Contents

The features marked with a star (*) are based entirely on material taken straight from standard research (and other Official and Therefore Always Correct) literature. Many of the other articles are genuine, too, but we don't know which ones.

ANNALS OF IMPROBABLE RESEARCH

On the Front Cover
A collection of defaced book covers of books about ants.

On the Back Cover
A different collection of defaced book covers of books about ants.

Special Section: Ants

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News & Notes

Some Coming Events

The Covid-19 pandemic has introduced excitingly boundless uncertainty as to whether, when, and where public activities will happen in the near future.

(See IMPROBABLE.COM for details of these and other events.)

September 12th, 2024
— The 34th First Annual Ig Nobel Prize Ceremony (and webcast).
MIT, Cambridge, Massachusetts, USA

September 14th, 2024
— Ig Nobel Face-to-Face,
MIT Museum, Cambridge, Massachusetts, USA

Spring 2025
— Ig Nobel EuroTour

May 23rd-26th, 2025
— Balticon,
Baltimore, Maryland, USA

Where There's More

There's always new improbable — it's not what you expect! — stuff on the **Improbable Research blog** at IMPROBABLE.COM

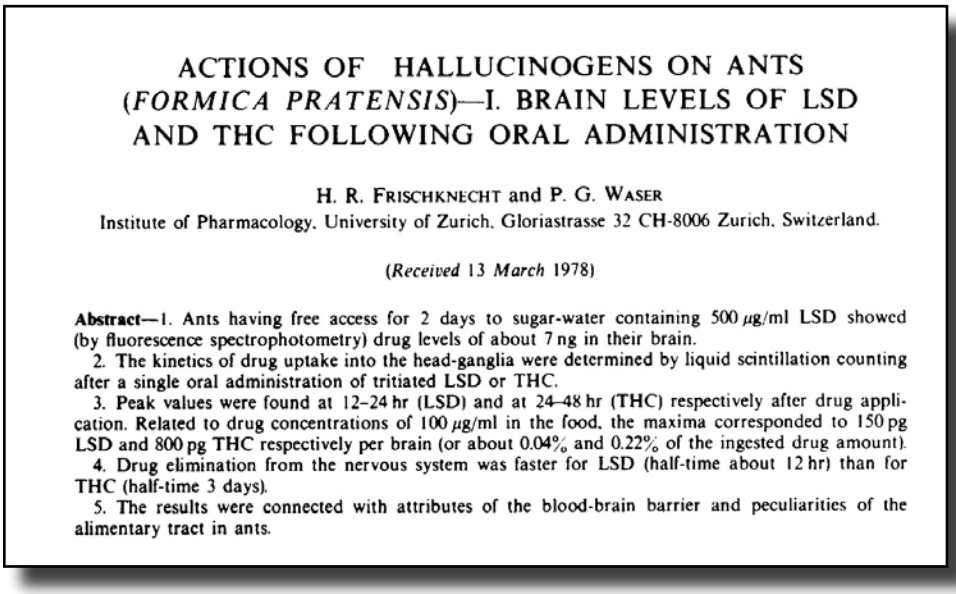
Ants on Drugs

Experiments with pharmaceuticals in small doses

compiled by Debra Morb Trilby, Improbable Research staff

Actions of Hallucinogens on Ants (1)

"Actions of Hallucinogens on Ants (*Formica pratensis*)—I. Brain Levels of LSD and THC Following Oral Administration," H.R. Frischknecht and P.G. Waser, *General Pharmacology: The Vascular System*, vol. 9, no. 5, 1978, pp. 369-373. *(Thanks to John Mull for bringing this series to our attention.)*



ACTIONS OF HALLUCINOGENS ON ANTS (*FORMICA PRATENSIS*)—I. BRAIN LEVELS OF LSD AND THC FOLLOWING ORAL ADMINISTRATION

H. R. FRISCHKNECHT and P. G. WASER

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(*Received* 13 *March* 1978)

Abstract—1. Ants having free access for 2 days to sugar-water containing 500 μg/ml LSD showed (by fluorescence spectrophotometry) drug levels of about 7 ng in their brain.

2. The kinetics of drug uptake into the head-ganglia were determined by liquid scintillation counting after a single oral administration of tritiated LSD or THC.

3. Peak values were found at 12–24 hr (LSD) and at 24–48 hr (THC) respectively after drug application. Related to drug concentrations of 100 μg/ml in the food, the maxima corresponded to 150 pg LSD and 800 pg THC respectively per brain (or about 0.04% and 0.22% of the ingested drug amount).

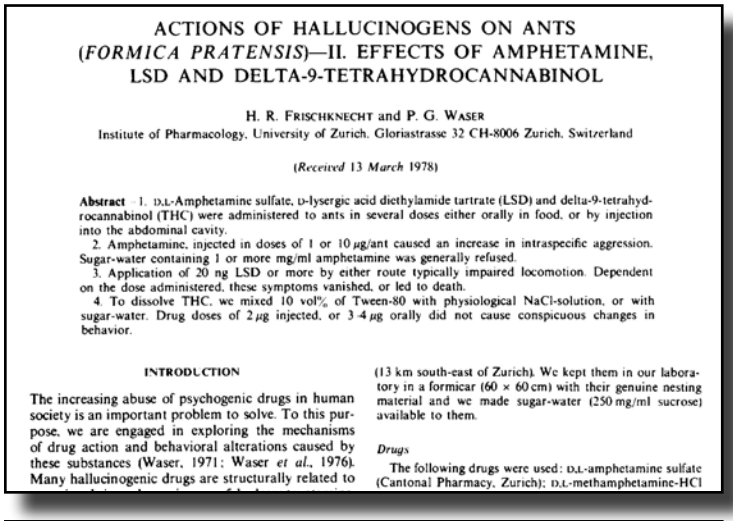
4. Drug elimination from the nervous system was faster for LSD (half-time about 12 hr) than for THC (half-time 3 days).

5. The results were connected with attributes of the blood-brain barrier and peculiarities of the alimentary tract in ants.

Actions of Hallucinogens on Ants (2)

"Actions of Hallucinogens on Ants (*Formica pratensis*)—II. Effects of Amphetamine, LSD and Delta-9-Tetrahydrocannabinol," H.R. Frischknecht and P.G. Waser, *General Pharmacology: The Vascular System*, vol. 9, no. 5, 1978, pp. 375-380. The authors report:

> Six in ten injected with 1fig amphetamine writhed very much when anesthesia faded.... Especially worth noting was that 30-90 rain after drug administration 5 in 10 ants began spontaneously to fight one another. After 2 hr I in 10 had been killed and the other nine walked about continuously in an excited fashion....
>
> [A]fter injections of 10ug amphetamine (one) ant seized its own antenna. After 20 hr two ants were vigorously fighting. Another one circled continuously on the spot with only short interruptions....
>
> THC, the active principle of hashish was administered in our experiments for the first time in insects. But neither injection (about 150/~g/g). nor oral application (250/ag/g) caused any conspicuous changes in behavior.



ACTIONS OF HALLUCINOGENS ON ANTS (*FORMICA PRATENSIS*)—II. EFFECTS OF AMPHETAMINE, LSD AND DELTA-9-TETRAHYDROCANNABINOL

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(*Received* 13 *March* 1978)

Abstract—1. D,L-Amphetamine sulfate, D-lysergic acid diethylamide tartrate (LSD) and delta-9-tetrahydrocannabinol (THC) were administered to ants in several doses either orally in food, or by injection into the abdominal cavity.

2. Amphetamine, injected in doses of 1 or 10 μg/ant caused an increase in intraspecific aggression. Sugar-water containing 1 or more mg/ml amphetamine was generally refused.

3. Application of 20 ng LSD or more by either route typically impaired locomotion. Dependent on the dose administered, these symptoms vanished, or led to death.

4. To dissolve THC, we mixed 10 vol% of Tween-80 with physiological NaCl-solution, or with sugar-water. Drug doses of 2 μg injected, or 3–4 μg orally did not cause conspicuous changes in behavior.

INTRODUCTION

The increasing abuse of psychogenic drugs in human society is an important problem to solve. To this purpose, we are engaged in exploring the mechanisms of drug action and behavioral alterations caused by these substances (Waser, 1971; Waser *et al.*, 1976). Many hallucinogenic drugs are structurally related to

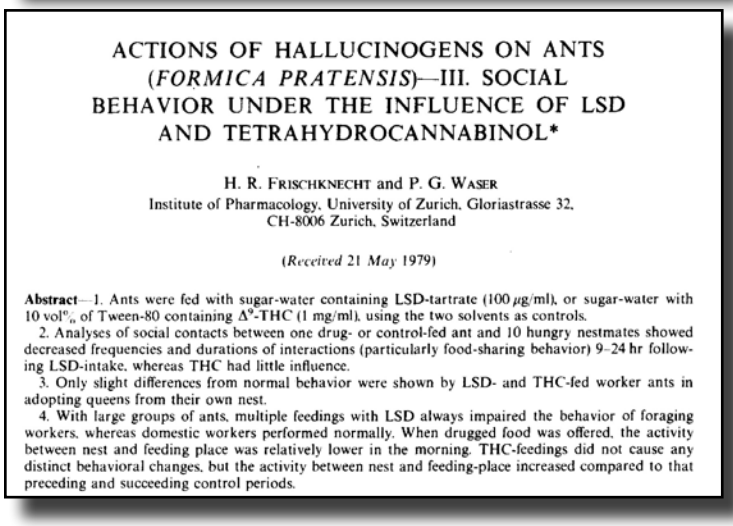
(13 km south-east of Zurich). We kept them in our laboratory in a formicar (60 × 60 cm) with their genuine nesting material and we made sugar-water (250 mg/ml sucrose) available to them.

Drugs

The following drugs were used: D,L-amphetamine sulfate (Cantonal Pharmacy, Zurich); D,L-methamphetamine-HCl

Actions of Hallucinogens on Ants (3)

"Actions of Hallucinogens on Ants (*Formica pratensis*)—III. Social Behavior Under the Influence of LSD and Tetrahydrocannabinol," H.R. Frischknecht and P.G. Waser, *General Pharmacology: The Vascular System*, vol. 11, no. 1, 1980, pp. 97-106.



ACTIONS OF HALLUCINOGENS ON ANTS (*FORMICA PRATENSIS*)—III. SOCIAL BEHAVIOR UNDER THE INFLUENCE OF LSD AND TETRAHYDROCANNABINOL*

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(*Received* 21 *May* 1979)

Abstract—1. Ants were fed with sugar-water containing LSD-tartrate (100 μg/ml), or sugar-water with 10 vol%, of Tween-80 containing Δ^9-THC (1 mg/ml), using the two solvents as controls.

2. Analyses of social contacts between one drug- or control-fed ant and 10 hungry nestmates showed decreased frequencies and durations of interactions (particularly food-sharing behavior) 9–24 hr following LSD-intake, whereas THC had little influence.

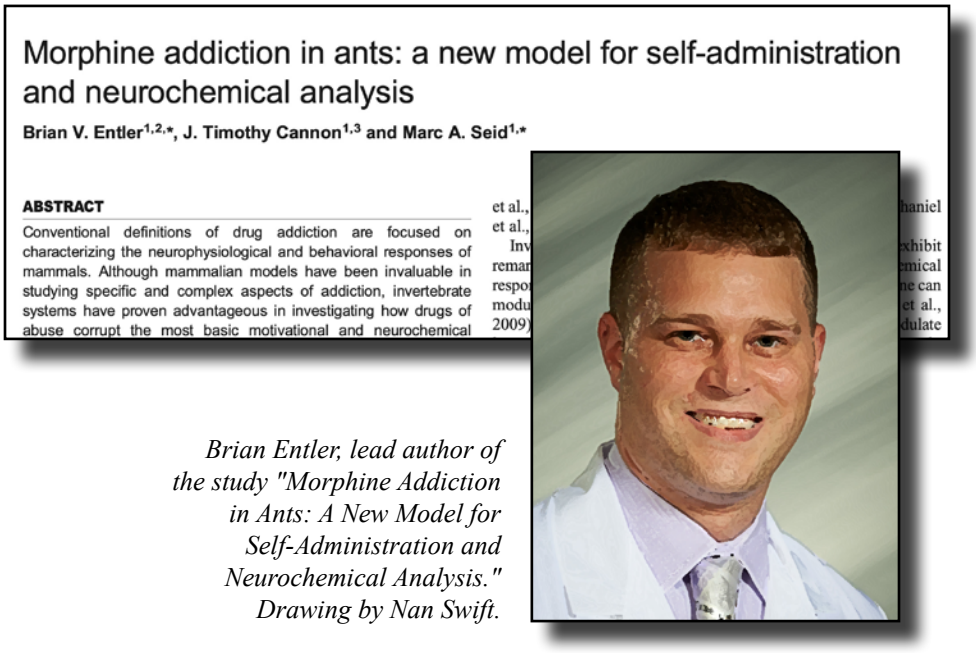
3. Only slight differences from normal behavior were shown by LSD- and THC-fed worker ants in adopting queens from their own nest.

4. With large groups of ants, multiple feedings with LSD always impaired the behavior of foraging workers, whereas domestic workers performed normally. When drugged food was offered, the activity between nest and feeding place was relatively lower in the morning. THC-feedings did not cause any distinct behavioral changes, but the activity between nest and feeding-place increased compared to that preceding and succeeding control periods.

Morphine Addiction in Ants

"Morphine Addiction in Ants: A New Model for Self-Administration and Neurochemical Analysis," Brian V. Entler, J. Timothy Cannon, and Marc A. Seid, *Journal of Experimental Biology*, vol. 219, 2016, pp. 2865-2869. *(Thanks to Richard Wassersug for bringing this to our attention.)* The authors report:

> [U]ntil now only mammals have demonstrated drug seeking and self-administration without the concurrent presence of a natural reward, e.g., sucrose. Using a sucrose-fading paradigm, followed by a two-dish choice test, we establish ants as an invertebrate model of opioid addiction. The ant species *Camponotus floridanus* actively seeks and self-administers morphine even in the absence of caloric value or additional natural reward. Using HPLC equipped with electrochemical detection, the neurochemicals serotonin, octopamine and dopamine were identified and subsequently quantified, establishing the concurrent neurochemical response to the opioid morphine within the invertebrate brain. With this study, we demonstrate dopamine to be governing opioid addiction in the brains of ants. Thus, this study establishes ants as the first non-mammalian model of self-administration that is truly analogous to mammals.



Morphine addiction in ants: a new model for self-administration and neurochemical analysis

Brian V. Entler[1,2,*], J. Timothy Cannon[1,3] and Marc A. Seid[1,*]

ABSTRACT

Conventional definitions of drug addiction are focused on characterizing the neurophysiological and behavioral responses of mammals. Although mammalian models have been invaluable in studying specific and complex aspects of addiction, invertebrate systems have proven advantageous in investigating how drugs of abuse corrupt the most basic motivational and neurochemical

Brian Entler, lead author of the study "Morphine Addiction in Ants: A New Model for Self-Administration and Neurochemical Analysis." Drawing by Nan Swift.

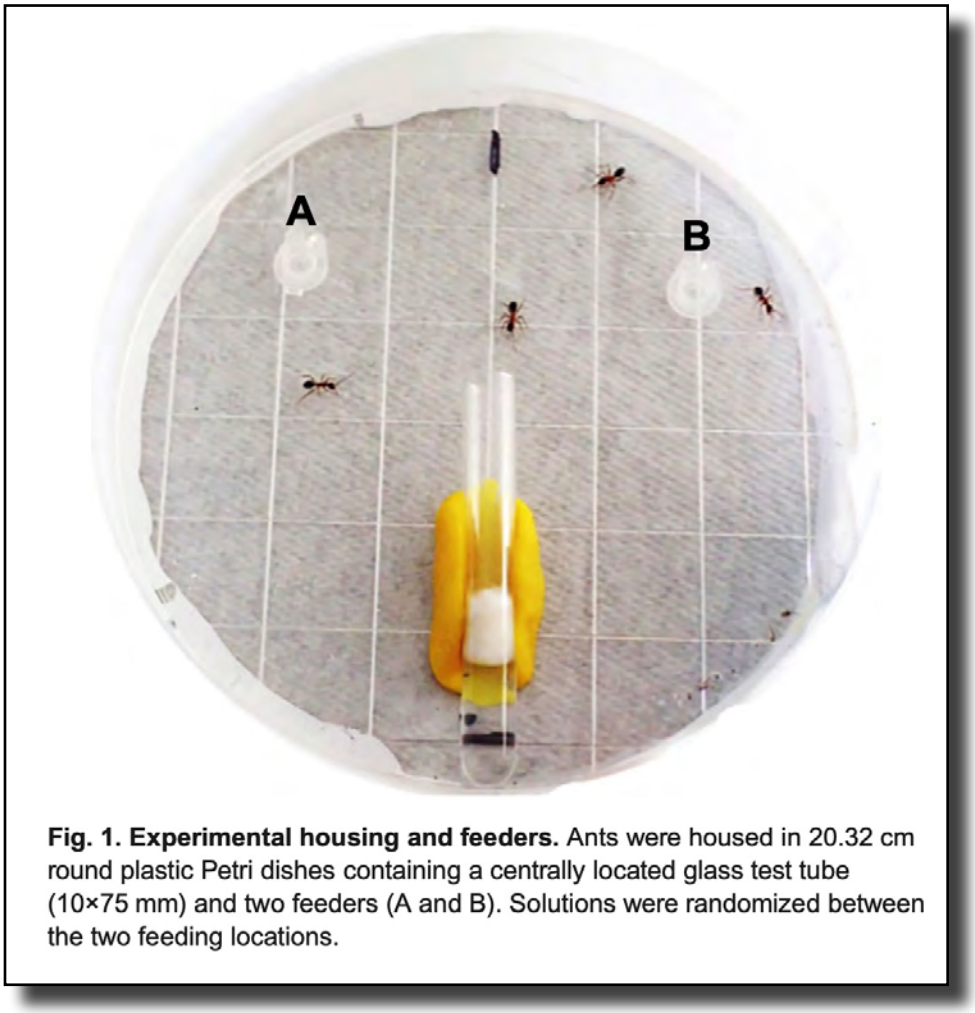


Fig. 1. Experimental housing and feeders. Ants were housed in 20.32 cm round plastic Petri dishes containing a centrally located glass test tube (10×75 mm) and two feeders (A and B). Solutions were randomized between the two feeding locations.

Detail from the study "Morphine Addiction in Ants: A New Model for Self-Administration and Neurochemical Analysis."