hold the skin sample at constant width, it does not show that the skin stores any energy at all. Shark skin is oriented on the shark like cloth cut on the bias. Alternate layers of collagen fibers wind around the fish's body in helices of opposite hand. Stretching such a skin longitudinally will make it shrink laterally. Most of the energy put into the skin by stretching it lengthwise may be passed on by the skin to the lateral restraints as it pulls them together. The apparent rise in stiffness with lateral tension may mean only that more work is being done on the lateral restraints. To find the energy stored in the skin in this experiment the authors would have had to record the lateral force-extension curve and subtract the area under it from that under the longitudinal force-extension curve.

The ability of the skin to store energy should depend mostly on the compliance of its collagen fibers, which, as Wainwright *et al.* (*1*) state, are very stiff in tension. Experiments in which the skin was stretched parallel to one set of fibers confirm this high stiffness (*2*) and show that most of the energy represented by the area under the force-extension curves described in (*1*) could not have been stored in the skin.

I have not observed sharks much, but in other fish the pattern of swimming motion is nearly independent of speed. To go faster the fish uses the same pattern of motion, but does it faster. Kinetic energy involved in this motion goes as (speed)^2, and so should any potential energy stored in springs if the same pattern of forces and motion is to be maintained. Ordinary springs do not have this property (*3*). In the experiments of Wainwright *et al.* (*1*) the skin appears to be a modulatable spring, but, as shown above, this apparent property is most likely a wrong interpretation of the experiment.

C. W. McCUTCHEN
Laboratory of Experimental Pathology, National Institute of Arthritis, Metabolism, and Digestive Diseases, Bethesda, Maryland 20205

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If stiffness is considered to be the resistance to extension, then our figure 2 (*1*) shows that the stiffness of shark skin varies with stress in the skin due to restraining force. Since the pressure under the skin varies with the swimming speed, so therefore do the restraining force, skin stress, and stiffness of the skin in a swimming shark: we find no reason to alter our conclusions. We are unable to draw the same range of conclusions from McCutchen's comment and his work on trout that he has drawn.

S. A. WAINWRIGHT
F. VOSBURGH
J. H. HEBRANK
Zoology Department, Duke University, Durham, North Carolina 27706

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Lateralized Cognitive Processes and the Electroencephalogram

Many investigators have found differences in the balance of electroencephalographic (EEG) activity between the two hemispheres during tasks which differentially require verbal as opposed to spatial processing. Such results have been interpreted as reflecting differences in hemispheric utilization for particular cognitive processes. Gevins *et al.* (*1*) have challenged this interpretation by pointing out that putatively left- and right-hemisphere tasks often differ not only in their cognitive demands, but also in their "stimulus characteristics, efferent activities (limb and eye movements), and performance-related factors (task demands and a subject's ability and effort)."

We believe that this contention is not strongly supported by their data (*1*) and is seriously challenged by a large body of data, much of which they did not cite. At least nine studies have reported significant differences in relative hemispheric activation in the predicted direction when the EEG was recorded in response to verbal and nonverbal stimuli and the subjects were not required to make any overt motor response (*2*, *3*). Significant left and right differences have also been found in studies where response requirements for verbal and nonverbal tasks were equated (*4*-*6*). Asymmetries in EEG activity have also discriminated between purely covert verbal and nonverbal tasks (*6*, *7*) involving no stimulus or response (*6*), thus rigorously satisfying the criteria of Gevins *et al.* (*1*) for controlling the three essential noncognitive aspects of task performance: stimulus characteristics, efferent activities, and performance-related factors.

In support of their contention that measures of EEG asymmetry do not reflect lateralized cognitive processes, Gevins *et al.* present the results of two studies. The results of the first study indicated that tasks could be differentiated on the basis of EEG laterality measures. A second experiment was performed to match more carefully tasks on "efferent components, stimulus characteristics, and performance-related factors." These tasks were of shorter duration (6 to 15 seconds each) than those in the first study (1 minute). We believe that the tasks chosen for the two experiments and the methods used contributed significantly to the negative outcome of the experiments and that definitive conclusions cannot be drawn from them. Although Gevins *et al.* found that the first 15-second segment discriminated between writing versus the Koh's block design task in experiment 1, the subjects' set would probably be quite different in this situation compared to that in experiment 2. It is not clear from their report whether Gevins *et al.* randomized tasks in experiment 2. The methods used in their two experiments differed significantly. The rapidity and possibility of random task presentation in experiment 2 might have prevented the subjects from adopting a consistent cognitive set. Moreover, the spatial task used by Gevins *et al.* in experiment 2 was different from the one used in experiment 1. Recent evidence indicates that the mental rotation task used in experiment 2 is associated with relative left-hemisphere activation in comparison with other spatial tasks where stimulus-, motor-, and performance-related factors were equated (*8*). Thus, in effect, Gevins *et al.* (*1*) may have been comparing the effects of three different "left hemisphere" tasks in experiment 2.

In sum, the results reported by Gevins *et al.* do not convincingly support their contention that EEG asymmetry is unaffected by cognitive differences among tasks. In their experiment 2, it is unclear whether cognitive differences did indeed exist among the tasks. Moreover, their study must be viewed in the context of many other studies in which noncognitive sources of variance have been controlled and significant differences in EEG asymmetry between left and right hemisphere tasks have been found. As Gevins *et al.* have indicated, there is clearly a need to consider a variety of

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Shark Skin and Locomotion

SA WAINWRIGTH, F VOSBURGH and JH HEBRANK

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