Kin Recognition

**Kin discrimination** = discriminating kin from non-kin or one kin class from another

**Kin recognition** = kin discrimination on the basis of cues that reliably predict kinship ("recognizing kinship as such")

Kin recognition usually tested with animals that are unfamiliar or equally familiar

Distinguish kin discrimination from kin recognition

Kin Recognition

Recognition of kinship ‘as such’

Components of kin recognition:
1. label or signature;
2. perceptual recognition;
3. decision rule;
4. behavioral discrimination

Greenberg: Genetic component of bee odor in kin recognition. Science 1979

Haplodiploidy in Hymenopterans (bees, wasps and ants)


Buckle & Greenberg (1982) – the ‘odd bee’ experiment

![Diagram of sweat bees *Lasioglossum zephyrum*](image)

**Testing situation**
- **Raising environment**
  - **Guard**
  - **All unfamiliar**

**Fig. 1.** Linear regression of frequencies with which introduced bees parsed guarding bees on the average coefficient of relationship of the tested bees. Each data point was weighted by the number of interactions for that relationship, shown next to each point. A total of 593 introduced bees was used to obtain the 1586 interactions shown. The regression line is described by the equation $Y = 0.07 + 0.924X$ and the Pearson product-moment correlation coefficient for the data = .93. The regression coefficient is significant at $P < .001$. The data points were also analyzed with a nonparametric test, Kendall’s coefficient of rank correlation, and found to be significant at $P < .001$. If one assumes worker-produced males and therefore cousin matings, the regression equation becomes $Y = 0.02 + 0.941X$, significant at $P < .001$. If the sister data are excluded from the regression analysis, the equation is $Y = 0.03 + 0.821X$, significant at $P < .001$. For the latter, Kendall’s coefficient of rank correlation is significant at $P < .001$. The data points show a better fit to a power function, but there are not enough points to show that it is significantly better.
Mechanisms of Kin recognition

Major Histocompatibility Complex (MHC)
A series of closely-linked genes (called HLA and on chromosome 6 in humans, called H-2 and on chromosome 17 in mice) that determine the major histocompatibility factors, i.e., surface antigens or receptors that are responsible for the recognition and elimination of foreign tissues.

Got its name from its relation to tissue transplants – donor and recipient should have similar HLA types (be ‘histocompatible’), otherwise tissue is recognized as foreign and is attacked and rejected by recipient’s immune cells (lymphocytes) – these immune cells normally play a key role in fighting disease.

Major Histocompatibility Complex (MHC)
At least some of the MHC genes are extremely mutable – hence many alleles exist at each of these loci – so that it is highly unlikely that 2 unrelated individual will be identical at this locus, and why organ donors must come from within the family.

Lewis Thomas (President, Sloan-Kettering Cancer Center, NY, and noted science writer, e.g., “Lives of a Cell”, “The Youngest Science”): hypothesized that MHC could code for a signal of individual identity that might be involved in social interactions (Thomas 1974).

First evidence for hypothesis derived independently by researchers at Sloan-Kettering (Yamazaki et al 1976) with congeneric mice (= strains of mice that are genetically identical except for 1 small genetic region): house male with female of same congeneric strain and one of different congeneric strain: he will preferentially mate, nest with the unlike female.

CONTROL OF MATING PREFERENCES IN MICE BY GENES IN THE MAJOR HISTOCOMPATIBILITY COMPLEX*

(From the Memorial Sloan-Kettering Cancer Center, New York 10021)

While observing AKR and AKR backcross mice being bred to produce an AKR-H-2b congeneric mouse strain, one of us (J. B.) noticed that homozygous H-2b♂♂ were more attracted to heterozygous H-2a*H-2b♀♀ than to H-2a homozygous ♀♀. Meanwhile another of us (L. T.), unaware of these observations, arrived at the theoretical conclusion that histocompatibility antigens might act as olfactory self-markers distinguishing different members of a population from one another (1).

This article is an account of our study of H-2-associated “matting preference.” By "H-2b" we imply the chromosomal region including H-2 which differentiates congeneric stocks from their partner strains. We used a straightforward experimental design: A ♀♂ mouse (e.g., “bb”) was caged with two H-2 congeneric ♀♀ (e.g., “bb” and “lk”), in estrus, and the trio was observed continuously until the ♀♂ successfully mated with one of the ♀♀.

**Figure 1:** The MHC is a large chromosomal region (around 2,000 kb in mice and 3,500 kb in humans) containing over 200 coding loci that control the immune system, growth, and reproduction. The term "MHC genes" usually refers to the highly polymorphic "classical" loci that encode class I and II antigen-binding molecules. Class I and II MHC genes arose by tandem duplication events and are inherited as a unit (haplotype) since they are closely linked in many species. A. Human MHC encodes six antigen-presenting molecules, and the polymorphism, which is still incompletely characterized, varies from one to 17 alleles per locus (41 on average; Parham and Ohta 1996). B. In house mice, there are five antigen-presenting molecules with over 100 alleles per locus in local populations (Husman et al. 1979; Klein 1986).

From Penn & Potts 1999

**Figure 4:** Examining the MHC genotypes of closely related mice reveals that self-inspection would not provide a particularly effective mechanism for avoiding kin matings (this pedigree is typical for house mice in the wild, as most individuals are heterozygous at MHC loci because these genes are highly polymorphic). For example, if female ac uses self-inspection, then she will risk mating with one-fourth of her siblings (bd) and one-half of her half-siblings (de and df). Familial imprinting, in contrast, would provide a more effective inbreeding avoidance mechanism. If female ac uses familial imprinting, then she can effectively avoid mating with her kin, including all full siblings (ab, bc, ad, bd, cd, de, df), half siblings (ce, cf, de, df), and half of all cousins. As house mice are often reared in communal nests and nursed by their aunts (Wilkinson & Baker 1988; Manning et al. 1992b, 1993), familial imprinting may enable females to avoid mating with all close cousins.

From Penn & Potts 1998

**Figure 22-3.** Schematic representation of the HLA loci on the short arm of chromosome 6. (From Miller, WV and Ridley, G: HLA without Tears. American Society of Clinical Pathologists, Chicago, 1981, p 38, with permission.)

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**Communal nesting patterns in mice implicate MHC genes in kin recognition**

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*Inbreeding avoidance: Self matching would lead to errors with p=1/4 for full sibs and p=1/2 for half sibs*