



Study of Memory in American Cockroaches and the Intraspecific Relationship among them

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Abstract



In the present study, we investigated the presence or absence of memory in American cockroaches (Bath cockroaches) on the one hand, and dealt with the intraspecific relationship of this kind of cockroach on the other. The purpose of this study was to achieve a better understanding of the nervous system in American cockroaches so that we could have a better understanding of other insects and organisms. This study was divided into two parts. In the first part, we examined the existence of memory by studying the effect that training can have on these species. In the second part, we investigated their intraspecific relationship by studying the reaction of some of them in an environment in which they had not been before. This was done in such a way that those in the main group communicated with some others which were of the same species and had previously been in the same place. With regard to the first part, we found out that memory exists in this kind of organism, and we also obtained some early findings about the duration of this memory. We also obtained some results in the second part that confirmed the initial hypothesis regarding the existence of such an intraspecific relationship (e.g., finding food) among these species.

Keywords: American cockroach, memory, intraspecific relationship

Introduction



The first part of this study is related to memory. Memory or retention is a mental capability for storing, memorizing and remembering information and experiences. In the following section, we refer to some of the studies conducted in this area:

One of the most famous studies in this area is the one conducted by Pavlov; he received the Nobel Prize for his research on memory and conditionalization. Ivan Pavlov had already carried out research on the conditionalization of dogs.

The conducted experiments on fishes in an aquarium at Oxford University showed that; fishes, contrary to the general impression, have a strong learning and memory capacity, so they learn quickly and can remember events for several months. From among other researches carried out on memory, we can refer to those related to plant memory. The result of such studies confirmed and showed the existence of memory in plants. Of course, this memory is different from that of creatures which is based on the nervous system.

Some studies have also proved that there is memory in the microbial world by changing the genetic code. After examining these researches, we decided to examine the neurological memory in insects (which is much more simple than that of animals like dogs, cats or even fishes), and in this research we investigated bath cockroaches.

The second part of the research was related to the relationship between bath cockroaches. Animals communicate in different ways and at different levels, and this communication can help them in their life. For instance, it can help them understand dangerous situations or find food. In researches conducted at the University of Arizona, scientists divided these communications into two types, i.e. interspecific communication and intraspecific communication.

Regarding intraspecific communication, more studies have been conducted on dolphins with a focus on the systems and organs of the transmitter and recipient of the waves emitted from these organisms. Regarding other insects, there are also some studies carried out on ants and it is noteworthy that this kind of research is still in its infancy.

Since the relationship between the sensory, processor and motion systems is neural and a better understanding of these systems leads to a deeper understanding of the nervous system, we examined the intraspecific relationship among American cockroaches in this part to gain a better understanding of the way nervous system evolves by examining the existence or absence of a specific kind of such a relationship

procedure



First part:

Purpose of the experiment: to investigate the presence or absence of memory in the American cockroach by training it to have a tendency toward a specific olfactory stimulus.

Description of the experiment: We divided 20 cockroaches with the above conditions into two groups of 10, i.e. group A and group B and placed them into two separate containers.

The used device was composed of a corridor that ended in two chambers. The fork (two-way) was in the shape of T, and the needed food for carrying out the experiment was placed at the two chambers which were at the end of the corridor.

We poured some mint distillate on the one side and some rose water on the other side of the dish. The dishes were similar and they were washed and sterilized before the experiment. The two sides which included rose water and mint distillate were displaced during training and experimentation. The aim was to investigate the effect of olfactory stimulus on the process of experiment.

The training program: We designed a training program for the cockroaches in group B, in such a way that they were placed at the top of the fork. Then, whenever a cockroach went to a place where the mint distillate exists, we let the cockroach drink some of it, but if the cockroach went to the side which the rose water was placed, we would impede it and made it return to the fork. We repeated this procedure twenty times for each cockroach in group B.

Now that Group B has been trained and Group A has not, the cockroaches in Group A and B will be put into the fork one by one and their performance will be observed and noted in the relevant table.

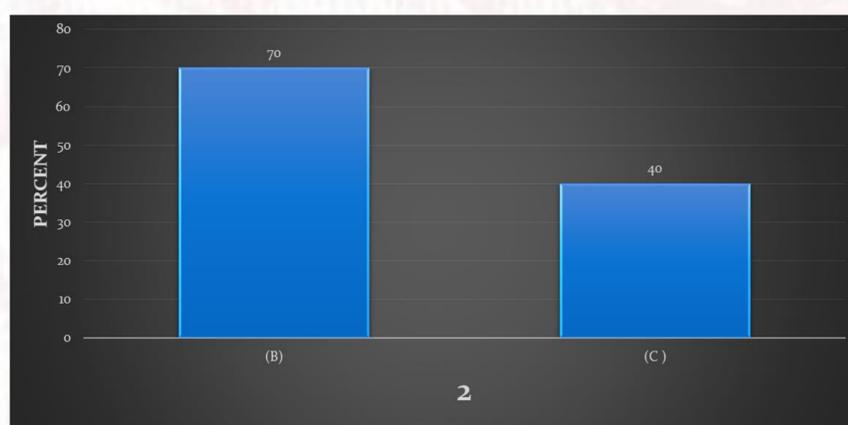
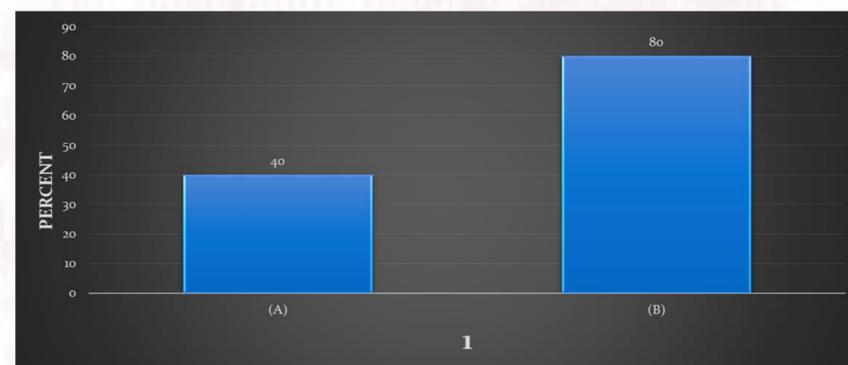
Second part:

Purpose of the experiment: to investigate the presence or absence of a strong and practical communication among the bath cockroaches. In fact, in this experiment, we tried to find out whether the cockroaches' nervous system had evolved to such an extent that they could interact and whether those cockroaches which had been trained or in any way stored information in their memory, could transfer it to other cockroaches. Moreover, we made an attempt to find out whether other cockroaches received the information and whether they followed the trainings that we had provided for the other group of cockroaches?

Description of the experiment: For this experiment, our experimental specimen space consisted of 25 identical cockroaches; they were first placed in three separate containers (5 and 10 cockroaches were placed in the first container and the next two containers, respectively). In other words, they were divided into three groups: A, B and C.

Now, we consider the training program mentioned in the first experiment for cockroaches in group A. After conducting the training program, we attached a small label on them (to identify them from those of group B) and immediately put them in the container in which the cockroaches of group B existed. We gave them some time to exchange information in case they were supposed to do so. Now we have to analyze and compare groups B and C to see whether their tendency to the mint distillate is the same or not? To do so, we put each of the cockroaches of groups B and C in the fork (Two-road), and each time we noted in the table the direction along which the cockroach had gone.

observations



Discussion and conclusion



The first experiment was about the presence or absence of memory in American cockroaches based on the way they responded to training (which is normally called conditionalization). Regarding observations and data analysis and the SPSS statistical methods used in this study or even an intuitive review of the two columns of Table 1, it can be concluded that the cockroaches in group B have received information and stored it in their memory. In other words, we can say that cockroaches have been conditioned by olfactory stimulus of rose water. This conditionality shows the existence of a structure for learning and storage in these cockroaches and possibly in insects. A structure that reflects the evolution in the nervous system of the insects. Existence of this evolution helps these organisms throughout their life to find food, avoid danger, etc. We anticipate that this memory is related to a part of the insect's brain which can be found and investigated as an easier and simplified structure to obtain a better understanding of human memory (which is much more complex and evolved than that of insects).

On the other hand, in one part of this research which is not included in this article, we examined the duration of memory in this kind of insect; therefore, we suspect that this type of cockroach has a complex memory which consists of two parts, i.e. short and long-term.

Regarding the second experiment, taking into account the intuitive and statistical analyses as well as Table 2, it can be observed that cockroaches in group B have a stronger tendency to mint compared to those in group C. The first experiment shows that the cockroaches of group A not only received and stored information in their memory, but also interacted with the cockroaches of group B and transferred the information to them which shows that the cockroaches have the ability to interact and communicate with each other. The existence of this ability in the nervous system of the cockroaches along with their memory can avoid repetition of such mistakes which can cause the extinction of this type of insect and helps it to survive and can be one of the factors that impede the extinction of the species on the earth. Communication is the result of receiving, processing, and sending signals; and with regard to the fact that these cockroaches have intraspecific communication, it can be concluded that this insect has a sensory and analytical system of efficiency. As a consequence of the simplicity of the system in the cockroaches compared to other owners of the ability (e.g., mammals such as dolphins), the cockroaches have the potential to be used in order to gain a better understanding of the process of communication and as a result a better understanding of the nervous system.

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