

"baseline" was noted. That latter averaged 307 ± 24 (11) and 290 ± 38 pg/ml for TM and control groups, respectively. Norepinephrine values for individual subjects fluctuated over the next 45 to 55 minutes, with mean coefficients of variation of ± 26 and ± 25 percent for the two groups, respectively.

A comparison of average norepinephrine levels during the actual meditation period (303 ± 38 pg/ml for the TM group, 270 ± 45 pg/ml for the control group) with the averages obtained from the 20-minute, 35-minute and terminal measurements (328 ± 39 and 302 ± 43 pg/ml respectively) indicates perhaps that rest, rather than TM, decreases plasma norepinephrine concentrations. A high correlation ($r = .81$) between the norepinephrine measurements of the two groups in those periods indicates constancy of ranking of individual subjects. Thus the physical situation, that is, being seated (resting in this instance) appears to modify but not override characteristic individual plasma norepinephrine levels.

Within the limits of the sensitivity of the assay, no significant fluctuations of the plasma epinephrine levels were recorded during meditation. Neither were significant differences ($\alpha = .05$) observed between controls and meditators.

Plasma lactic acid concentrations were lowest during or 10 minutes after meditation. Again, observed differences among these measurements were not significant, either within a group or between the two groups.

The problem of whether or not our subjects were meditating "properly" is a difficult question to answer objectively, but eight of the ten subjects were qualified teachers of TM, and all the subjects reported having had a "good" meditation. It follows that, while a psychological benefit may be derived by its practitioners from the act of TM, it cannot be expressed in terms of the biochemical parameters measured by this study.

Woolfolk (14) pointed out that a thoroughly consistent, easily replicated pattern of responses to meditation remains to be demonstrated. Our results are consistent with those of a study of sleep during TM by Pagano *et al.* (15), which concluded that TM does not induce a "unique state of consciousness" such as the "wakeful hypometabolic state" described by Wallace *et al.* (7).

R. R. MICHAELS, M. J. HUBER
D. S. MCCANN

Research and Education, Wayne County General Hospital, Eloise, Michigan 48132, and University of Michigan, Ann Arbor 48104

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16. This work was supported by the Medical Staff Research and Education Fund of Wayne County General Hospital, Eloise, Mich. We thank the members of the Students International Meditation Society of Metropolitan Detroit who volunteered to serve as subjects for this study and Dr. E. Lederman for a statistical analysis of the data.

23 February 1976

Retardation of Autoshaping: Control by Contextual Stimuli

Abstract. *Training pigeons with random presentations of a tone and food proactively interferes with the acquisition of autoshaped keypecking to a lighted key. The interference effect is context-specific (observed only when testing for autoshaping occurs in the initial training environment). An interpretation based on blocking by background cues is suggested by the data.*

Brown and Jenkins (1) have reported that hungry pigeons spontaneously begin pecking a lighted response key if illumination of the key signals that grain is forthcoming. Acquisition of such "autoshaping" has been shown to be governed by the Pavlovian relation between the lighted key (conditioned stimulus, CS) and the grain (unconditioned stimulus, US) rather than by the instrumental relation between the keypecking response and the food reinforcement (2, 3). Theoretical accounts of autoshaping subscribe, with various degrees of reservation, to a Pavlovian model of the phenomenon (4).

Despite the reliability with which autoshaping normally develops, some manipulations during initial training can interfere with the subsequent acquisition and maintenance of autoshaping. Uncorrelated presentations of the key-light and food (2, 5-7), of houselight and food (8), and unsignaled presentations of food (9, 10) all retard the acquisition (6-9) or maintenance (2, 5) of autoshaping in pigeons.

Several investigators have suggested cognitive mechanisms of "learned irrelevance" (6), "general attention" (8), and "learned laziness" (9) to account for the retardation of autoshaping that follows the manipulations. Although the particulars of these accounts differ, they share the premise that the retarded acquisition of autoshaping results from associative interference engendered by the initial training with an unpredictable US. That is, subjects exposed to a situation in

which the occurrence of the US is unpredictable presumably learn that it is unpredictable. This learning transfers to the autoshaping situation, where it proactively interferes with the acquisition of autoshaping.

While such an interpretation is consistent with the data on autoshaping and is compatible with interpretations of related Pavlovian phenomena (11), alternative mechanisms of Pavlovian associative retardation could conceivably provide a unified account of the retardation effects. For example, Kamin (12) has demonstrated that conditioning to a novel CS can be retarded if that novel CS is compounded with another CS that had been previously conditioned to the US (CS_x). The magnitude of such "blocking" is directly related to the amount of CS_x conditioning that preceded the introduction of the novel CS. Therefore, a blocking interpretation can account for differences in the acquisition of autoshaping if CS_x is more highly conditioned in the groups that are retarded than in the groups that are not.

A blocking stimulus must be (i) present during initial training, (ii) associated with the US during initial training, and (iii) compounded with the lighted key CS during autoshaping. The static, situational, contextual stimuli of the conditioning environment become associated with the US (13, 14). Such stimuli can subsequently prevent the lighted key CS from controlling operant keypecking in pigeons (14). Furthermore, the procedures that retard autoshaping are also those

that would be expected, on the basis of recent theoretical formulations of Pavlovian conditioning to favor the development of context conditioning (15). Thus, the context may function as an incidental stimulus associated with the US unless its effect is overshadowed by the presence of more valid predictors of the US (16). Where US occurrences are unpredictable, the context is not overshadowed and can, therefore, function as a blocking stimulus.

I attempted to evaluate a context-blocking interpretation of the retardation of autoshaping by examining the extent to which retardation is affected by the presence or absence of previously conditioned contextual stimuli. The context-blocking hypothesis specifies that the retardation depends on the presence of those contextual stimuli that were present during initial training.

Pigeons ($N = 24$) were tested for autoshaped keypecking to a green key CS after they had been exposed to the US presented randomly (R) (uncorrelated) with respect to a tone CS (group R). Half of these subjects were trained in the surroundings subsequently used during the autoshaping test, while half were trained in different surroundings. The purpose of the change was to remove as many previously conditioned contextual stimuli as possible from the autoshaping test and to assess the effects on autoshaping. Retardation was evaluated against two control conditions: (i) an original learning control group (group OLC) of experimentally naive animals, and (ii) a group that was exposed to the same amount of the tone CS and the US during the initial training as group R but whose treatment differed in that the US was predictable (group P).

Seventy-two experimentally naive adult pigeons maintained at 70 to 75 percent of their free-feeding weights were unsystematically divided into six groups of 12 pigeons each in a 3 by 2 factorial arrangement, with three initial training procedures (P, R, OLC) and two context arrangements (change, no change). The experiment was conducted in four standard pigeon operant conditioning chambers (17).

On day 1, 48 subjects were trained to approach and eat from the food hopper. Half of the subjects were trained in the chamber in its normal condition (autoshaping context); the other half were trained in a brown, corrugated cardboard liner that fit the inside dimensions of the conditioning chamber (cardboard context). Apertures in the liner accommodated the food hopper, response key,

Table 1. Mean number of trials to autoshape to a criterion of responding on five consecutive trials $\pm$ the standard errors of the means for groups of 12 subjects each. Abbreviations: P, predictable unconditioned stimulus; OLC, original learning control group; R, randomly presented unconditioned stimulus.

Group	Trials to criterion	
	Context change	No context change
P	77.58 $\pm$ 12.40	79.25 $\pm$ 11.82
OLC	94.17 $\pm$ 17.81	92.58 $\pm$ 13.07
R	89.75 $\pm$ 15.34	199.00 $\pm$ 28.79

and speaker grill. All subjects received their initial training in the context in which they were trained to the hopper.

On day 2, the 24 subjects in group P received the first of 20 daily sessions of training; each session consisted of 60 Pavlovian delay conditioning trials in which a 6-second, 1000-hertz, 87-db tone CS was followed immediately by 4 seconds of access to a hopper of mixed pigeon grain (US). Trials were programmed according to a variable time (VT) 45-second schedule. The 24 subjects in group R were trained with the same CS and the same US as were used with group P, but the US was independent of the CS. Two independent 16-mm film readers programmed CS and US presentations.

After 20 days of training, all subjects were tested for autoshaping in the unlined chamber. In the autoshaping trials, the response key was illuminated by a 555-nm light for the 6 seconds immediately preceding the US presentation. Autoshaping trials were programmed according to the VT 45-second schedule used in the initial training. Sixty autoshaping trials were given per session. Subjects were run until they had acquired the autoshaped response (defined by criterion of responding on five consecutive trials).

The 24 remaining subjects (group OLC) were trained to the hopper on the day immediately preceding the test for autoshaping. Half were trained in the autoshaping context and half in the cardboard context. The autoshaping of subjects in group R (random tone-food relationships during the initial training) was substantially retarded compared to that of subjects in group P and group OLC (Table 1). This observation is consistent with previous reports (6-8) of retarded autoshaping following experience with randomly related stimulus events, and it extends those observations to the case in which the training CS and the test CS are from different sensory modalities.

Changing the context did not affect autoshaping in groups P and OLC; however, autoshaping in group R was not retarded as it was when the context was not changed (Table 1). Thus, the retardation of autoshaping that followed experience with an unpredictable US was specific to the context in which the initial training occurred.

The data were subjected to a two-way analysis of variance, which revealed significant main effects of type of initial training [$F(2,66) = 7.77$, $P < .005$] and context arrangement [$F(1,66) = 6.46$, $P < .025$] and a significant interaction between initial training and context [$F(2,66) = 6.46$, $P < .005$]. That these effects are due to the retarded autoshaping observed in group R (no context change) is indicated by Duncan's multiple range test: group R (context change) required more trials to attain criterion ($k = 6$, d.f. = 66, $P < .001$) than did the other five groups, which did not differ from one another.

The same pattern of results was noted in two additional measures of autoshaping (number of trials to first response and number of responses on the criterion trial), but the results were not statistically significant. Responding during the inter-trial interval was also variable and not statistically significant.

The results suggest that retardation of autoshaping is not a general transfer phenomenon, but, rather, is attributable to differences related to context control. A blocking analysis based on those differences in context control seems to provide an adequate account of the data. The implications of such an analysis for alternative demonstrations of stimulus-specific "learned irrelevance" (2, 5, 6), and nonspecific transfer of control (11, 18) warrant further investigation.

ARTHUR TOMIE

Department of Psychology, Busch Campus, Rutgers, The State University of New Jersey, New Brunswick 08903

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5 January 1976; revised 19 March 1976

Baboon Infant Produced by Embryo Transfer

Abstract. *An embryo was recovered surgically from a naturally ovulating, naturally inseminated Papio cynocephalus female on day 5 of gestation and transferred surgically to a naturally synchronized, nonmated Papio cynocephalus female on 20 March 1975. A male baboon weighing 875 grams was delivered by cesarean section on 5 September 1975, 174 days after estimated ovulation time.*

The first nonhuman primate infant to be produced by embryo transfer was delivered 5 September 1975. The male infant, weighing 875 g, appeared entirely normal when delivered by cesarean section 174 days after estimated ovulation time (the average duration of gestation in baboon is 175 days).

The embryo had been collected surgically (1) from a naturally inseminated, naturally ovulating *Papio cynocephalus* female on day 5 after ovulation. The embryo, appearing very similar to the baboon embryo shown in Fig. 1, was in the morula stage of development before implantation. The embryo was recovered in tissue culture medium 199 with Hanks salts, 0.35 g of sodium bicarbonate per liter, and 100 mg of neomycin solution

(Grand Island Biological) per milliliter and was maintained in a covered embryological watch glass for 20 minutes at 32°C.

The recipient female was maintained in an individual cage and was not mated. She was selected on the basis that her sex skin cycle was synchronized with that of the donor; that is, the estimated day of ovulation of the recipient was the same as that of the donor. The recipient was prepared for the surgical transfer with ketamine hydrochloride and atropine prior to anesthesia and was maintained under halothane anesthesia during the transfer procedure. The uterus was exposed via a midventral laparotomy, and a puncture hole was made in the uterine fundus with an 18-gauge Intracath

(Jelco, Raritan, N.J.). The embryo was deposited into the uterine lumen, along with 1 μ l of the collection medium, by means of a Micro/pettor (Scientific Manufacturing Industries, Emeryville, Calif.) via the puncture hole.

The pregnancy was diagnosed on day 20 after ovulation, by means of a monkey chorionic gonadotropin test on both urine (2) and plasma (3); it was confirmed on days 20 and 52 after ovulation on the basis of increases of progesterin and estrogen in the plasma; and on day 100 by radiography and ultrasonic monitoring of the fetal heart beat. The infant (Fig. 2) was delivered by cesarean section on day 174 after ovulation and is being reared in the baboon nursery.

The fact that the offspring is a male rules out the unlikely possibility that this pregnancy was induced by parthenogenesis. The possibility that the recipient's ovum might have been fertilized by a spermatozoon transferred with the embryo is ruled out by the fact that the transfer was performed 5 days after the estimated day of ovulation, at which time the ovum of the recipient would have already degenerated. Therefore, since the recipient had not been mated, it is concluded that this offspring is the result of the continued development of the transferred embryo within the recipient uterus.

Attempts to find genetic markers that would exclude the foster mother as the genetic mother have been unsuccessful. The initial survey included red cell blood groups, electrophoretically separable blood proteins (serum and cellular), and lymphocyte antigens (RhL-A antisera) that had previously been shown to cross

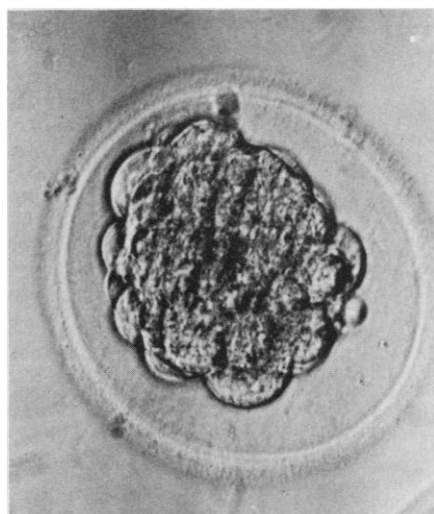


Fig. 1. A baboon embryo collected on day 5 after ovulation. It is similar in appearance to the embryo that was successfully transferred. The transferred embryo was not photographed ($\times 1000$).



Fig. 2. The baboon infant, at 63 days of age, is shown in the center. The donor mother is to the infant's left and the recipient mother is to the infant's right.