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Note: individual differences in taste adaptation

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Abstract. Subjects who had previously participated in a taste adaptation study (DuBose, *et al.*, 1977) were retested one year later using the same stimuli (.1 M and .36 M sucrose and NaCl) and experimental conditions (3-minute continuous flow over anterior dorsal tongue surface). Results indicated that individual differences in the reported degree of adaptation were maintained over the long intersession interval. Salivary sodium levels and salt recognition thresholds could not account for the persisting individual differences in adaptation to NaCl. Direct examination of subjects' tongue movements is suggested.

Meiselman and his coworkers have found that complete adaptation is not reported by a majority of subjects (Buffington and Meiselman, 1978; DuBose, *et al.*, 1977; Meiselman, 1968, 1972, 1975; Meiselman and DuBose, 1976). Their studies have demonstrated that the degree of adaptation reported by subjects is significantly influenced by the method of stimulus presentation and by the response task, but not by the instructional set. They have also noted that large individual differences exist among subjects in the degree of adaptation reported.

The present experiment was undertaken to examine several issues concerning individual differences in taste adaptation: 1) *the consistency of adaptation reports in individual subjects over an extended time interval.* Meiselman and DuBose (1976) reported that 75% of their subjects were consistent over three replicate trials within a single session in their tendency to adapt or not adapt completely to NaCl stimuli, and DuBose, *et al.* (1977) found 70% subject consistency with NaCl and sucrose stimuli. In the present study, consistency was examined by retesting subjects, using the same stimuli and experimental conditions, approximately one year after the original test. 2) *the relationship between salivary sodium levels and the tendency to adapt completely to salt stimuli.* It might be expected that relatively high salivary sodium would be associated with complete adaptation to NaCl stimuli. 3) *the correlation between an individual's salt recognition threshold and his tendency to adapt or not adapt completely to salt stimuli.* High recognition thresholds might be expected in individuals with tendencies toward complete adaptation.

Of the 20 subjects who were run in the original study (DuBose, *et al.*, 1977), 10 were rerun in the present study. The stimuli and procedure for the adaptation were the same as those used previously. Briefly, the stimulus (.36M or .1M sucrose or NaCl) was flowed, for 3 minutes, at 36°C, over the dorsal surface of the subject's tongue, which was extended into a tongue fixation apparatus. Subjects recorded magnitude estimates of the stimulus intensity during the flow at 15 second intervals upon a signal from the experimenter. The perceived intensity at initial contact with the tongue was assigned a value of 10, and the remaining judgements were made relative to the modulus. Each subject was tested with all 4 stimuli in one session;

they were presented in random order with the restriction that neither the two salt solutions nor the two sucrose solutions follow each other.

Mean magnitude estimates were plotted over time for each stimulus and concentration from the responses of the 10 subjects in the original test and in the retest (Figures 1 and 2). An analysis of variance showed that the taste intensity judgements changed significantly over time ($F = 6.99$, $df = 13,177$, $p < .001$), as expected in an adaptation situation. However, the other main effects of session (1975, 1976), concentration (.1M, .36M), and stimulus (NaCl, sucrose) were found to be not significant. There was a significant interaction between concentration and stimulus ($F = 12.44$, $df = 1,9$, $p < .01$).

The subjects were individually categorized as "adapted" or "not adapted" to each stimulus by using the criterion that a magnitude estimate of zero given at any time during the stimulus presentation constituted complete adaptation (Table I). Three of the 10 subjects (S_1, S_2, S_3) completely adapted to all 4 stimuli in the original study and in the retest. One subject (S_6) did not adapt completely to any of the stimuli in either test. For the 10 subjects and the 4 stimuli, 75% of the responses were consistent from the first session to the next, according to our criterion.

Pearson product moment correlation coefficients were computed for each subject, collapsing over concentration, solution, and time in order to obtain a sufficient

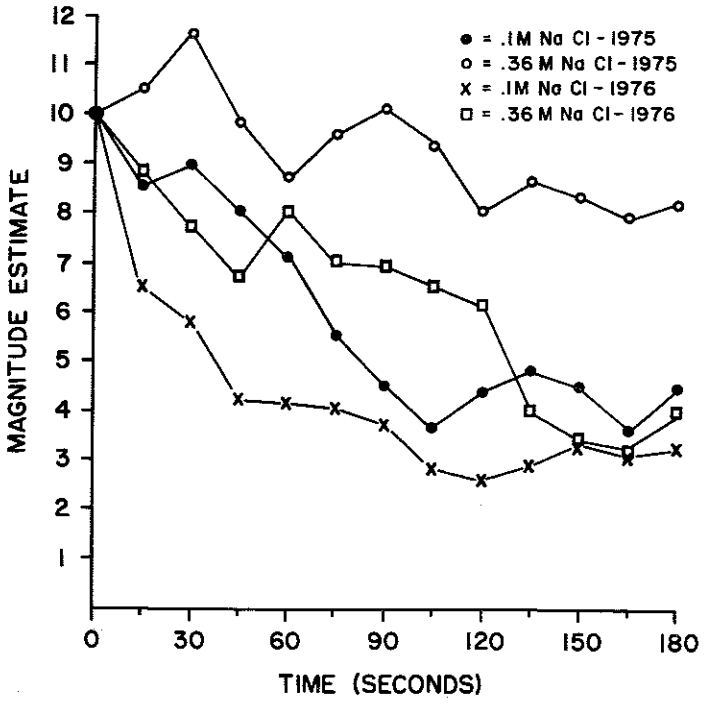

Fig. 1 Mean magnitude estimates of NaCl intensity during 3-minute dorsal flow presentation. Same subjects participated in original test and in replication with identical experimental conditions one year later. ($n = 10$).

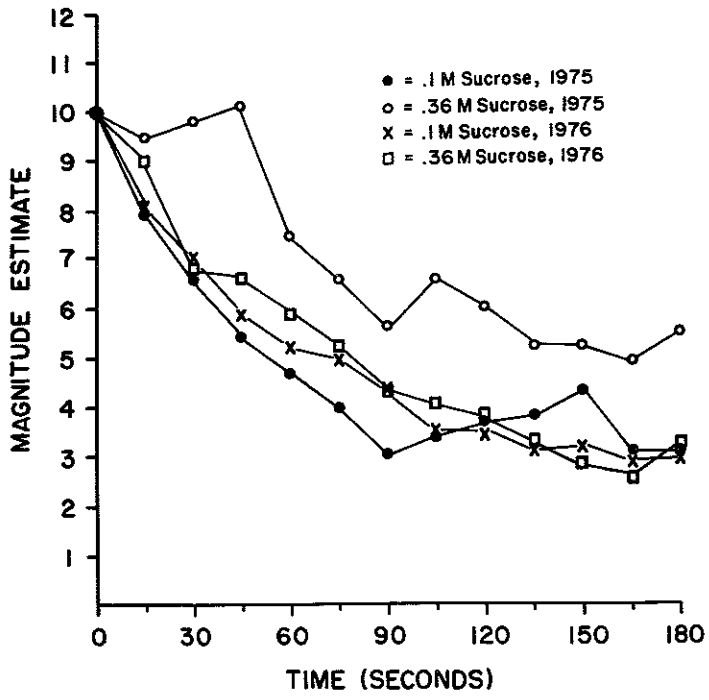

Fig.2 Mean magnitude estimates of sucrose intensity during 3-minute dorsal flow presentation. Same subjects participated in original test and in replication with identical conditions one year later (n = 10).

Table 1. Performance of individual subjects in adaptation test and in replication one year later.

	.1M NaCl		.36 M NaCl		.1 M Sucrose		.36 M Sucrose		correlation coefficients
	test	retest	test	retest	test	retest	test	retest	
S_1	*	*	*	*	*	*	*	*	.677†
S_2	*	*	*	*	*	*	*	*	.212
S_3	*	*	*	*	*	*	*	*	.488†
S_4	*	*	*	–	*	*	*	–	.274†
S_5	*	*	*	*	*	–	*	–	.574†
S_6	–	–	–	–	–	–	–	–	−.514
S_7	–	–	–	–	–	*	–	*	.548†
S_8	–	*	–	–	–	–	–	–	.764†
S_9	–	–	–	–	*	–	–	–	.462†
S_{10}	*	–	–	–	–	–	*	–	.179

* = adapted completely

– = did not adapt completely

† = $p < .05$

number of observations for a stable statistic. The assumption made in computing the coefficient by this method is that subjects are equally reliable from year to year for the concentrations, solutions, and time involved, but that individual subjects

manifest different year to year consistency. Seven of the correlations were positive and significant ($df = 54$, $p < .05$, Table I). The correlations indicate that for the majority of subjects, a statistically significant proportion of the variance can be accounted for by persisting judgemental or sensory factors peculiar to the individual. Although the magnitudes of the correlations may appear low, they are statistically significant and should be considered nonnegligible. Moreover, considerable time elapsed between the experiments, and it has been shown that there is a tendency for psychophysical response inconsistency to increase monotonically as a function of interstimulus interval (Teghtsoonian and Teghtsoonian, 1971). Furthermore, a correlation coefficient is generally lowered by a lack of variability in scores within a data set since it is specifically designed to measure the proportion of variation in one data set that is mirrored by the variation in the other data set. Typically, in an adaptation test, subjects report a minimum magnitude estimate at some point and then continue to report this value for the remainder of the test, thus limiting the variability. In spite of the tendency for magnitude estimates to become less consistent with long intersession intervals and in spite of the asymptotic nature of the adaptation function, 7 of the 10 Ss gave responses on the retest which were significantly correlated with those on the first test.

At the beginning of the adaptation session, and again on 2 separate occasions several weeks later, salivary sodium was tested. Saliva samples were collected from each subject in the morning and in a resting state. They were analyzed for sodium content by an atomic absorption spectrophotometer (Perkin Elmer 370). The sodium levels for each subject varied widely among the samples (Table II), as expected from previous research (Hawk, Oser, and Summerson, 1954; Langley, 1971). Examining the saliva tests taken just prior to the adaptation test (sample 1), there appeared to be no consistency between the sodium levels and the state of adaptation.

At the time that the third salivary sample was collected, salt recognition thresholds were also determined for 8 of the 10 subjects. Using the ascending method of limits, the series was run twice, and subjects identified the taste quality of stimuli as sweet, salty, bitter, sour, vague or indistinct, or no taste. The average of

Table II. Salivary sodium levels and salt recognition thresholds of individual subjects

		sodium content of saliva g/L			recognition threshold
	adaptation to NaCl stimuli	Sample 1	Sample 2	Sample 3	equivalent Na g/L
S_1	A	.165	.168	.105	.575
S_2	A	.235	.212		
S_3	A	.237	.125	.094	.345
S_4	A	.128	.140	.070	.230
S_5	A	.521	.146	.101	.690
S_6	NA	.134	.207	.112	.690
S_7	NA	.247	.237	.086	.805
S_8	NA	.153	.203	.178	.863
S_9	NA	.387	.179		
S_{10}	NA	.331	.118	.082	.345

the points at which the salty response was first given was taken as the recognition threshold. Generally, the salt recognition thresholds were monotonically related to the salivary sodiums measured at the same time (sample 3). However, there appeared to be no consistent relationship between an individual's salt recognition threshold and his tendency to adapt completely to salt stimuli or between his threshold determined at one time and his salivary sodium content analyzed at another time.

The test-retest adaptation results support the contention that subjects have consistent response tendencies. It is important to distinguish the consistent or systematic individual differences found in this and previous studies from random differences which would result from a "noisy" method. The general difficulty of obtaining complete adaptation (McBurney, 1976; Gent & McBurney, 1978) does not explain the consistent individual differences seen here. On the basis of the present data, we cannot identify either salivary sodium or salt recognition thresholds as being contributing factors. Other factors peculiar to an individual, e.g., tongue movements, may contribute to the observed differences.

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