Evolution of Communication

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Introduction

Ants *(Formicidae)* are eusocial insects. Like other eusocial insects, they use cuticular hydrocarbons as components of pheromones that mediate social behaviors, such as caste and nest mate recognition, and regulation of reproduction. Our search shows that because food acquisition requires effective communication system for teamwork in food recuitment and competition for high-quality food, ants use pheromones as mediate of communication within colony for foraging efficiency. This behaviors allows for hierarchical division of labour and more effective foraging system. The evidence is described below.

Humans have been observed to have similar behaviors of kin recognition. This behavior is associated with olfaction that attributes mother-infant recognition after birth. This communicative behaviors via olfactory cues contribute to parental care behavior in most mammals. This behaviors would be heavy selection pressure against wasting resources on unrelated individuals since such behavior has the effect of depriving, thereby risking insuffcient nutrients to their own offsprings. Similarly experiment in human ability in kin recognition is provided below.

Figure 1. Black Ants
Modified from https://sciencing.com[1]

Figure 2. *Pheidole megacephala* recruit nest mates to allocate its food source
Modified from https://commons.wikimedia.org[2]

Nest Mate Recognition Behaviors in Ants

Ants have olfactory receptors, found on the antennae of ant workers, that detects cuticular hydrocarbon (pheromones) to identify nest mate. When pheromone receptors detect CHCs pheromones emitted by nest mates, complex CHCs signatures associated with eusocial recognition then enter to the brain and are translated into appropriate behavioral responses[1]. Through these pheromones, ants can recognize nest mates and different castes within the same colony, allowing for division of labor within colonies. The use of pheromones allows foragers to track the trail to food sources effectively.

Exploration pheromone accelerates recruitment process

The experiment is to investigate whether the presence of an exploration pheromone enables more rapidly recruitment towards a food source[2]. The experiment consisted of three treatments. Foraging treatment (F), ants were allowed to forage at two food sources of equal quality for 1h. Exploration treatment (E), ants had access only to the two platforms and were allowed to explore the bridge for 1h. Exploration then foraging treatment (E+F), ants were allowed to explore the bridge for 1h after which a food source was placed on each platform and ants were allowed to forage for 1h. When ants were allowed to explore prior to foraging, traffic flow increased faster during the foraging phase compared with when the ants were not allowed to explore (Figure 3).

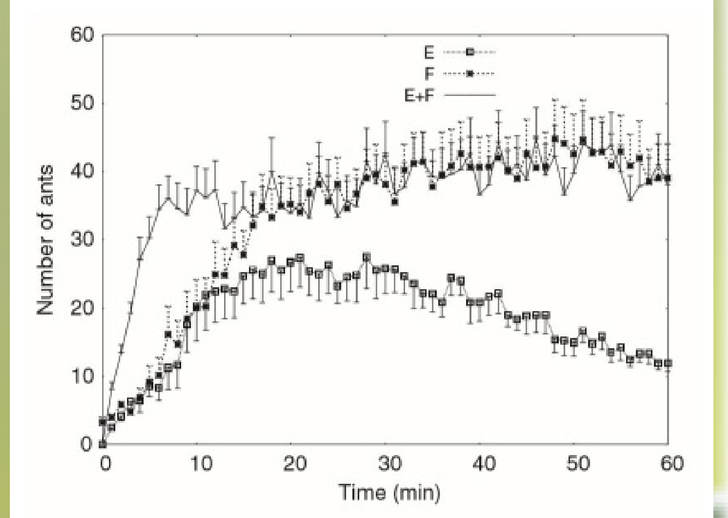

Figure 3. Average number of outbound ants crossing the two branches of the bridge every minute. N =15 replicates for each treatment. Modified from A. Dussutour[2]

Figure 5. Newborns' recognition of their mothers Modified from https://www.parentingexperttomom.com[3]

Kin Recognition Behaviors in Humans

Humans are capable of recognizing close biological kin through olfactory cues alone. Olfactory cue or signatures are a reflection of individual genotypes, providing mothers and newborn child ability to recognize each other.
The mechanism has been suggested to be a function of unique chemically-complex skin lipids, or signature odors[3]. However, it is still debatable that these variable odors are not pheromones and instead are better referred to as 'signature odors'[4]. This ability offers distinct advantages as humans can distinguish between individual conspecifics or members of distinct sub-groups and social categories, allowing for discriminative investment in kin alone.

Maternal recognition of neonates through olfactory cues

The experiment was concerned with mother's ability to recognize their infants through the odor of soiled garments within the first few days after birth. In the first experiment, all 20 mothers had been exposed directly to their infants (in the mothers' hospital rooms) prior to testing. The second experiment was conducted to determine whether mothers who had only limited exposure to their infants would still be able to identify their infants by olfactory cues. The results from both experiments showed that 16 of the 20 mothers correctly identified the garments worn by their own infants (in comparison to garments worn by unfamiliar infants) through odor alone within the first 6 days after childbirth[4] (Table 1). Moreover, the race, sex or feeding combination of the two infants within a comparison pair did not affect the outcome of the tests.

Table 1. Results of olfactory choice summarized according to sex, race, and feeding combination of pairs of stimulus infants Adapted from Richard H.[4]

		Experiment 1		Experiment 2	
		Correct Choices	Incorrect Choices	Correct Choices	Incorrect Choices
Sex combination of pairs of stimulus infants	Male/Male	5	1	5	1
	Male/Female	7	2	5	2
	Female/Female	4	1	3	1
Racial composition of stimulus pairs	Black/Black	1	0	0	0
	Black/White	10	3	7	2
	White/White	5	1	6	2
*Feeding combination of stimulus pairs	Breast/Breast	1	1	0	0
	Breast/Bottle	5	1	6	2
	Bottle/Bottle	10	2	6	2

*Information regarding feeding was unavailable for one of the comparison infants in Experiment 2. Therefore, although 17 mothers were tested in Experiment 2, the feeding combinations of only 16 stimulus pairs are included in Table 1.

CONCLUSION

Both ants and human do communicate through olfactory cues, despite of different purpose of recognition and the object they recognize. For ants, the use of pheromones for nest mate recognition also regarded as kin recognition, which enables effiicient foraging and recruitment under high competition for food sources. Likewise, this communicative behaviors in humans allowing mother-infant recogntiion after birth via olfactory cues contribute to parental care behavior. This behaviors give humans the advantage of discriminative investment, increasing the rate of survival of offspring. However, the limitations of experiment is human's olfactory cues may be constrained by sample size, which to some extent affects the credibility of the results. Moreover, in human, the evidence that human signature odors also serve as pheromones is still not clear-cut.

CITATIONS

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Citations for Images

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