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IMPACT OF BLOCKING SOME MAJOR SENSORY INPUTS ON THE FEEDING BEHAVIOUR OF *PERIPLANETA AMERICANA* (BLATTARIA : BLATTIDAE)

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The time taken by control *Periplaneta americana* adults kept confined in a chamber, to track down food placed at the food rack in the chamber was noted. The food tacking time increased significantly when the animals were antenectomized or eye blocked in various combinations. The co-ordination of the eyes and antennae in sensory input has been discussed.

INTRODUCTION

The antennae serve as receptors of many stimuli, because they bear various types of sensilla that function as tactile and odour receptors, contact chemoreceptors, hygroreceptors and thermoreceptors. Since antennae are involved in the perception of odours, they enable an insect to locate its food from a distance. The actual role played by antenna and eye was studied by antennectomy and eyeblocking experiments (Ambrose *et al.*, 1986). Bernays & Simpson (1982) reported that the compound eyes are often involved in locating food and they are particularly in predators. In the present study, the efficacy or antennae and eyes in food tracking has been investigated in the cockroach, *Periplaneta americana*. This study has been conducted with the aim of understanding the individual contribution of each sense organ in the totalistic response to stimuli of the animal and to understand how best the functions of a particular sense organ be substituted by another.

MATERIAL AND METHODS

Cockroaches were obtained from the local specimen supplier. Male cockroaches alone were selected for the study. The test individual were starved for 5 days, so that they will start searching for food as soon as they are released into the experimental chamber. The experimental chamber was 40 cm long, 25 cm broad and 12 cm deep made up of wooden frame and covered by means of a closely knitted wire net. At one corner of the chamber, a food rack was diagonally kept. On the opposite corner a small chamber with a door was arranged, which enclosed a floor space of 50 cm^2. The shortest route to the food rack from this chamber was diagonal distance of 47.2 cm^s. The door was closed and the starved cockroach was allowed into this enclosed area 2 hr prior to the experiment. After 2 hrs when all the fright reactions of the cockroach were over, the door was opened from above to expose out the food kept on the food rack arranged diametrically opposite to the small enclosure.

Since cockroaches were nocturnal the experiments were conducted after 7 P.M. under dim light, because cockroaches are nocturnal animals. Soon after releasing the animal from the enclosure, the stop watch was started. The total time taken by the animal to go over to the food source and start eating was recorded as the food tracking time. Antenectomy was performed by removing the entire antenna using a sterilized pair of

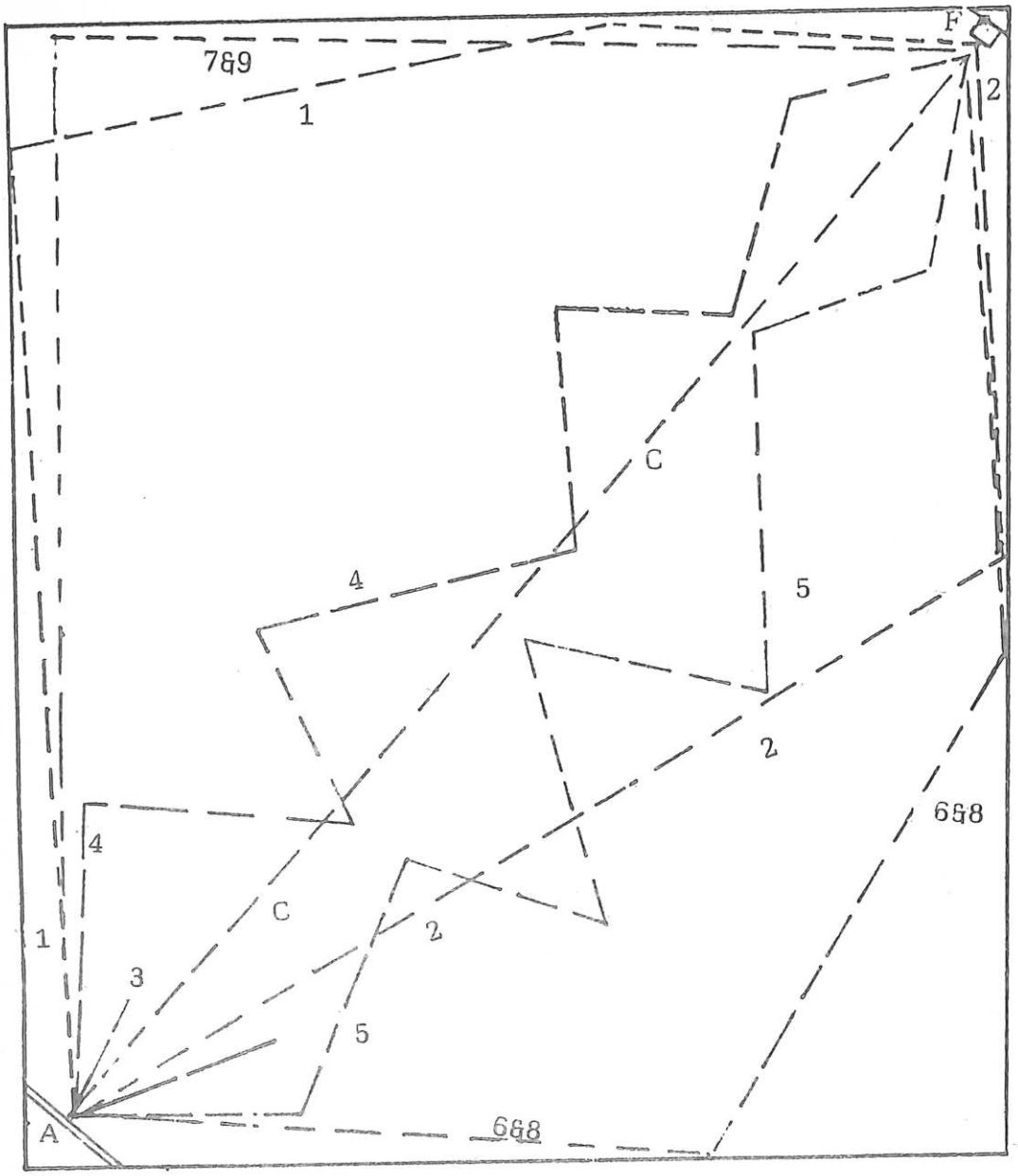

Fig. 1. Track movement diagram : Record of the movement of sensory input blocked *P. americana.*

1. Right antenectomy; 2. Left antenectomy; 3. Right and left antenectomy; 4. Right antenectomy-Left eye white paint blocking; 5. Left antenectomy-Right eye white paint blocking; 6. L. antenectomy-L. eye w. paint blocking; 7. R. antenectomy-R. eye w. paint blocking; 8. L. antenectomy-L. eye b. paint blocking; 9. R. antenectomy-R. eye b. paint blocking.

(A=Animal chamber; C=Control; F=Food rack)

scissors and after antenectomy, the animal was shut inside the enclosure for about 2 hours before starting the experiment. Commercial white and black emusion paint were used for blocking the eyes. Black coating on the eyes totally blocked light from entering into the eyes whereas white paint served as a translucent.

RESULTS AND DISCUSSION

Control cockroaches moved diagonally towards the food source. The mean time recorded from this movement was 263 ± 2 sec (4 min 23 sec). The diagonal length from the animal chamber to the food rack was 47.2 cm. The animal has moved at a speed of 10.77 cm/min (Fig. 1; Table I).

The right antenna was first removed. The animals showed left ward movements as they walked forwards. This was due to the reason that the animal was unable to feel things on the right hand side because the right antenna has been amputated. The mean time taken to reach the food source was 2537 ± 3 sec (42 min 17 sec). Thus there was an increase in the time required to reach the food source. This increase is statistically significant, working out to a hike of 864.6 percent ($P = 0.01$).

When the food tracking experiment was attempted with the left antenna cut, the mean food tracking time as 2536 ± 10 sec (42 min 16 sec), which has an 864.2 percent increase.

When both the right and left antennae were cut, the food tracking behaviour was totally absent. The animal could move only for a very small distance, and then abruptly stopped. Ambrose *et al.* (1986) reported that antenectomy significantly increased the duration of predatory feeding by 1.04 times over the control bug, *Acanthaspis quinquespinosa.*

The feeding behaviour of antenectomized (right antenna) eye blocked (left eye-white paint) cockroaches were studied. These animals moved very slowly. Since the right antenna was cut, the animals move in a leftward direction. But on the left hand side the movement was impaired by paint coated eyes. The vision was partially blocked. So the animal moved very slowly and took a mean period of 2 hr 45 min (9900 sec) to reach the food source kept at a distance of 48 cm. The speed of the animal worked out to about 0.29 cm/min. The speed of movement of the animal was curtailed to a large extent.

In another set of experiments above (right antenectomy coupled with left eye white paint blocking) were slightly modified by coating black paint on the eyes, the animals failed to move and they never could track the food out. This shows the importance of coupling action of vision with the sensory action of the antennae.

Another combination of sensory input block was worked out. The right antennae were amputated and the right eyes were blocked with white paint. This resulted in a one way block which made the animals move with difficulty. The time taken for reaching food was (54 min 3240 sec).

In another set of cockroaches, the left antennae were removed and left eyes were blocked with white paint. Here also the animals were straining their normal halves to reach the food source. The time taken to reach food source was 51 min (3060 sec). When the right antennae were removed and the right eyes were blocked with black paint, the cockroaches could use only one side of their body for gathering signals.

Cockroaches whose left antennae were removed and left eyes were blocked with black paint, the time required to track the food source was 56 min (3360 sec). For right eye blocking with black paint and right antenectomy, the mean food tracking time was 54 min (3240 sec). Thus it is clearly seen that cockroaches use only one side of their head to absorb chemical and physical stimuli when the other side is partially or totally blocked.

Callahan (1975) considered the whole structure of antenna to be adapted for the perception of far infra red emissions from molecules. The antenna bear a number of sensilla. The adult *Periplaneta* have about 250000 sensilla, on each antenna.

Table I. Effect of blocking sensory input in the mean food tracking time of *Periplaneta americana*.

	Control	Antenectomy		Antenectomy and eye blocking - white paint				Antenectomy and eye blocking - black paint	
		Right	Left	R-antennae L - eye	L-antennae R - eye	R-antennae R - eye	L-antennae L - eye	R-antennae R - eye	L-antennae L - eye
Mean food tracking duration (in sec) (n ± SD)	263 ± 2	2537 ± 13	2536 ± 10	9900 ± 120	9240 ± 600	3240 ± 60	3060 ± 180	3240 ± 60	3360 ± 120
Percent change over control		+864.6	+864.2	+4025	+3750	+1250	+1175	+1250	+1300

All deviations are statistically significant at p = 0.01
(R = right; L = right; n = 10)

Ambrose *et al.* (1983) studied the impact of antenectomy, eye- blocking and tibial coating on the feeding behaviour and predatory efficiency of a heteropteran, *Rhinocoris marginatus*. Ambrose *et al.* (1986) studied four different sets of experimental individuals of a hemipteran species, *Acanthaspis quinquespinosa*, namely, antenectomized, eye blinded, fossula spongiosa coated and rostrum coated. The coating with black paint resulted in an increase in the food capturing duration compared to white paint. When both eyes were blinded with black paint total feeding duration was l.l. times more than the control animal values. But when white paint was used the feeding duration was only 1.08 times more than what was observed in the control animals. The above study clearly supported the observations recorded in the present investigation regarding the duration of food tracking and other parameters.

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