of words that are similar to the conditioned word in meaning but differ from it in verbal form and another series that are similar in form but differ in meaning, the conditioning values of the two factors may be readily compared and the amount of pure semantic—or meaning—conditioning easily determined.

A preliminary study of this rather significant problem was thus undertaken by the writer with the aid of a list of homophones and synonyms and with the use of salivation as the conditioning technique. Four simple words—*style, urn, freeze* and *surf*—were flashed on a screen at random order before three subjects who were chewing gum, sucking at lollipops or eating small tea-sandwiches. The subjects' individual eating periods lasted three minutes, in the course of which each word-to-be-conditioned was flashed fifteen times, and altogether five eating periods were made in each experimental session. After each eating period came an eight-minute testing period, during which the subjects' salivations to the exposed words were determined. The determinations were made by means of the writer's "cotton" technique that consists in ascertaining increments in weights of dental cotton rolls inserted under the subjects' tongue for periods of one minute. (With the use of proper control and rotation this technique is highly satisfactory and reliable.) The subjects were not aware of the attempts to condition them and were told that the purpose of the experiment was "to study the effect of eye-fatigue upon digestion." They became conditioned rather quickly, after two or three eating periods, but the tests with the transfer words were begun only on the second experimental session. The transfer words were: *stile, fashion; earn, vase; frieze, chill; serf, wave.*

TABLE 1

CONDITIONED SALIVATIONS OF 3 ADULT HUMAN SUBJECTS TO 4 WORDS, THAT HAVE BEEN FLASHED ON A SCREEN WHILE THE SUBJECTS WERE EATING, AND TO 4 HOMOPHONES AND 4 SYNONYMS OF THESE WORDS*

Words	Experimental session 2	3	4	5	Mean
Style	234mg.	276	293	218	255
Stile	57%	51%	43%	49%	50%
Fashion	64%	76%	66%	69%	69%
Urn	186	199	234	223	211
Earn	41%	34%	26%	34%	34%
Vase	50%	54%	48%	44%	49%
Freeze	268	308	314	246	284
Frieze	38%	32%	45%	46%	40%
Chill	43%	56%	68%	72%	60%
Surf	190	230	240	310	243
Serf	24%	20%	18%	28%	23%
Wave	46%	52%	68%	58%	56%
Mean for conditioned words	220	253	270	249	249
Mean for homophones	40%	34%	33%	39%	37%
Mean for synonyms	51%	60%	63%	61%	59%

* Each entry is a mean of 9 determinations and represents milligrams of net conditioned salivation (minus control salivation) in one-minute periods (the entries for the homophones and synonyms are given in percentages of the main conditioned salivation).

The results are presented in Table 1. The entries in this table are means of nine determinations, three for each of the three subjects. The entries for the conditioned words, or the words that have actually been associated with the eating, are given in milligrams of net conditioned salivation (minus control salivation) per one-minute periods. The entries for the transfer words are in percentages of salivation of the conditioned words. As seen from the table, by far the greater portion of the transfer conditioning went to the synonyms rather than to the homophones. The average transfer to the former was 59 per cent. and to the latter only 37 per cent., quite a pronounced difference. Furthermore, there was also some evidence that, as the conditioning progressed, the homophones lost some of their transfer and the synonyms gained. Again, while the amount of transfer for different synonyms varied considerably, ranging from 43 per cent. for *freeze-chill* in the first experimental session to 76 per cent. for *style-fashion* in the second experimental session, still in no case was the transfer for any homophone greater than that for its corresponding synonym. Within the limits of the present study the conclusion seems thus to be warranted that verbal conditioning is primarily semantic.[3] A subject gets more conditioned to the meaning of a word than to its mere visual-auditory form (although this pure form conditioning is, as seen from the table, by no means negligible). At any rate, the experiment provides an objective method for an experimental attack of a problem that heretofore could be discussed only in the light of subjective introspection or, at best, in the light of gross clinical observation.[4]

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THE GELATIN OF BROM PHENOL BLUE[1]

WHILE investigating the kinetics of the fading of brom phenol blue (tetrabromophenolsulfonphthalein) in dilute alkali, we[2] observed that the completely faded solution, on acidification, became progressively more viscous and in a few minutes set to a clear lemon-colored gel. Although gel formation is not an unusual phenomenon with high molecular weight solutes, the concentration sufficient to produce a stiff jelly is so low as to merit further study from those interested in the mechanism of gelation. Although only a few dyes of its series have been investigated, brom phenol blue appears to be unusual in forming a gel. Phenolphtha-

[3] The possibility that the conditioning to the synonym was only indirect, through first recalling the actual conditioned word, was ruled out by a "free association" test.

[4] Salivation is of course not the only suitable response for dealing with this problem. The galvanic skin response, the pupillary and wink reflexes and indeed any response that is readily conditioned and quantified should, as far as we know, be equally good.

[1] Contribution from the Chemistry Department, Columbia University.

[2] Amis and LaMer, *Jour. Am. Chem. Soc.*, 61: 905, 1939.

lein fades in alkali and can be regenerated by acidification but does not gel. The time of gelation after acidification is dependent upon the initial concentration of the dye (Table 1).

TABLE 1

Molar concentration of dye	Gelation time
1.0×10^{-2}	1 min.
4×10^{-3}	35 min.
1.7×10^{-3}	only viscous liquid

The fading process consists in a high dielectric solvent like water of the rate-determining addition of a univalent negative hydroxyl ion to the divalent negative ion of brom phenol blue forming a colorless carbinol. In solvents of dielectric constant less than 64.5, the kinetic process involves the univalent $(NaBr\Phi B)^-$ ion. On acidification the colorless carbinol reacts with hydrogen ion forming the yellow acid form of brom phenol blue, since the addition of alkali sufficient to neutralize the acid added regenerates the characteristic blue color of the dye in intensity dependent upon the length of time lapsing after acidification. The kinetics of this process is being investigated.

It is suggested that the gel formation is dependent upon hydrogen bond formation. The gel gives evidence of being thixotropic. It is stable for only a few hours, after which time brown crystals, presumably the acid form of the dye, appear and grow steadily throughout the gel.

A solution 10^{-2} M in dye and 0.2 N in NaOH was not completely faded in 27 days. When heated to 60–70° for 20 minutes to hasten the fading we observed that the blue color of the original solution was regenerated. After 4 hours at room temperature the color faded, approximating that of the original on the 27th day. Gelation occurred both before and after heating.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PRACTICAL METHOD OF OBTAINING BACTERIA-FREE CULTURES OF TRICHOMONAS HOMINIS

Trichomonas hominis has been isolated in bacteria-free culture by using the following procedure: 6 mm Pyrex tubing 8 inches in length is plugged with cotton in each end, wrapped in paper and then sterilized by dry heat. The paper is removed from the sterile tube and, using a micro-burner, a capillary tube 16 inches long is drawn from one end of the tube. The distal tip is then broken off with a sterile forceps (great care must be exercised throughout the remainder of the procedure not to contaminate the terminal 4 inches of the capillary until it has been sealed). The tube is grasped in one hand and the proximal portion of the capillary tube in the other hand; then, by working on the edge of a very low flame, a series of loops or traps 3 or 4 mm in height are made as shown in the illustration.

Using a rubber tube (portion of an 18-F catheter) attached to a 10-cc syringe, the butt end is slid on the cotton-plugged end of the tube. Suction is then applied and the tube filled to within one inch of the top with sterile liquid medium. (Ringer 1 part, horse serum 8 parts.) Great care must be taken to see that no air bubbles are introduced into the capillary portion of the tube. The distal end of the capillary is sealed in a flame so that very little if any air is trapped in that portion of the tube. For stability and protection the capillary end of the tube is now slipped into a clear Cellophane envelope and the envelope fixed to the tube by adhesive tape. The tube is then incubated in a vertical position in a special rack (using pinch clothes pins for holders), for 48 hours and then observed for sterility. If no turbidity develops, for practical purposes it can be considered sterile. The liquid suspension of protozoa and bacteria is then carefully inoculated by layering into the top of the tube. The inoculated tubes are kept vertical and incubated at 37° C. From time to time the migration of the protozoa can be observed under the microscope by mounting the microscope on a platform so that the stage can be held in a 45 to 90° angle to the horizontal plane and using a mechanical stage prepared as illustrated. Trichomonas migrate slowly, and it usually takes 48

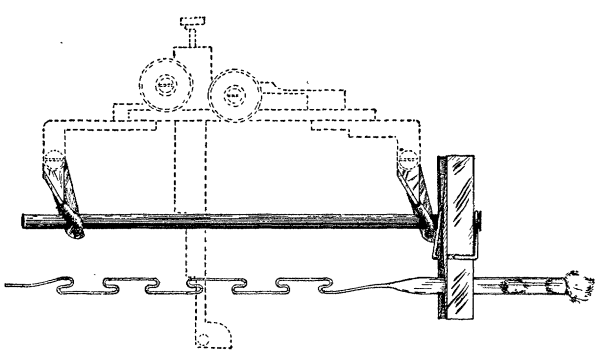

FIG. 1

hours or longer for the organisms to reach the bottom of the tube.

When the protozoa have reached the bottom of the tube the distal end of the capillary is cut off and sealed at the same time by applying a small flame to the area of the last trap. The severed sealed capillary is again observed for actively motile protozoa (usually many