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Conditioning *Coenobita clypetus* to Retain Information

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Abstract

The purpose of this experiment was to determine if the hermit crab, Coenobita clypetus, could be conditioned to learn and retain information. A runway was designed with a hole off to one side and cues near the hole. When the crab fell into the hole, it remained in a bowl for five minutes with a bright, hot light shining on it. This light was used as a negative stimulus. The crab was then taken from the hole and placed on the runway where it was run through ten trials. Data was collected as to whether the crabs avoided the hole by identifying it with the cues, or if they came into contact with the hole throughout the trials. The results, which were figured with a Chi-Square test, indicate that the cues do not affect the crabs movement near the hole and that the conditioning stimulus of the light does not affect their behavior in regards to the hole.

Introduction

Research with the Chasmagnathus crab has shown that hermit crabs can only retain avoidance learning up to 24 hours (Fernandez-Duque, et al. 1992). However, the larval form of the Coenobita clypetus is aquatic and the female must carry the eggs to the water. Often the female crab will travel up to 18-20 miles. At the speed these animals travel, there is no way for the female to travel to the water and then return to her original starting point in one day. The female either retains information as to the path she travelled by using cues, or she does not return to her original starting point. The first possibility is going to be tested to determine if the crabs can retain short- term information based upon cues or if they do not retain information

Most of the research previously conducted has used negative stimuli such as light and dark chambers (Denti, et al. 1988), starvation (Abramson and Feinman, 1990), and electrical shock (Rakitin, et al. 1991). Passive avoidance learning and multitrial inhibitory avoidance learning were demonstrated through these experiments. The following experiment was designed to determine if C. clypetus are able to retain short-term information based on cues and a negative stimulus. It is hypothesized, due to the literature stated above, that they will be able to demonstrate some significant learning.

Materials and Methods

For this experiment, C. clypetus hermit crabs were collected on the island of St. Croix during March 1993. Approximately fifty crabs were brought back to the United States. These crabs are kept in an aquarium and fed crackers, dog food or pretzels and are given water approximately every other day or when needed.

In order to obtain data that would support the hypothesis, three different experiments were carried out. Initially, a maze was designed that the crabs could move through very freely. This maze was designed to determine if the crabs are able to learn by using positive stimuli. Food and/or water was placed at the end of the maze as that stimuli. The crabs were placed at the beginning of the maze (Figure 1) and timed as to how long it took them to complete the maze.

The second experiment used a runway built from plywood (Figure 2). During the experiment, newspaper was placed on the runway and slots were cut in the paper where the hole was located. This was done to camouflage the hole. The runway was placed on a plastic bowl which the crabs would fall into when they crossed over the hole. The crabs were not able to crawl out of the bowl. Once the crabs fell into the hole, they were then ran through again, this time the hole was covered.

The third experiment also used a runway with a hole present in it and cues, sea shells, near the hole (Figure 3). This runway was designed so that the crabs were started in the same place every time and they had a choice as to go around the hole or go to the hole and either fall in or turn around and find another way around. This experiment also utilized a negative stimulus of a bright, hot light. Every time the crab would fall through the hole into the bowl, the light was shone on it for five minutes. Each crab was run through this experiment ten times after the initial falling into the bowl and being exposed to the negative stimulus. Data was recorded as to if the crab completely avoided the hole or if it came into contact with the hole.

Results

For the first two experiments, no results which support the hypothesis were collected. The data collected for the first experiment consisted of the crabs paying no attention to the positive stimulus or not even reaching the positive stimulus. In regards to the second experiment, every crab demonstrated that no information was retained because they all passed over the covered hole with no hesitation immediately after falling into the uncovered hole.

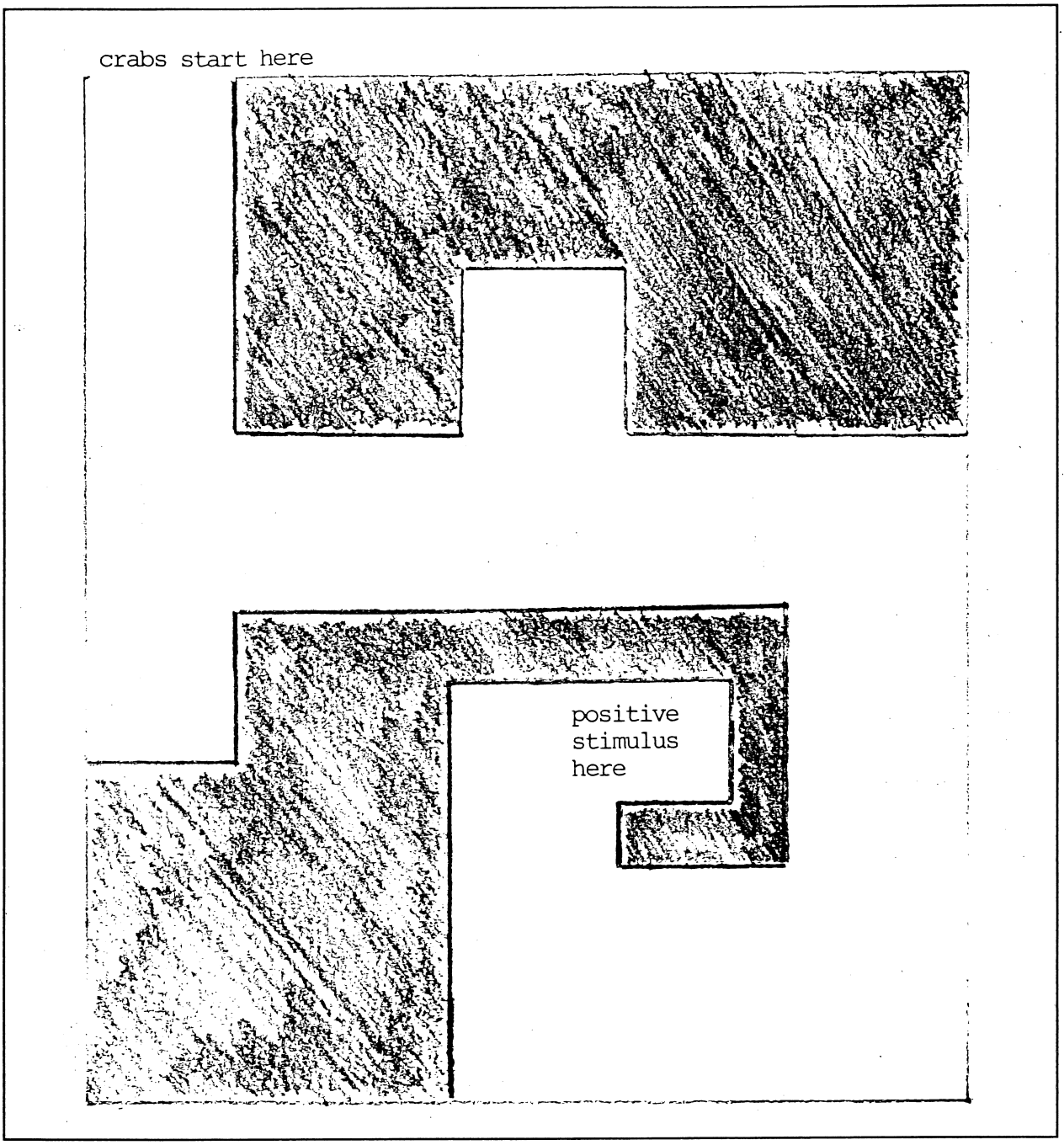

Figure 1. Maze designed for experiment 1.

The data collected for the third experiment was divided into two categories. The avoidance category consisted of the crabs either going completely to the right of the hole or going to the corner. The contact category includes the crab going to the hole, feeling around and then turning away from the hole and going to the hole and falling in.

Tables 1, 2 indicate the results which were received by using the Chi-Square test for experiment.

Table 1. Supports the null hypothesis that the cues do not affect the movement near the hole.

n = 100 trials for 10 crabs	
Avoidance	43
Contact	57
Chi-Square results = 1.96 (not significant)	

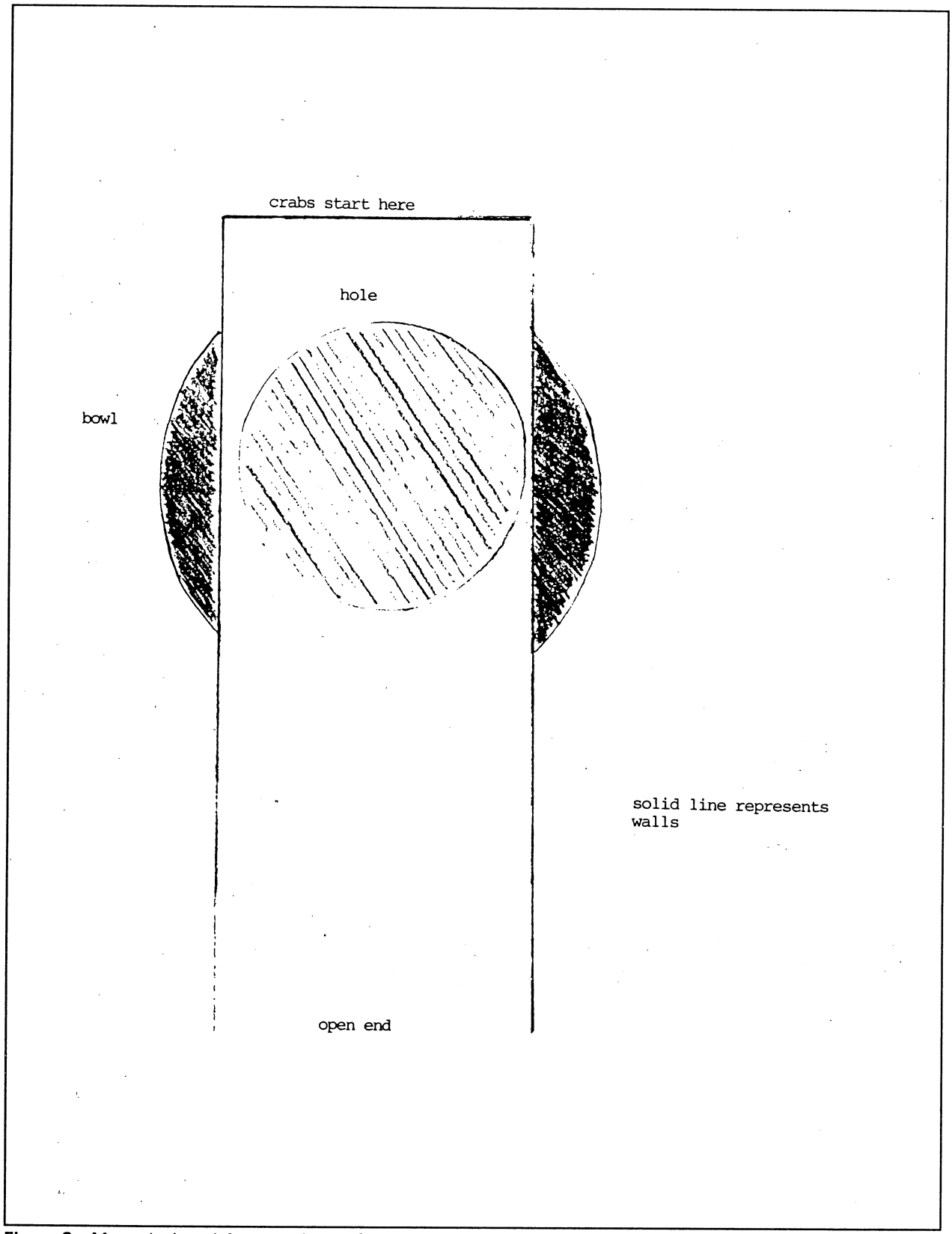

Figure 2. Maze designed for experiment 2.

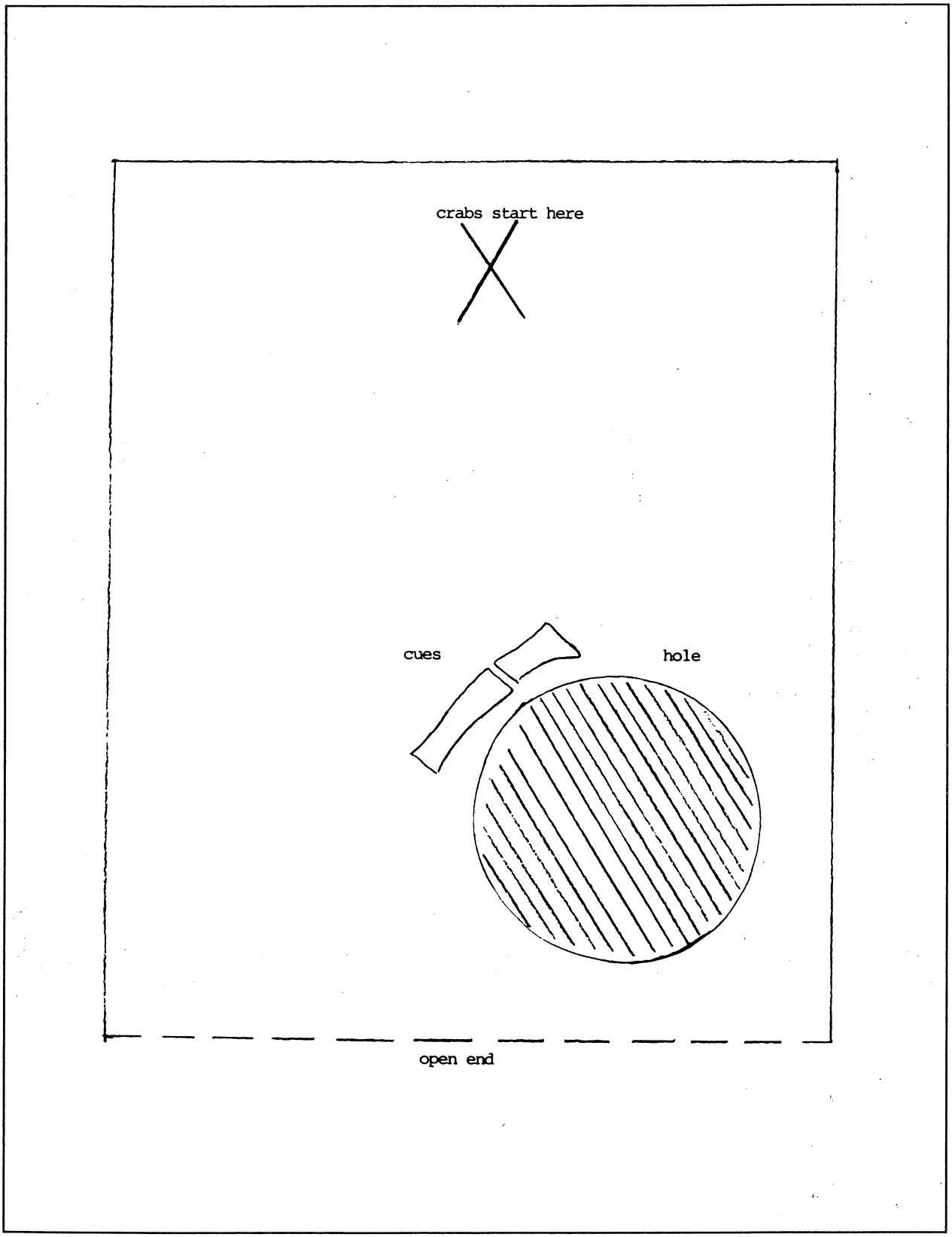

Figure 3. Maze designed for experiment 3.

The results are based upon x = 3.84 with a degree of freedom equal to n-1.

Table 2. Conditioning stimulus of bright light does not affect the behavior near the hole. These results are based upon the crab retreating from the hole and falling into the hole.

n=57 trials for 10 crabs	
Retreat	32
Fall in	25
Chi-Square results = .86 (not significant)	

Discussion

As the first two experiments were conducted, it became obvious early on that the crabs were unable to obtain any significant information. The problem with the first experiment dealt with lack of interest from the crabs. They were not responsive enough to gather any information which would be significant to the hypothesis. The problem with the second experiment dealt with the design of the runway. This runway was only good as a crab trap because it did not give the crabs another option. Their natural instinct was to go forward which meant they went straight over the covered hole.

The results for the third experiment did not support the hypothesis that the crabs retain short-term information. However, it did support the null hypotheses that the crabs move randomly and the cues do not affect their movements, and the conditioning stimulus with the light does not affect the crabs behavior near the hole. With this information, one can use reasoning that, when crabs are in their natural habitat, they deal with their encounters when they come upon them, not storing the information as an experience for future encounters.

Literature Cited

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