

## XIV. COMMUNICATIONS BIOPHYSICS

### A. Animal Communication

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#### 1. THE SHAKING DANCE OF HONEYBEE WORKERS: EVIDENCE FOR AGE DISCRIMINATION

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One of the dances of the honeybee Apis mellifera L. is called the shaking dance. The shaking dance is enacted by a worker bee (called the "shaker") that vibrates its body dorsoventrally by means of rapid contractions of the leg muscles. The shaker usually makes contact with another bee that remains motionless during the shake and then resumes its previous activity.<sup>1</sup> Workers perform this dance on all three castes of bees,<sup>2</sup> but we studied shaker bees only in the worker caste. A bee, after shaking once, will typically crawl across a portion of the comb and soon shake again, either alone, on another bee, or on several bees together. A sequence of such events is termed a "shaking run." Occasionally actions of trophallaxis or waggle dances are performed during a shaking run.

#### Methods

A small observation hive (4.6 × 16 × 16 cm) was constructed to provide enough room for approximately 500 bees. A hybrid queen and several of her workers were placed in the hive on June 25, 1972. Every day 10-30 newly emerged workers from a stock observation hive were color-marked to enable individual identification,<sup>3</sup> and added to the small colony. In all, 820 bees were marked, but because of attrition the population peaked between 200 and 350. This miniature colony was maintained for observation until July 26, 1972.

Observations were made of shaking dances performed by these bees, whose color-marking allowed for quick and accurate determination of age. The colony was observed at random times during the day. The data included the type of shaking situation (i. e., shaking alone, one-on-one, or one-on-several), the age of the shaker, and if another bee was involved, the age of the bee shaken. Also, if trophallaxis occurred during a shaking run, the ages of the participants were recorded, and whether the shaker was the receiver or the provider of food was noted.

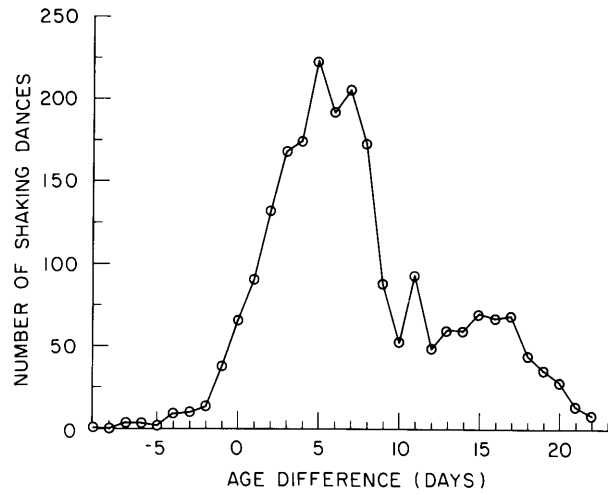


Fig. XIV-1. Number of one-on-one shaking dances as a function of the age difference (age of shaker minus age of bee shaken) of the bees involved.  $n$  (number of shaking dances) = 2237.

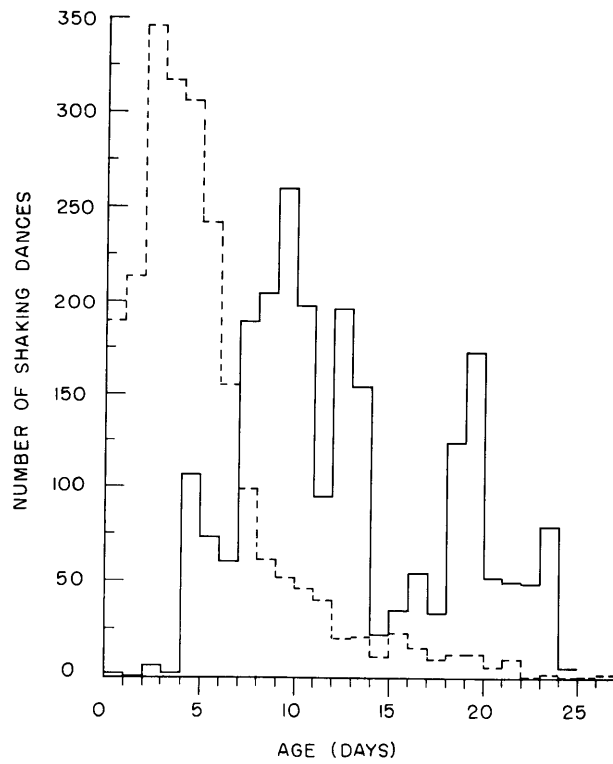


Fig. XIV-2 Number of one-on-one shaking dances as a function of age of shaker (solid line) and of bee shaken (dashed line).  $n = 2237$ .

## (XIV. COMMUNICATIONS BIOPHYSICS)

High-speed movies of the stock observation hive were taken to provide information on the duration and frequency of vibrations in shaking dances.

### Results

During the 28-day period, 4949 shaking dances were observed. Of these, 2039 (41.2%) were performed alone, 2220 (44.8%) were one-on-one, and 690 (14%) were done while straddling more than one bee. The data showed that 96.6% of the one-on-one shaking dances were performed on bees not older than the shaker (Fig. XIV-1). More than 90% of the shaking dances were performed on bees not older than the shaker for each age of shaker at which an adequate number of one-on-one shaking dances was observed. The age range of shakers was 0-24 days, and the age range of bees shaken was 0-26 days. Histograms of number of shaking dances versus age show peaks at 9 and 19 days for shakers and at 2 days for bees shaken (Fig. XIV-2).

Only 141 acts of trophallaxis were observed during shaking runs, compared with 4949 observed shaking dances. Of these, the shaker was the receiver of food 77.3% of the time.

The films of 11 shaking dances performed by 9 different bees indicate that the average duration of a dance is 1.2 s (standard deviation 0.26 s). The mean frequency of vibrations within the shaking dance is 16.3 Hz (standard deviation 5.8 Hz).

### Discussion

A relationship has been found between the age of the shaker and of the bee shaken: the shaker is nearly always older. It is concluded that shaking is not performed at random, but with some discrimination determined by age. This implies some kind of age recognition in the hive. Such recognition could depend upon physiological variation with age with respect to such traits as strength, health, glandular growth, or labor category (which is partially related to age and partially to food conditions in the hive), or some combination of these. This behavior may be related to the waggle dance or to trophallactic behavior, which are occasionally incorporated into the shaking run.

### References

1. M. D. Allen, "The 'Shaking' of Worker Honeybees by Other Workers," *Anim. Behav.* 7, 233-240 (1959).
2. V. G. Milum, "Honeybee Communication," *Amer. Bee J.* 95, 97-104 (1955).
3. K. V. Frisch, The Dance Language and Orientation of Bees (The Belknap Press of Harvard University Press, Cambridge, Mass., 1967), pp. 14-17.

