Letters

Proposed "Sex Survey"

William Booth incorrectly writes that I called the National Institutes of Health (NIH) "sex survey" "pornographic" (News & Comment, 28 Apr., p. 419). Used in such a limited explanation of the NIH survey, the connotation of the survey as pornographic conjures up images of language befitting a stereotypical religious zealot.

What I have said is that the survey seems more apropos for the pages of a pornographic magazine, with explicit sexual questions for a very limited audience, than as something to be passed off as a scientific study.

As for the survey's proponents, "who include a blue-ribbon panel of social scientists," clearly the American taxpayer views the blue ribbons in a different light—more along the lines, say, of awards to an omnivorous prize porker that has spent its life parked in front of the public trough.

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A Specialization for Speech Perception?

Alvin M. Liberman and Ignatius G. Mattingly (Articles, 27 Jan., p. 489) write that general auditory and cognitive processes are inadequate to explain much of speech perception, and that one must posit the existence of an innate specialized "phonetic module" to recover phonetic gestures. This putative specialization is offered as an explanation for both "computing the articulator movements [production] and . . . for dealing with the acoustic consequences [perception]." We suggest that this proposed solution to difficult problems in speech perception is an extravagant one and, while perhaps appropriate for a time when less was known about general auditory and cognitive processes, it stands at odds with more recent experimental findings.

Liberman and Mattingly say that their view of the special nature of speech is unconventional. This is only partially correct. Few would dispute the presence of specialized brain mechanisms for human communication, as the many studies of aphasia will attest. However, our growing knowledge of auditory and cognitive processes is helping to explain many fundamental facts about speech. For example, there exists a number of regularities in phonetic inventories used by different languages. Some speech sounds are used almost universally, while others occur only rarely, if at all. And many of these regularities can be predicted only on the basis of auditory functions (*1*). Thus, it is general auditory processes that help provide an explanation for the range of phonetic units found in human speech (*2*).

Liberman and Mattingly discuss an interesting problem of how talkers and listeners come to agree upon phonetic categories. They recommend that "parity" between sender and receiver is provided by innate hardware. It bears note, however, that agreement on phonetic categories is no more difficult (and no easier) than agreement on most other sorts of categories frequently used, such as birds, trees, and chairs. The success of certain nonhuman animals in learning phonetic categories (*3*) strongly suggests that innate specialization is not a requirement for phonetic categorization.

The laboratory phenomenon of duplex perception is an interesting one. It should be noted, however, that duplex perception is not restricted to speech sounds (*4*). Furthermore, it seems odd to us that a speech-specific module should be capable of incorporating nonspeech sine-wave components in its operation. In any event, Liberman and Mattingly seem prepared to abandon their strong claim that the phonetic module precedes other auditory analysis.

Finally, one unfortunate consequence of embracing the postulation of a speech-specific module is that there remains no way to apply all that we continue to learn about general auditory and cognitive processes. One could, as Liberman and Mattingly suggest, look forward to classifying and arranging future hypothetical modules. However, we suggest that a theory of speech perception should be evaluated, like any scientific theory, by its predictive power, simplicity, and generality. In the spirit of parsimony, the more fruitful approach is to learn all we can about general processes of audition and cognition in order to further develop a theory that predicts fundamental phenomena of speech perception.

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Response: It is surely not a criticism of our position that some of the phonetic regularities across languages conform to certain properties of the auditory system, since, as must be obvious, the gestures that evolved for phonetic communication would have been selected only if the sounds they produced could be resolved by the ear.

The requirement of parity, which applies only to communication systems, is that what count as message units for the sender must count as message units for the receiver (*1, 2*). Such a requirement is in no way relevant, although Kluender and Greenberg appear to think it is, to "agreement on most other sorts of categories frequently used, such as birds, trees, and chairs."

Despite the claim, referred to by Kluender and Greenberg, that research with Japanese quail shows that nonhuman animals perceive phonetic structures as humans do, there is evidence that monkeys do not (*3*).

Duplex perception is a phenomenon in which listeners form a coherent percept by combining two acoustically nonoverlapping stimuli that are simultaneously perceived as coming from two different sources, even from two different locations, with the result that one stimulus simultaneously yields perceptual representations of two distinctly different types, for example, a phonetic structure and a nonspeech chirp [references 8 to 11 in (*2*)]. Two of the papers cited by Kluender and Greenberg as examples of duplex perception in the nonspeech domain deal with binaural interactions in the extraction of pitch from noise, but not, so far as we can tell, with duplex perception. Neither of the other two papers includes the critical tests, described in detail in our paper, that rule out the possibility of a trivial "cognitive" interpretation. Further research by Fowler and Rosenblum, authors of one of those papers, shows that their example does not, in fact, pass all of those tests (*4*). On the basis of our own observations, we believe that the other example will not pass, either. Of course, there is no reason in principle why other combinations of distinctly different processes should not yield duplex perception and thus offer testimony to their distinctness, but so far, no convincing examples have been offered.

Rather than being "odd," as Kluender and Greenberg say, it is, to the contrary,

perfectly reasonable, even predictable, that a speech-specific module of the kind we have described should be capable of incorporating sine-wave components in its operation. After all, the information needed by that module is just exactly the information the sine-waves provide—the trajectories of the formants, hence the articulator movements (*5*) produced by the underlying gestural structures that are elements of the phonological message (*1, 2*). Indeed, sine-wave speech has been found, in three different kinds of experiments, to provide direct support for the existence of the distinct phonetic system we assume (*6*).

In their comment about the order of processing, Kluender and Greenberg appear to confuse open and closed modules. We did concede that the evidence is equivocal for our claim that the closed phonetic module is preemptive with respect to the closed scene-analysis module, but we have found no reason to abandon the wholly independent claim that the closed phonetic module preempts information from the open modules.

It would, of course, be "unfortunate" not "to apply all that we continue to learn about general auditory and cognitive processes," especially if, as Kluender and Greenberg appear to believe, phonetic communication is merely an epiphenomenal outgrowth of processes that developed independently of language. But if, as we believe, phonetic processes are narrowly adapted to the special requirements of the phonology, then they will be properly understood only when, taking careful account of those special requirements (*7*), we uncover the equally special, species-typical mechanisms that apparently evolved to meet them. Consider, in this connection, how little the general principles of audition and cognition have figured in the stunning successes that have been scored in investigations of such auditory specializations as echolocation in the bat, sound localization in the barn owl, and song in the bird (*8*).

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Financial Impact of Animal Regulations

I was pleased to read that the National Institutes of Health are finally beginning to recognize that they must confront the animal rights activists head on (News & Comment, 28 Apr., p. 415). It was particularly refreshing to read that Charles Schuster, head of the National Institutute on Drug Abuse, sees that the growing list of federal regulations "will price us out of existence" and estimates that the new regulations on primates and dogs are estimated to cost $40,000 to $70,000 per grant.

This estimate is probably low. Since I last renewed my grant in 1986 to study the cardiovascular system, the cost of a "random source" dog has gone from $146 to $570. The increase in the cost of animals over the remaining 3½ years of the grant comes to $97,870, excluding the increased costs of care associated with new regulations and indirect costs. This increase represents about 20% of the total direct costs and only accounts for regulations introduced since 1986, not those now being proposed, which are likely to have an even greater fiscal impact.

Last year, when I wrote Congresswoman Barbara Boxer (D–CA) to express my concern that HR778, the Pet Protection Act, which would have forbidden federal funding of research using pound or shelter animals, would drive up the cost of research in an era of tightening budgets, she wrote back

> . . . the Director of the National Institutes of Health Division of Research Resources recently stated that "we have no information on any studies comparing the use of random sources and purpose-bred animals in research relative to fiscal and scientific factors." However, I am aware that a 1973 study by the National Institutes of Health entitled "Research Animals in Medicine" found that the initial purchase price of a laboratory animal... represents only 6.7% of the total expense related to the animal.

In other words, on the basis of the information provided by the NIH, it appeared that Congress could placate the animal rights activists at little or no cost to the taxpayer. The NIH needs to provide a more current and candid view of the fiscal impacts of the animal rights movement for Congresswoman Boxer and her colleagues.

The $30,000 a year in extra expenses animal rights costs my grant would be enough money to support two graduate students or one postdoctoral fellow at a time when the number of federal fellowships is declining. Instead, it is going to the dogs. The result is that we have simply slowed the pace of the work, a victory for animal rights activists who see fewer dogs being used for biomedical research.

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Squaring the Grecian Circle

If, in playing the game of squaring a circle or cubing a sphere, cutting and pasting is a permissible tactic (Research News, 5 May, p. 528), then the solution of the problem was available to Democritus. All he had to do was dissect (conceptually) any object into its constituent atoms and then reassemble them into any other desired shape. Then one would have to deal with approximately 10^{23} objects, rather than 10^{50}. Also, one would not have to wade through 39 pages of sophisticated mathematical arguments to be convinced of its rationality. Of course, either dissection would be a Herculean task, but the precise reassembly would be even more difficult in view of ambiguities arising from the uncertainty principle, a limitation that would be immeasurably greater for 10^{50} objects.

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Erratum: In Constance Holden's News & Comment article "Computers make slow progress in class" (26 May, p. 906), a network developed by the National Geographic Society and the Technical Education Research Centers was incorrectly identified (p. 907). The network described in the article is named the National Geographic Kids Network, not "Kidsnet," which is a separate program.

Erratum: In the article "Pattern and prevalence of same-gender sexual contact among men" by R. E. Fay *et al.* (20 Jan., p. 338), the estimated percentages and standard errors from the 1988 NORC General Social Survey in table 7 should have been 2.4(0.7), 1.7(0.8), 2.4(1.8), 4.3(1.7), 2.3(1.1), 2.1(0.9), 2.3(1.3), and 3.2(1.9), respectively.