected from a heterogeneous population and (ii) the possibility of sampling biases.

There are at least two situations that can produce a result of no significant response to an independent variable. One is that nearly all subjects within a group show little or no response to the variable, thus a measure of the variability of this group would be small. A second possibility is that some subjects respond in one direction to the variable, others in the opposite direction. This latter possibility is a special case of the broad class

of situations in which the data are characterized by more than one mode—situations that would produce no mean group response to the variable, but a large within-group variability.

In Witelson's case, the idea of bihemispheric representation of spatial function in dyslexic boys stems from results of two tests in which the mean score of dyslexics was the same to left- and right-sided stimulation, whereas the mean scores of normal readers showed the predicted left-sided superiority. Dyslexics are thought to be a heterogeneous group of children with respect to cognitive and perceptual function, as Witelson and others (1, 2) have noted. Thus, we might expect that the reason for the obtained null result in dyslexics stems from the second possibility described. Presentation of the distribution of signed difference scores for each group is the minimum information needed to properly