the data by the scientific community. I therefore think that there is an urgent need, when publishing scientific data, to distinguish clearly in references between perennial information (available on the Web but also safely preserved in multiple institutional libraries scattered around the world and accessible anytime to anybody) and information with an unpredictable lifetime (that is, available on the Web exclusively from one server). In order to protect our credibility, reference to possibly short-lived information in scientific publications should, I believe, be restricted to commentaries and, perhaps, letters and systematically banned from regular articles and reviews.

Y. Poumay
Department of Histology-Embryology,
Faculty of Medicine,
University of Namur,
61 Rue de Bruxelles,
B-5000 Namur, Belgium
E-mail: yves.poumay@fundp.ac.be

■

Research on Auditory Cortex Plasticity

This year, Michael P. Kilgard and Michael M. Merzenich published a report, "Cortical map reorganization enabled by nucleus basalis activity" (13 Mar., p. 1714). In 1996, we published a study, "Induction of physiological memory in the cerebral cortex by stimulation of the nucleus basalis" (*1*). In both studies, pairing a tone with nucleus basalis stimulation produced tone-specific changes of neuronal responses in the primary auditory cortex of adult animals. We reported associative receptive field changes that involved selective increased response to a frequency paired with stimulation of the nucleus basalis, similar to the receptive field plasticity that is induced during tone-shock associative behavioral learning (*2*). In our study of the nucleus basalis, as in behavioral experiments, plasticity was induced in a single session of 30 pairings and only in paired versus unpaired groups. The results of both studies support a long-standing cholinergic model of learning-induced cortical receptive field plasticity (*3*).

We welcome the additional observations of map changes that devolve from receptive field changes and the statement of a cholinergic basis for the effects of nucleus basalis stimulation. Readers should be aware, however, that the 1998 report is not the first study to show that paired activation of the nucleus basalis is sufficient to induce specific receptive field changes in the auditory cortex. The subject of the two papers has been of sufficient general interest to warrant invited commentaries: a *Science*'s Compass research commentary, "Mapping the sensory mosaic" by Sharon L. Juliano (13 Mar., p. 1653), and a commentary by Charles D. Gilbert (*4*), which provide overviews of the field.

Norman M. Weinberger
Center for the Neurobiology of
Learning and Memory,
University of California,
Irvine, CA 92797–3800, USA,
E-mail: nmweinberger1@vmsa.uci.edu
Jonathan S. Bakin
Rockefeller University,
New York, NY 10021, USA
E-mail: jbakin@rna.rockefeller.edu

References and Notes

1. J. S. Bakin and N. M. Weinberger, *Proc. Natl. Acad. Sci. U.S.A.* **93**, 11219 (1996).
2. ———, *Brain Res.* **536**, 271 (1990); additional characteristics of rapid associative receptive field plasticity in the primary auditory cortex are provided by N. M. Weinberger in *The Cognitive Neurosciences*, M. S. Gazzaniga, Ed. (Massachusetts Institute of Technology Press, Boston, MA, 1995), pp. 1071–1089.
3. N. M. Weinberger *et al.*, *Concepts Neurosci.* **1**, 91 (1990).
4. C. D. Gilbert, *Proc. Natl. Acad. Sci. U.S.A.* **93**, 10546 (1996).

Response: Weinberger was among the first to hypothesize that the central cholinergic system is involved in the synaptic plasticity underlying fear conditioning and other forms of learning. Members of his laboratory have probed these mechanisms with the use of both electrical stimulation of nucleus basalis and direct iontophoresis of cholinergic agonists. This rich body of work represents a significant portion of the foundation for our recent experiments. It was not our intention to overlook any of the relevant earlier studies by Weinberger and others, and we cited several of them (*1*) in our report. Furthermore, our report did not state that we were the first to use cholinergic modulation to generate receptive field plasticity.

Four main points made in our report are, to our knowledge, new. First, as Weinberger mentions, our study quantified plasticity guided by cholinergic modulation at the level of the cortical map by recording from up to 100 locations in a single animal. Second, we demonstrated that the plasticity we recorded was progressive over the course of several weeks and endured for at least 24 hours. Third, the observed map reorganizations were of a larger scale than would be expected from short-term studies of receptive field plasticity. Fourth, and most important, we demonstrated that the details of the stimulus paired with nucleus basalis activation determine whether receptive fields expand or contract.

Michael Kilgard
Michael Merzenich
Department of Otolaryngology, and
Department of Physiology,
University of California,
San Francisco, CA 94143, USA
E-mail: kilgard@phy.ucsf.edu

References

1. N. M. Weinberger, *Curr. Opin. Neurobiol.* **3**, 570 (1993); T. M. McKenna, J. H. Ashe, N. M. Weinberger, *Synapse* **4**, 30 (1989); R. Metherate and N. M. Weinberger, *Brain Res.* **480**, 372 (1989); *Synapse* **6**, 133 (1990); J. S. Bakin and N. M. Weinberger, *Proc. Natl. Acad. Sci. U.S.A.* **93**, 11219 (1996); R. Metherate, N. Tremblay, R. W. Dykes, *J. Neurophysiol.* **59**, 1231 (1988).

■

One Infant's Memory of *Oedipus*

In their report "Infants' memory for spoken words" (26 Sept. 1997, p. 1984), my former colleague Peter W. Jusczyk and Elizabeth A. Hohne give an elegant demonstration of language memory in infants who do not yet speak but who had, of course, been exposed to speech for many months.

In 1941, psychologist Harold E. Burtt published the last of three papers of a related experiment on language memory in the absence of "knowledge" of the language (*1*). When the child (Benjamin B. Burtt) was 15 months old, his father read 20-line passages from Sophocles's *Oedipus Tyrannus*, changing them every 3 months until the boy reached the age of 3, for a total of seven selections. Benjamin was subsequently tested for his memory of the passages by a prompting-learning method at the ages of 8.5 years, 14 years, and 18 years. The seven selections plus three additional ones chosen for comparability were learned through many prompting sessions in a rotating order so that every passage appeared approximately equally often in every position. The results were clear: at 8.5 years it took about 27% to 30% fewer repetitions to learn the previously heard material than the new material; the passages heard later in the 3-month learning period were learned most quickly; at the age of 14, the savings advantage was reduced to about 8%; the last test, at age 18, revealed no savings at all, although Benjamin reported that the material sounded familiar. It would be interesting if, 18 years hence, Jusczyk and Hohne were to locate some of the participants in their study and test them for response latencies to the Story-Word and Foil-Word lists.

Richard A. Littman
Department of Psychology,
University of Oregon,
Eugene, OR 97403, USA
E-mail: rlittman@darkwing.uoregon.edu