

GENETIC, HORMONAL AND ENVIRONMENTAL FACTORS THAT INFLUENCE REPRODUCTIVE TRAITS IN MICE

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STRAIN DIFFERENCES IN THE BEHAVIOR OF MALE AND FEMALE MICE TOWARD NEWBORN PUPS AND IN AGGRESSION TOWARD INTRUDERS

1. There are marked strain differences in the behavior of sexually naive males toward newborn pups. Fostering studies have shown that these strain differences are not mediated by postnatal factors.

(Svare, Kinsley et al. 1984; Perrigo and vom Saal 1989)

2. Within some stocks of mice (CF-1) there is variability in the behavior of sexually naive males toward newborn pups: some males are parental while others are infanticidal. Ejaculation during mating dramatically alters the behavior of males toward pups during a 2-month period after mating.

(vom Saal and Howard 1982; vom Saal 1985; Perrigo, Bryant et al. 1990)

3. Most domesticated female mice do not exhibit infanticide, while most sexually naive or pregnant wild female mice exhibit infanticide

(McCarthy and vom Saal 1985)

4. There are strain differences in tolerance of male and female mice toward intruders.

(Parmigiani, Brain et al. 1989)

NON-GENETIC SOURCES OF VARIATION IN PHENOTYPE IN OUTBRED MICE

1. The intrauterine position phenomenon: variation in circulating testosterone and estradiol due to proximity to other male or female fetuses.

A. Males

1. Differences in accessory reproductive organ size and function in males due to prior intrauterine position: Opposite effects of testosterone and estradiol levels during fetal life on prostate and seminal vesicle size in adulthood.

(Nonneman, Ganjam et al. 1992)

2. Implications of fetal differences in hormone levels during fetal life for prostate and seminal vesicle pathology during aging in male mice.

(Bronson and Desjardins 1986; vom Saal, Finch et al. 1994)

3. Differences in infanticide and aggression toward an adult male intruder based on prior intrauterine position in male mice: Infanticide and intermale aggression are negatively correlated.

(vom Saal 1989; vom Saal 1989)

B. Females

1. Genital morphology - Anogenital Distance as a measure of fetal testosterone exposure.

(vom Saal and Bronson 1978; Vandenberg and Huggett 1995)

2. Traits influenced by prior intrauterine position: Timing of puberty, length of estrous cycles, production of and response to pheromonal cues regulating neuroendocrine function in females, sex ratio of litters, interfemale aggression.

(vom Saal and Bronson 1978; vom Saal, Pryor et al. 1981; vom Saal 1989; vom Saal 1989; Vandenberg and Huggett 1994)

OTHER NON-GENETIC SOURCES OF VARIATION IN PHENOTYPE

I. Maternal Stress alters sexual differentiation, but only in fetuses with low circulating levels of testosterone

(vom Saal, Quadagno et al. 1990)

II. Location of fetuses in the uterus in relation to blood flow in the maternal uterine artery influences fetal growth.

(vom Saal and Dhar 1992; Even, Laughlin et al. 1994)

III. Age of a female at the time of mating influences the traits of her offspring (F_1 generation) as well as traits of the F_2 generation - evidence for non-genetic inheritance of traits.

Unpublished observation

ENVIRONMENTAL ENDOCRINE DISRUPTING CHEMICALS: EFFECTS ON FETAL DEVELOPMENT

1. Sources of thyroid hormone mimicking, antiandrogenic and estrogenic chemicals in the environment.

(Colborn, vom Saal et al. 1993)

2. Effects of fetal exposure to estrogenic chemicals in plastics (bisphenol A) and pesticides (methoxychlor) on prostate development, subsequent adult testicular sperm production, and prostate size and prostatic androgen receptors in male mice.

(Nagel, vom Saal et al. 1997; vom Saal, Cooke et al. 1997; vom Saal, Timms et al. 1997)

3. Effects of fetal exposure to estrogenic pesticides (DDT and methoxychlor) on adult territorial behavior and aggression in male mice.

(vom Saal 1995; vom Saal, Nagel et al. 1995)

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