KIN AND INDIVIDUAL RECOGNITION

Odor Signals, Social Experience, and Mechanisms of Recognition

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Abstract

We summarize a series of experiments on the mechanisms of individual and kin recognition by odor cues in two species of hamsters, golden hamsters (Mesocricetus auratus) and Turkish hamsters (M. brandti). Using habituation-discrimination methods, we demonstrated that the flank gland odors of full-siblings are sufficiently similar that they are not discriminated unless the subjects have interacted with the siblings that provide the stimulus odors. These experiments provide evidence for family or kinship odors, and indicate the importance of social experience for learning the cues of closely-related individuals. The individual odors of nest mates are remembered for at least 9 months after separation at weaning, providing evidence for long-term memory of individual nest mates. Other experiments indicate that hamsters recognize kin by odors, as shown by higher levels of scent marking behaviors to odors of non-kin than to those of kin. Cross-fostering studies showed that kin recognition as assessed by scent marking was based on a phenotype-matching mechanism and was not based on learning the odors of nest mates. Thus, there appear to be two separable mechanisms involved in learning about odor-based recognition: (1) learning the individually distinctive odors of nest mates, and (2) developing a family-odor template for kin recognition.
1. INTRODUCTION

Olfaction is the primary modality for social recognition and communication in nocturnal rodents (Johnston, 1983; Halpin, 1986, 1991). For example, most mammals that have been tested discriminate between the odors of individual conspecifics that are not close relatives (e.g., Johnston, et al., 1993; Johnston & Jernigan, 1994; Todrank & Heth, 1996) and many species may use these individually distinctive odor cues for recognition of kin versus non-kin as well (e.g. Block, et al., 1981; Hepper, 1983). Most secretions that are individually discriminated also contain information about other attributes of the individual, such as the sex, reproductive state, and species of the odor donor (Johnston, 1983; Heth, Beauchamp, Nevo & Yamazaki, 1996).

Despite considerable evidence for discrimination of odors of individuals, the processes that animals use to recognize and classify individuals and their odors remain unclear. Learned associations probably help animals recognize an odor as belonging to a particular individual, but little is known about what is learned or what kinds of experiences are necessary for such learning. Recently it has been shown that one effect of experience with individuals is that hamsters learn that several odors with different odor qualities (e.g., flank glands and vaginal secretions) belong to the same individual and they form multi-component representations of known individuals (Johnston & Jernigan, 1994). There is also considerable uncertainty about the relationship between the cues and processes used for individual and kin recognition. It could be that there are separate signals for these two processes or it could be that individually distinctive odors are used for kin recognition as well. Similarly, the processes involved in learning to recognize kin probably share some features with learning about individuals, but also must have some unique aspects.

This chapter summaries work done with golden hamsters (Mesocricetus auratus) and Turkish hamsters (Mesocricetus brandti) designed to deepen the understanding of the mechanisms used in social recognition by individual odor cues. The research demonstrates the high degree of similarity in the odors of close relatives, the importance of social experience in discrimination of these odors, and the importance of these family similarities in odor for kin recognition.

2. DISCRIMINATION OF ODORS OF INDIVIDUALS AND EVIDENCE FOR KINSHIP SIGNALS

Although much research has been done on the ability of animals to discriminate between the odors of unrelated individuals and also to recognize siblings (i.e., to show differential responses toward odors of familiar nest-mates versus the odors of unfamiliar individuals), little work has been done on the ability to discriminate between and recognize individual nest mates or other, closely-related individuals (Halpin, 1986). We used habituation-discrimination methods (Johnston, 1993; Johnston, et al., 1993; Todrank, Heth & Johnston, 1998) to study the discrimination of odors of scent donors that were related (full siblings) or unrelated to one another and also that were either familiar (by rearing together) or unfamiliar to the subjects.

2.1. Methods

In these experiments we exposed a male subject in its home cage to the flank gland odor of another male on four, successive, 3-min trials with 15 min inter-trial intervals; we