Psychological Reports, 2004, 94, 1107-1115.

DEVELOPMENT OF AN ETHANOL MODEL USING SOCIAL INSECTS: IV. INFLUENCE OF ETHANOL ON THE AGGRESSION OF AFRICANIZED HONEY BEES (*APIS MELLIFERA* L.)[1,2]

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Summary.—Experiments were designed to determine whether ethanol influenced aggression in honey bees. Two experiments are reported. In Exp. 1, harnessed honey bees were fed a 1%, 5%, 10%, or 20% ethanol solution. Two control groups received either a sucrose solution only or no pretreatment, respectively. The dependent variable was the number of sting extensions over 10 min. Analysis showed that aggression in harnessed bees was not influenced by prior ethanol consumption. Because there was some suspicion that the extension of the sting apparatus may be hindered by harnessing, and the authors wanted to use a design that increased ecological validity, Exp. 2 was conducted with free-flying bees. Sucrose or 20% ethanol solutions were placed in front of beehives, and the number of stings on a leather patch dangled in front of the hive served as the dependent variable. The experiment was terminated after 5 hr. because bees exposed to ethanol became dangerously aggressive. A unique aspect of the study was that Africanized honey bees were used.

This is the fourth in a series of behavioral experiments testing the suitability of honey bees (*Apis mellifera*) as an animal model for the study of alcoholism. Useful animal models possess characteristics that facilitate the study of general biological phenomena. These characteristics include (1) short life cycles, (2) small adult size, (3) easy to acquire, (4) easy to maintain in the laboratory, and (5) exhibit endpoints relevant to the phenomena being investigated and general enough to be applied to other organisms and systems (Bolker, 1995).

Bees exhibit all of these characteristics (Seeley, 1985). The authors' previous research has shown several effects common among humans and bees. These include self-administration, disruption of learning and locomotion, preferences for commercially available alcoholic beverages, and the ability of an emitic to limit consumption of ethanol (Abramson, Stone, Ortez, Luccardi, Vann, Hanig, & Rice, 2000; Abramson, Fellows, Browne, Lawson, & Or-

[1]This research was supported in part by a grant from Conselho Nacional de Desenvolvimento Científico e Tecnológico.

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tez, 2003; Abramson, Kandolf, Sheridan, Donohue, Božič, Meyers, & Benbassat, 2004).

The present paper continues the search for common behavioral effects of ethanol on human and honey bee behavior by asking whether ethanol consumption influences aggressive behavior in free-flying honey bees. It is known that aggressive behavior of rhesus monkeys, rats and mice is influenced by ethanol (Mos, Olivier, & Van Oorschot, 1990; Hilakivi-Clarke, Lombardi, Durcan, & Goldberg, 1993; Higley & Linnoila, 1997), and it would be of interest from a comparative psychological perspective to assess whether aggression is influenced by ethanol in other species. A unique aspect of the present study is that Africanized honey bees were used. The so-called "killer bee" is known for its aggressive behavior as compared to the more docile European honey bee (Abramson & Aquino, 2002a, 2002b).

In humans, there is a consistent positive correlation between ethanol intoxication and aggression. Data from both laboratory investigations and epidemiologic studies suggest that the more ethanol consumed, the greater the frequency of violent acts including homicide, assault, sexual predation, marital violence, and child abuse (e.g., Bushman & Cooper, 1990; Murdoch, Pihl, & Ross, 1990; Pernanen, 1991; Roizen, 1997).

In the first of two experiments, aggression was measured by the number of harnessed honey bees extending their stingers as a function of ethanol concentration. In the second experiment, free-flying bees had access to a 20% ethanol solution. The dependent variable was the number of stings on a leather patch.