

ular formation produces either inhibition or facilitation of the response of lateral geniculate units to visual stimulation (6). Also, a large proportion of visual cortical units are responsive to auditory stimuli (7). Thus, the auditory effect upon the visual response of lateral geniculate units might be mediated via either of these routes.

LEO M. CHALUPA*

ANGELICA W. MACADAR

DONALD B. LINDSLEY

Departments of Psychology, Physiology, and Psychiatry and Brain Research Institute, University of California, Los Angeles 90024

References and Notes

1. D. F. Lindsley, K. L. Chow, M. Gollender, *J. Neurophysiol.* **30**, 628 (1967); F. Morrell, in *The Neurosciences—A Study Program*, G. C. Quarton, T. Melnechuk, F. O. Schmitt, Eds. (Rockefeller Univ. Press, New York, 1967), pp. 452–469; V. G. Skrebitsky, *Exp. Brain Res.* **9**, 269 (1969).

2. K. L. Chow, D. F. Lindsley, M. Gollender, *J. Neurophysiol.* **31**, 729 (1968).
3. Tonic and phasic cells may correspond to X and Y cells, respectively [C. Enroth-Cugell and J. G. Robson, *J. Physiol. (Lond.)* **187**, 517 (1966); B. G. Cleland, M. W. Dubin, W. R. Levick, *ibid.* **217**, 473 (1971)]; however, all the criteria for X and Y cells were not used by us. We observed that tonic cells have smaller and more centrally located receptive fields than phasic cells.
4. T. Hotta and K. Kameda, *Exp. Neurol.* **8**, 1 (1963); J. M. Godfraind and M. Meulders, *Exp. Brain Res.* **9**, 183 (1969); J. N. Papaioannou, *ibid.* **17**, 10 (1973).
5. R. W. Guillery, *Z. Zellforsch. Mikrosk. Anat.* **96**, 39 (1969).
6. H. Suzuki and N. Taira, *Jpn. J. Physiol.* **11**, 641 (1961); D. Satinsky, *Electroencephalogr. Clin. Neurophysiol.* **25**, 543 (1968); W. E. Foote, R. J. Maciewicz, J. P. Mordes, *Exp. Brain Res.* **19**, 124 (1974).
7. K. Murata, H. Cramer, P. Bach-y-Rita, *J. Neurophysiol.* **28**, 1223 (1965); D. N. Spinelli, A. Starr, T. W. Barrett, *Exp. Neurol.* **22**, 75 (1968); F. Morrell, *Nature (Lond.)* **238**, 44 (1972); M. C. Fishman and C. R. Michael, *Vision Res.* **13**, 1415 (1973).
8. Supported by PHS grants NS-8552 and MH-25938 to D.B.L. and aided by NIMH training grant 5 T1 MH-6415.

* Present address: Department of Psychology, University of California, Davis 95616.

2 August 1974; revised 22 April 1975

Temporal Pattern Shifts in Singing Birds: A Critique

Ficken *et al.* (1) have hypothesized that the red-eyed vireo (*Vireo olivaceus*) and the least flycatcher (*Empidonax minimus*) change their patterns of singing to avoid acoustic interference when they are breeding in the same habitat. We believe, however, that the data and analysis presented do not necessarily constitute a complete test of the hypothesis.

Ficken *et al.* used data from five pairs of birds in which the recording sequences contained from 43 to 519 songs of the flycatcher and from 59 to 512 songs of the vireo. Song initiation for each species of each pair was scored as either an interruption or not, and a χ^2 value was obtained for each bird. This test is quite appropriate if the assumption is made that each song produced by a single bird is temporally independent of all other songs produced by that same bird. Our major criticism is that there is likely to be a lack of temporal independence among songs within an individual's singing. Birds appear to sing in bouts of song; that is, there would be two major categories of silences, long intervals between singing bouts (between the last song of a particular bout and the first song of the next bout) and short intervals between songs within a bout. It is known that these latter intervals are rather constant (2). Thus a test of the hypothesis presented by Ficken *et al.* should recognize the three potential states of an individual bird as (i) singing within a bout, (ii) silent within a bout, or (iii) silent between bouts.

If one bird happens to start a bout while the other is between songs (within a bout), this one episode may be sufficient to ex-

plain the phase displacement during the rest of the bout. Bout occurrences then should constitute the data rather than individual songs. Because of the chance displacement mentioned above, it is important to know how Ficken *et al.* "selected" the five vireo-flycatcher pairs at Lake Itasca, Minnesota. Some individuals may have been singing out of synchrony with an individual of the other species, others may have been singing in synchrony, and still others may not have been singing at all. The occurrence of bout singing does not negate the possibility of acoustic avoidance; however, it does demand a different approach to the analysis. It seems necessary therefore to suggest the tentative nature of the conclusions presented.

R. J. PLANCK
GRANT McLAREN

*Department of Zoology,
University of Western Ontario,
London, Ontario, Canada N6A 3K7*

MASAKAZU KONISHI
*Division of Biology,
California Institute of Technology,
Pasadena 91125*

References

1. R. W. Ficken, M. S. Ficken, J. P. Hailman, *Science* **183**, 762 (1974).
2. J. A. Mulligan, *Univ. Calif. Publ. Zool.* **81** (No. 4) (1966); R. E. Lemon and C. Chatfield, *Anim. Behav.* **19**, 1 (1971); N. L. Thompson, *Z. Tierpsychol.* **31**, 39 (1972).

9 October 1974; revised 25 March 1975

Contrary to the assertion by Planck *et al.*, we did *not* attempt to test the hypothesis that the vireo and flycatcher "change their patterns of singing to avoid acoustic interference." To dismantle the straw man, we repeat that we recorded the species singing together and found that song overlap occurred less frequently than would have been expected from the simplest quantitative model of singing. The results suggested to us that some mechanism to avoid overlap has evolved, but we do not even agree among ourselves as to the most likely mechanism.

The other assertion by Planck *et al.*, that the data may have been "selected" by recording only when no song overlap occurred, is easily answered: of course not. This is so obvious a potential bias that we did not even bother to mention in the original report that tapes were made opportunistically by R.W.F. and M.S.F. whenever possible.

The substance of the technical comment by Planck *et al.* is thus not a "critique" but rather an additional suggestion on the mechanism of overlap avoidance. R.W.F. and M.S.F. have data to indicate that the proposal of phase-displacement at the beginning of a bout, although clever, is unlikely. Contrary to the assertion of Planck *et al.*, neither species sings in a truly regular fashion; birds do not stay out of phase or even begin out of phase and drift slowly into phase. We are still investigating the problem and will consider the phase-displacement possibility quantitatively when a more propitious occasion arises.

ROBERT W. FICKEN
MILLICENT S. FICKEN

*Department of Zoology, University of
Wisconsin-Milwaukee, Milwaukee 53201*

JACK P. HAILMAN
*Department of Zoology, University of
Wisconsin-Madison, Madison 53706*

13 August 1975

Electrophysiological Correlates of Meaning: Vocalization Artifact

Johnston and Chesney (1) recorded the visual evoked potential from a frontal electrode in a choice reaction-time (RT) paradigm requiring a vocal response. They compared, by means of factor analysis, the wave forms evoked by a visual stimulus that was interpreted either as a letter ("B")

or number ("13"), depending upon the context in which the stimulus appeared. Their results indicated a consistent factor (in three of four subjects) that differentially loaded on "B" and "13" in the interval from 160 to 240 msec after stimulus presentation (the maximum time sample in