Photically Induced Seizures in the Yellow Baboon, Papio Cynocephalus

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SUMMARY: *Significant susceptibility to photically induced seizures has in the past been observed only in Senegalese baboons* ***(Papio papio)*** *and epileptic humans. However, we have unexpectedly observed a photomyoclonic response to intermittent photic stimulation in 5 of a sample of 6 yellow baboons* ***(Papio cynocephalus).***

RÉSUMÉ: *Une susceptibilité significative aux crises épileptiques induites par la lumière n-avait été observée, jusqu'ici, que chez les babouins Sénégalais* ***(Papio papio)*** *et certains humains épileptiques. Nous avons dernièrement observé une réponse photomyoclonique à la stimulation lumineuse intermittente chez 5 parmi 6 babouins jaunes* ***(Papio cynocephalus).***

INTRODUCTION

Perhaps the most dramatic example of extreme susceptibility to seizures in animals is the photomyoclonic syndrome discovered in Senegalese baboons, *Papio papio* (Killam et al., 1967a). These animals display a significant incidence of generalized electrographic and behavioral seizures in response to light flickering at frequencies of 20-25 Hz. The predisposition to epileptiform activity possessed by *P. papio* is also reflected in the occurrence of spontaneous seizures in some members of the species (Wada et al., 1972) and in the rapid rate of development of generalized seizures (kindling) with repeated electrical stimulation of the amygdala (Wada and Osawa, 1976). In contrast to *P. papio,* other infrahuman species of primate, including other baboons, reportedly display little or no photosensitivity (Killam et al., 1966; 1967b; Stark et al., 1968; Wada et al., 1972), and amygdaloid kindling proceeds slowly and without full generalization in rhesus monkeys, the only other primate thus far tested (Goddard et al., 1969; Wada et al., 1978). Investigation of photosensitivity in *P. papio* could offer insight into photosensitivity in epileptic humans, the only other primate known to display a significant degree of susceptibility to photically induced seizures. In contrast to earlier reports, however, we have observed a significant incidence of photosensitivity in a sample of a species of baboon other than *P. papio*, suggesting that excessive susceptibility to seizures could be more widespread among primates than was previously recognized.

METHODS

We examined 6 adolescent female *Papio cynocephalus* for susceptibility to photically induced seizures. The baboons originated in the highlands of Ethiopia and were purchased from a commercial dealer, the Primate Import Corporation of New York City. After purchase, the baboons resided in our primate colony for 1 year before testing. During that period and throughout the experiment, the baboons received a daily diet of water, monkey chow, and fresh fruit. A 12-hour light/dark cycle was maintained in the colony, and all testing occurred in a separate room during the day. Four of the baboons carried multiple depth and cortical recording electrodes chronically implanted under sterile conditions, whereas the other 2 baboons did not carry chronic electrodes and were surgically naive. Electroencephalographic (EEG) recordings were obtained from the latter animals by acute insertion of needle electrodes into the scalp. Before testing began we gentled the animals for several weeks and attempted to habituate them to the presence of one of the experimenters (M.C.). During the testing sessions the baboons were partially restrained in a darkened room, and they were exposed to photic stimulation in the form of a flickering light produced by a Grass photostimu-

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lator set at maximum intensity and at a frequency of 25/sec. We selected these parameters because they reliably induce seizures in *P. papio* (Killam et al, 1967a); other parameters were not tested. EEG was recorded on a 16-channel machine, and the intensity of the convulsive behavioral response was rated according to the following classification (Wada et al., 1972): C−0, no response; C+1, clonic jerking of the eyelids; C+2, clonic jerking of the facial musculature and head; C+3, generalized clonic jerking of the limbs or entire body; C+4, self-sustained generalized jerking that continued after termination of the photic stimulation. Of the species of primate tested previously, only *P. papio* displayed a significant frequency of behavioral seizures at an intensity of C+2 or greater (Killam et al., 1966, 1967b; Stark et al., 1968; Wada et al., 1972).

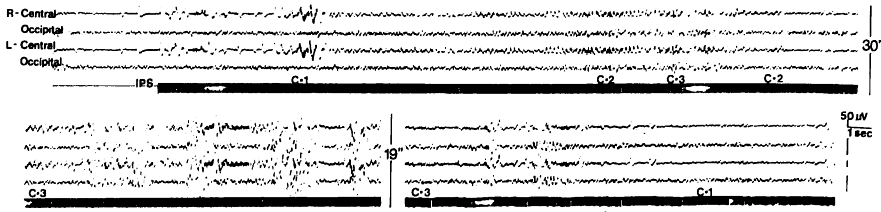

Fig. 1 — A sample of scalp EEG recorded from a *P. cynocephalus* during a seizure induced by intermittent photic stimulation (IPS). The beginning of each stage of the clinical seizure is indicated with the terminology used in the test: C+1, jerking of the eyelids; C+2, jerking of the facial musculature and head; C+3, generalized jerking of the limbs of entire body. Clinical seizure activity was continuous once the seizure began; onset of the seizure occurred at the first C+1, in the upper line. Note that scalp EEG is not always correlated with the intensity of the clinical response (e.g., compare the presence of EEG alterations during C+3 response in the upper line to the absence of EEG alterations during the later C+3 response, in the lower line).

RESULTS

A moderate to high degree of photosensitivity was displayed by *P. cynocephalus.* As shown in Table 1, 2 of the 6 baboons on first testing displayed a C+2, considered to be a moderately photosensitive response; 3 baboons displayed a C+3, considered to be a strongly photosensitive response; and the sixth baboon was insensitive. The occurrence of C+3 responses in the 2 baboons that did not carry implanted electrodes indicates that photosensitivity in the baboons with electrodes was not induced by the surgical procedures used to implant the chronic electrodes or by the presence of the electrodes themselves. We cannot rule out the possibility that implantation of depth electrodes could have exacerbated a weak predisposition to photically induced seizures, although Wada et al. (1972) observed a transient *decline* in photosensitivity of *P. papio* after implantation of electrodes. The behavioral manifestations were strong, symmetrical, and stimulus bound (i.e., they ceased when photic stimulation ceased). Once begun, the photomyoclonic responses were usually sustained for 10 or more seconds, and occasionally they persisted for the maximum duration of the period of photic stimulation, 2 minutes. After displaying a C+2 or C+3 response in a given session the baboons usually became nonresponsive, and further responses could not be evoked within that session. Because the baboons retained some degree of movement during testing, EEG records were often obscured by movement artifact. Nonetheless, it was usually possible to detect spikes and multiple spikes-and-waves over the dorsal convexities; a sample scalp EEG record is presented in Figure 1. Repeated testing of the baboons at intervals of 3 to 12 days indicated that the photomyoclonic response was reliable and repeatable. The 5 photosensitive baboons displayed responses of C+2 intensity or greater on each occasion, whereas the nonsensitive animal remained nonresponsive. Thus, of a total sample of 6 *P. cynocephalus*, 5 displayed reliable photomyoclonic responses, and the responses of 3 of the 5 susceptible baboons were at a near-maximum intensity of C+3.

TABLE 1

Number of Baboons ***(Papio cynocephalus)*** *Displaying Photically Induced Seizures*

	Maximum Behavioral Response in Any Session					
	C+0	C+1	C+2	C+3	C+4	Total
Baboons with implanted electrodes	1		2	1		4
Baboons without implanted electrodes				2		2

DISCUSSION

We have observed a striking and unexpected degree of photosensitivity in a small sample of yellow baboons, *Papio cynocephalus,* a species of baboon distinct from *P. papio.* Although additional yellow baboons will have to be tested before the generality of this phenomenon can be established conclusively, we think that it probably reflects a predisposition to photically induced seizures that is possessed by the population from which our sample was drawn, namely the species *P. cynocephalus.* For this hypothesis to be considered seriously, it is necessary to account for the failure of others (Killam et al., 1967b) to observe any significant degree of photosensitivity in this species. Although a number of explanations are possible, the most likely one is, in our view, that photosensitivity in *P. cynocephalus* varies with the geographic origin, sex, and age of the animals, as it does with *P. papio* (Balzamo et al., 1975). A high proportion of photosensitive subjects is present only in *P. papio* captured in the Casamance region of Senegal; female *P. papio* are more likely than males to be photosensitive; and photosensitivity declines with age in both sexes. If similar factors affect the incidence of photosensitivity in *P. cynocephalus*, it may be significant that Killam et al. (1967b) examined mature females captured in Kenya, whereas our baboons were adolescent females captured in Ethiopia.

The strong predisposition to epileptiform activity in *P. papio* is expressed not only in photosensitivity but also, in some animals, in the occurrence of spontaneous seizures (Wada et al., 1972). This propensity to spontaneous seizures may be shared by *P. cynocephalus*. Altman (cited by Killam, 1969) has observed a spontaneous seizure in an adult male *P. cynocephalus* in the wild, and we have observed recurrent spontaneous primary generalized seizures in one of three *P. cynocephalus* subjected to amygdaloid kindling (Corcoran et al., 1977). Indeed the rate and pattern of amygdaloid kindling in *P. cynocephalus* (Corcoran et al., 1977) are very similar to those in *P. papio* (Wada and Osawa, 1976), indicating a further similarity between the two species. Thus, *P. cynocephalus* may be an additional species of primate in which the factors controlling a marked predisposition to epileptiform activity can be investigated experimentally.

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