Attempts to Cue Successful Escape From A Highly Intense Microwave Field by Photic Stimulation

ABSTRACT

In a study designed to assess conditions under which a highly intense 918-MHz microwave field will motivate escape learning, different groups of hooded rats received 25 trials of training under one of four conditions (all *ns* = 4): exposure to a highly intense field ($\dot{D}$ = 60 mW/g); exposure to the field as temporally paired with a photic cue; or exposure to the photic cue alone. In all three of these conditions, crossing of a rat into a large "safe" area resulted in virtually instantaneous cessation of radiation. In the fourth condition, cessation of faradic shock to the feet of active controls served as a negative reinforcer of the escape response. Acquisition of the escape response was rapid for the shocked animals and was less rapid but reliably demonstrated by irradiated animals cued by light. Cessation of light did not motivate escape behavior and, although there was evidence of some learning during later trials by rats subjected only to microwave radiation, their performances failed to differ reliably from the rats in the light-only condition. These data reconfirm and extend those of Carroll, *et al*. which indicate that nearly-lethal, deeply penetrating, non-pulsed microwaves in a multi-path field apparently lack the sensory qualities required to motivate escape.

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SUMMARY

It is well documented that human beings and small mammals can detect the *presence* of microwaves, especially pulsed radiations at high peaks of power density (cf. King, et al., 1971; Frey and Messenger, 1973; and Chou, Guy and Galambos, 1977). However, whether *cessation* of intense irradiation by continuous-wave or sinusoidally modulated microwaves is detectable and can function as a negative reinforcer of escape behavior is conjectural. Since microwave energy circa 1 GHz is highly penetrating, the resultant heating of a small absorbing body would be relatively diffuse; also, thermal gradients from electrical "hot spots" would largely be smoothed out by circulation of the blood. Diminution of field strength, even if abrupt, may not result in the sensory witness of diminishment if the basis of microwave detection is based on thermal decrements; the long thermal time constant of water in tissues would produce a low rate of cooling--in a phrase, the field might vanish but the calories would linger on. In a study performed to test behavioral implications of this hypothesis, Carroll and her colleagues (1978) found that reduction to 3% of a nearly lethal field ($\dot{D}$ = 60 mW/g) by a simple locomotor response failed to motivate successful escape by rats in a multi-mode cavity.

In the study, which was performed on 16 visually pigmented rats, an absolute reduction of dose rate (60 to 0 mW/g) was assessed in a 918-MHz cavity as a negative reinforcer of escape, and was tested with (n = 4) and without (n = 4) an accompanying photic stimulus. Cessation of faradic electrical shock to the feet of active control rats (n = 4) also served as a negative reinforcer. Following one day of baseline measures, five 2-minute trials per day over a 5-day period were scheduled in the cavity, which delivered half-wave 60-Hz sinusoidally modulated microwaves. Acquisition of an escape response by electrically shocked rats was, as expected, extremely rapid. Photically cued cessation of microwave irradiation also resulted in escape learning, but rate of acquisition was reliably below that to foot shock. Uncued microwave radiation after 15 trials resulted in weak signs of escape learning, but performances failed to differ statistically from those of non-irradiated rats (n = 4) for whom cessation of photic stimulation was the reinforcer (Fig. 1).

The data comport with the proposition that while the *presence* of a highly intense and penetrating electromagnetic field is easily detected by the rat, *cessation* of the field in the absence of collateral cuing by a salient sensory stimulus is an ineffective negative reinforcer. Our data are in accord with unpublished findings of Lovely and his colleagues, who found that rats exposed to 2450-MHz radiation in a cylindrical wave guide learned rapidly to escape, and then to avoid an intense field, but only when they were cued by a photic stimulus.

The implications for human workers and for infrahuman animals exposed to intense RF fields are obvious: e.g., workers in the leather and plastics industries, or animals that may someday be exposed to intense microwave radiations near receiving antennae of satellite power stations. Non-pulsed microwaves that penetrate deeply into the bodies of organisms, at least when they are of multi-path origin, apparently lack the sensory qualities required for timely withdrawal.

REFERENCES

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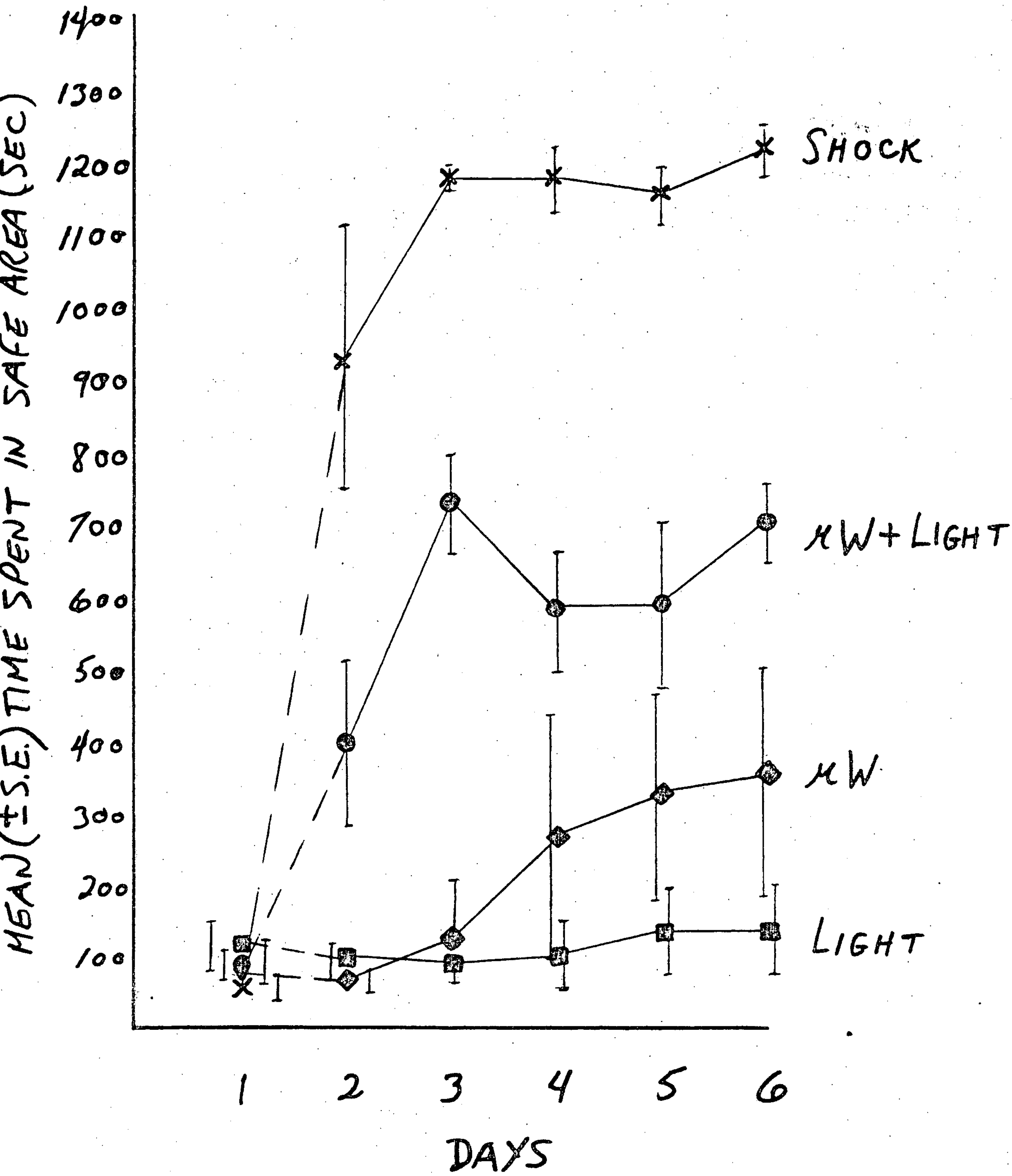

Figure 1. Mean time in seconds (± standard errors) spent in the safe area by the four animals in each treatment condition.