The Effect of Sexual Isolation on Feeding Pattern in Mice

Introduction. Studies of the control of feeding patterns in man and laboratory animals have considerable background in the literature.

The experimental literature has contributed the major insight that the central control of food intake resides in the ventral hypothalamus[1-5]. From studies utilizing either stereotaxic electrode stimulation or stereotaxically placed electrode lesions, the picture of two distinct hypothalamic nuclei involved in the control of feeding has emerged[2,3]. Destruction of lateral hypothalamic areas causes anorexia, destruction of ventromedial areas of the hypothalamus causes hyperphagia.

The clinical and psychological literature in contrast has emphasized such peripheral factors as stress and psychic variants, that influence appetite control.

Efforts to identify the site and mechanism of the central contribution of 'appetite' control have been materially aided by the discovery of BRECHER and WAXLER[6] that a single injection of aurothioglucose (ATG) can cause a lasting and severe obesity in mice. Following the administration of aurothioglucose to mice and to a lesser extent rats, extensive lesions, particularly in the area of the ventromedial nucleus of the hypothalamus, have been described by several investigators[7,8].

The present experiments were undertaken to determine whether two variables like stress and central control mechanism affect feeding behavior independently and/or whether the two factors exert an addictive influence upon control of appetite and food consumption of an animal.

Materials and methods. Mice of the Swiss Albino strain, obtained from Charles River Laboratories, were used for all experiments with aurothioglucose. The animals ranged from 28–32 g and were approximately 60 days old at the commencement of the experiment. They were housed in wire cages (dimensions 6 · 12 · 6 in.) and were fed ad libitum. A single injection of a freshly prepared solution of gold thioglucose obtained from Schering Corp., Rahway, New Jersey, dissolved in 0.9% saline was given i.p. (to Swiss mice). The dosage employed was 0.5 mg/g body weight. The animals were divided into four groups.

Group 1 was made up of male mice injected with 0.9% saline and housed one male with two females. *Group 2* consisted of male mice housed singly and injected with taline. *Group 3* consisted of male mice injected with aurothioglucose (ATG) and housed two females and one male so a cage, and *Group 4* consisted of male mice injected with ATG and housed singly. Weights were recorded once a week over a 10 week period.

Results. As indicated in the Table and in the Figure, the injection of ATG into young male mice in the dosage employed was effective in inducing a hyperphagia and a subsequent obesity in more than 50% of the animals so treated. The magnitude of the weight gain recorded over a 10 week period was, however, considerably increased among isolated mice responding to the thioglucose, as compared to the animals that were housed in a group. The differences are significant at the 0.02 level.

Small but statistically significant differences in weight gain were also recorded between normal untreated young male mice kept in sexual isolation, as compared with mice housed in a group and permitted to mate.

Discussion. The finding revealed by this study, that the magnitude of the weight gain is greater among sexually isolated animals than among animals that are housed together, is of interest. The mechanism by which sexual isolation becomes instrumental in increasing the pattern

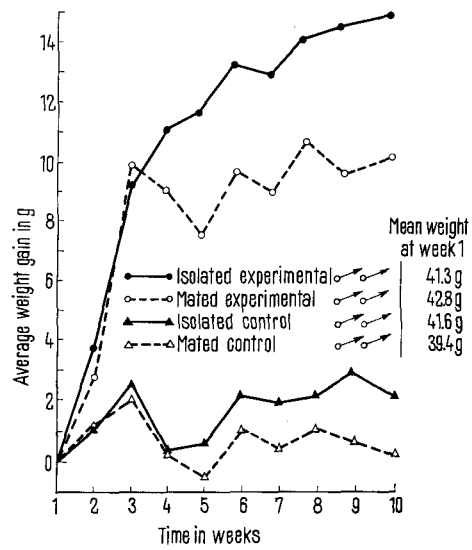
Comparison of weight gain of isolated and non-isolated male mice injected with aurothioglucose

Group	(1) Mean weight gain in g of entire group	(2) Mean weight gain in g of significant weight gainers
(A) Experimental isolated	14.7 ± 1.52 (12)	21.8 ± 3.05 (7)
(B) Experimental mated	10.1 ± 1.63 (9)	12.9 ± 1.19 (8)
(C) Control isolated	1.9 ± 0.64 (10)	–
(D) Control mated	0.1 ± 0.55 (10)	–

Experimental male mice injected with 0.5 mg aurothioglucose per g body weight. The weight gains ± S.E. of the mean and the number of animals (*n*) are given. – 'Significant weight gainers' designates those mice responding to aurothioglucose with an increase in body weight of 10 g or more.

Student *t*-test

Groups	*P*	Groups	*P*
A1 vs. C1	0.001	A1 vs. B1	0.05
B1 vs. D1	0.001	A2 vs. B2	0.02
		C1 vs. D1	0.05



Average weight gain of isolated and non-isolated mice (controls) and mice treated with aurothioglucose (experimentals). The differences in weight gain between isolated and non-isolated groups are statistically significant.

[1] B. K. ARAND and J. R. BROBECK, Yale J. Biol. Med. *24*, 123 (1951).
[2] J. R. BROBECK, Phys. Rev. *26*, 541 (1946).
[3] J. R. BROBECK, J. TEPPERMAN, and C. N. H. LONG, Yale J. Biol. Med. *15*, 831 (1943).
[4] A. W. HETHERINGTON and S. W. RANSON, J. comp. Neurol. *76*, 475 (1942).
[5] J. MAYER, R. G. FRENCH, C. Y. ZIGHERA, and R. J. BARNETT, Am. J. Physiol. *182*, 75 (1955).
[6] G. BRECHER and S. H. WAXLER, Proc. Soc. exp. Biol. Med. *70*, 498 (1949).
[7] R. A. LIEBELT and J. H. PERRY, Proc. Soc. exp. Biol. Med. *95*, 774 (1957).
[8] N. B. MARSHALL, R. J. BARNETT, and J. MAYER, Proc. Soc. exp. Biol. Med. *90*, 240 (1955).

of food intake, is difficult to interpret. In the light of the frequently repeated implication of the clinical literature[9] that many obese patients respond to stressing situations by becoming voracious feeders, the hypothesis that perhaps sexual isolation constitutes a stress which might exert inhibitory effects on the 'satiety' center is one worthy of further testing.

Evidence for some kind of relationship between these factors comes from observations reported by LIEBELT, DEAR and GUILLEMIN[10] who showed that ATG induced hypothalamic lesions in mice are accompanied by an increase in ACTH secretion as measured by presence of circulating corticosteroid levels in treated animals[11].

Resumen. Se investigaron los efectos del 'stress' y la obesidad en diversos mecanismos fisiológicos hipotalámicos. La obesidad fué evidente inyectando aurothioglucose. Estadisticamente se registraron mayores aumentos en ratones aislados que en aquellos mantenidos familiarmente.

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November 24, 1965.

[9] M. BEAUDOIN and J. MAYER, J. Am. diet. Ass. *29*, 29 (1953).
[10] R. A. LIEBELT, W. DEAR, and R. GUILLEMIN, Proc. Soc. exp. Biol. Med. *108*, 377 (1961).
[11] Acknowledgments: We wish to thank Dr. P. L. PEARLMAN of Schering Corporation for providing the aurothioglucose used for this study.

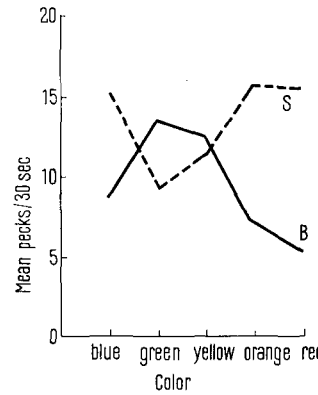
Mirror-Image Color-Preferences for Background and Stimulus-Object in the Gull Chick (*Larus atricilla*)

The newly-hatched chick of the Laughing Gull (*Larus atricilla*) and other species pecks at its parent's reddish beak, thereby eliciting regurgitation of semi-digested food upon which the chick feeds. Tests with models[1] indicate that the optimal stimulus for eliciting the response is an elongate, vertically-oriented shape of about the dimensions of the parent's bill. The stimulus shape is optimal if colored red or blue, and minimal if green, when the background is achromatic. This study reports the effect of the color of the background field when the stimulus-shape is achromatic.

Chicks hatched and reared in dark incubators were tested individually at between 24 and 36 h after hatching. Experimental birds (Group B, of 10 individuals) were tested with colored background panels in a randomized sequence, while control birds (Group S, of 15 individuals) were tested with randomly ordered colored dowel rods, in a repeat of previous experiments[1]. One half of the Group B chicks were first given a white rod with all the background colors in succession, and then a black rod with all the backgrounds; the other half of the group received the black rod first and then the white one. An analogous procedure in which differently colored rods were presented against black backgrounds and white backgrounds was used with Group S. Rods were $^5/_{16}$ in. diameter wooden doweling painted flat black except for the final $4^1/_8$ in. that were painted gloss color, white or black. The rods, pivoted at a point $10^3/_4$ in. above the glossy tip, were moved in time to a metronome set at 80 beats/min, known to be the optimal speed to elicit pecking[1]. Background panels were made of painted masonite rectangles $8^1/_4$ in. by $6^3/_4$ in., placed about $^1/_2$ in. behind the rod. Colors used were spray enamel of high gloss (Testors 'Pla': blue 11, green 24, yellow 14, orange 27, and red 3); spectral reflectance curves for these paints are given in [1].

Each chick was tested individually for a 30 sec trial on each stimulus situation, the trial commencing with the first peck given to the rod. Between trials, a translucent box was lowered over the chick for about 5–10 sec while the stimulus or background was changed. Trials were performed in direct sunlight or in intense indirect sunlight in the field laboratory of the Institute of Animal Behavior at Brigantine National Wildlife Refuge, New Jersey. The number of pecks given during a trial was recorded on a mechanical hand-tally counter; two observers ran the trials and their results agree.

The color preference for the rod shown by Group S (Figure, broken curve) agrees closely with that of a previous experiment utilizing scale models of the parental head with only beak color altered[1]. The color-preference



Mean pecking rates of dark-reared Laughing Gull chicks to chromatic stimuli having achromatic backgrounds (Group S broken curve) and achromatic stimuli having chromatic backgrounds (Group B solid curve) as a function of the color of the chromatic component. Combined means for the achromatic components are shown, although there are slight differences between black and white when the chromatic component is yellow or orange (see text).

[1] J. P. HAILMAN, *The Ontogeny of an Instinct*, unpublished thesis, Duke University (1964); and in preparation.