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SECRETORY RATE OF THE PAROTID GLAND AS PART OF THE INDIVIDUAL'S ADAPTIVE PATTERN

by

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INTRODUCTION

Experiments by *Chauncey et al.* (1964) and *Winer et al.* (1965) indicate that the effects of suggested gustatory stimuli on the secretory rate of the parotid gland are similar to the effects produced by actual stimuli. With a procedure of hypnotic induction it has also been shown that the response of the parotid gland to water is increased by the suggestion that the water is citric acid, while the response to citric acid is reduced by the suggestion that the acid is tasteless (*Barber et al.*, 1964). *Hayashi & Araeci* (1963) and *Jenkins & Dawes* (1966) concluded from experiments that the flow of saliva could be stimulated by conditioned reflexes, *i.e.* the sight of food. This conclusion, however, has been contradicted by the findings of *Kerr* (1961) and *Enfors* (1962).

The influence of man's psychic status on the rate of salivary secretion has been investigated by *Davies & Palmai* (1964) and *Palmai & Blackwell* (1965). These writers have found that depressed individuals have a lower parotid secretory rate than have healthy controls.

Obviously, there are some grounds for the assumption that psychogenic factors exert an influence on the salivary output. In the present study observa-

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tions have been made to ascertain whether psychic factors are able to exert an influence on the individual parotid flow-rate during stimulation in healthy individuals.

MATERIAL

The material comprised 39 healthy individuals, male and female, selected by formal randomization from the clientele of the School of Dentistry in Umeå. The age varied between 27 and 62 years, with an average age of 41 years. The participants were divided into two groups, one comprising 20 individuals (Group I) and the other 19 individuals (Group II).

METHOD

Secretory

The method used for the determination of the secretory rate is a modification of the method described by *Diamant & Wiberg* (1965) and reported in detail by *Ericson* (1968).

The secretory determinations were carried out during gustatory stimulation with citric acid. The parotid outputs from the two glands were collected simultaneously and *via* a water-filled system connected with a drip-chamber where the drops (0.06 cc) from each gland fell past an electric counter.

Two recordings were made for each group: group I after stimulation of the taste buds with 1 per cent citric acid for 5 minutes and group II with 6 per cent citric acid for 2 minutes. Between recordings the mouth was carefully rinsed with water and flushed out. The interval between recordings varied according to how quickly the gland returned to resting secretion after the first stimulation period. A fresh stimulus was administered at the earliest 5 minutes after this.

Psychophysical

The participants were not informed of the aim of the investigation, the strength of the stimuli applied or of the fact that the experiment was to be repeated.

The psychophysical experiments on taste were carried out according to the method of magnitude estimation introduced by *Stevens* (1957) and *Ekman* (1961). A prerequisite for the application of this method is that the subjects shall be able to handle figures and make quantitative estimations on the ratio level. Their ability in these respects was tested in a trial.

In order to arrive at a simple method for individual comparison of the intensity of the sensation of acidity during the stimulation with citric acid, a scale for ratio estimations has been elaborated. The scale comprises 16 degrees. The scale values were anchored with the help of verbal terms (Table I). For each verbal designation there were two numerals to choose between. The higher numeral indicated a higher degree of subjective acidity than the lower numeral. The scale was presented to the testees in »A 4» format, with equal distances between the numerals. The numeral chosen was taken as the basis for statistical analyses.

Table I

Scale for quantitative analysis of the intensity of taste during stimulation with citric acid.

0	No acid taste		
1 > 2	Very, very faintly acid	9 > 10	Rather strongly acid
3 > 4	Very faintly acid	11 > 12	Very strongly acid
5 > 6	Faintly acid	13 > 14	Very, very strongly acid
7 > 8	Neither faintly or strongly acid	15 > 16	Intolerable

RESULTS

Tables II and III show the rate of secretion after stimulation with 1 and 6 per cent respectively of citric acid and the subjective estimations of the acidity of the citric acid. From Table II it emerges that 17 individuals showed changed sensations of taste and 3 unchanged between IN I and IN II (investigation one and two) for the same stimulus — 1 per cent citric acid. For the 17 individuals for whom changed taste was noted as between IN I and IN II a change in the same direction, positive or negative, was noted for the secretory rate. A sign-test between change in taste and rate of secretion gives significance at the 1‰ level. For the three individuals for whom unchanged taste was registered the difference in secreted volume as between IN I and IN II was least. The correlation between change in taste sensation and change in secretory rate amounts to 0.70*** for group I.

The corresponding analysis was carried out with 6 per cent citric acid solution in group II (Table III). Of 19 individuals, 14 had changed gustatory

Table II

Comparisons between the secretory rate of the parotid gland and the individual estimation of the acidity of the stimulus in 20 persons. Stimulus: 1 per cent citric acid.

Examination occasion				Difference 1—2			Agreement in change in taste and secretory change
1st		2nd		Secretion		Taste	
No. of drops	Taste	No. of drops	Taste	Absol. value	% change		
98	5	112	7	—14	—14	—2	+
63	9	67	10	— 4	— 6	—1	+
94	2	88	1	+ 6	+ 6	+1	+
108	3	157	4	—49	—45	—1	+
84	6	79	6	+ 5	+ 6	0	
43	3	45	3	— 2	— 5	0	
121	9	147	10	—26	—21	—1	+
62	4	84	9	—22	—35	—5	+
56	5	67	6	—11	—20	—1	+
43	4	61	7	—18	—42	—3	+
39	1	72	3	—33	—85	—2	+
107	5	90	3	+17	+16	+2	+
78	2	79	2	— 1	— 1	0	
210	6	200	5	+10	+ 5	+1	+
98	5	89	4	+ 9	+ 9	+1	+
73	5	81	6	— 8	—11	—1	+
67	7	58	6	+ 9	+13	+1	+
187	10	244	13	—57	—30	—3	+
48	7	65	9	—17	—35	—2	+
105	6	109	7	— 4	— 4	—1	+

taste as between IN I and IN II, while 5 experienced the same taste. For all except two of those who noted changed taste the change in the sensation of taste and the secretory volume showed the same direction, *i.e.* more intense taste results in higher secretory rate and weaker taste in lower secretory rate ($P<0.01$). In agreement with the experiment with 1 per cent citric acid stimulation, the difference between IN I and IN II in secretory rate during stimulation with 6 per cent citric acid is least for the individuals who experienced the same sensation of taste in connection with the two stimulations. The correlation between change in taste and secretory rate is 0.89***.

Table III

Comparisons between the secretory rate of the parotid gland and the individual estimation of the acidity of the stimulus in 19 persons. Stimulus: 6 per cent citric acid.

Examination occasion				Difference (1—2)			
1st		2nd		Secretion		Taste	Agreement in change in taste and secretory change
No. of drops	Taste	No. of drops	Taste	Absol. value	% change		
113	10	96	9	+17	+15	+1	+
118	12	97	11	+21	+18	+1	+
119	11	151	14	—32	—27	—3	+
79	11	81	11	— 2	— 3	0	
129	13	98	12	+31	+24	+1	+
53	7	51	9	+ 2	+ 4	—2	—
119	7	109	7	+10	+ 8	0	
98	12	109	14	—11	—11	—2	+
75	13	94	15	—19	—25	—2	+
94	15	98	14	— 4	— 4	+1	—
104	13	105	13	— 1	— 1	0	
119	10	68	8	+51	+43	+2	+
68	8	81	9	—13	—19	—1	+
165	10	188	12	—23	—14	—2	+
92	11	95	11	— 3	— 3	0	
131	9	57	5	+74	+56	+4	+
118	11	125	12	— 7	— 6	—1	+
232	15	234	15	— 2	— 1	0	
92	13	100	14	— 8	— 9	—1	+

DISCUSSION

Earlier investigations have shown that there is a logarithmic correlation between the hydrogen-ion concentration of a stimulus and its stimulating effect (*Chauncey et al.*, 1963; *Borg et al.*, 1967a and 1967 b; *Jenkins*, 1966). The connection has been considered so strong that the secretory rate can be used as a test of the taste perception (*Chauncey & Shannon*, 1960; *Feller et al.*, 1965). However, the experiments carried out in this investigation show that it is not only the strength of the stimulus that affects the rate of secretion, but also the individual's adaptive pattern of the acidity of the stimulus. This is shown by the fact that the individual congruence between changes in taste and secretion for the same stimulus is good.

The cause for changes in the gustatory sensation are difficult to define. One possible explanation may lie in the assumption of a psychic influence, *e.g.* suggestion; another explanation may be that the initial stimulation with citric acid has caused damage to the gustatory receptors or, a third possibility, that the swallowing of the citric acid has evoked secondary vegetative effects. Against the latter explanations and in favour of the psychic hypothesis, however, may be adduced the circumstance that the gustatory experience has not in all cases taken the same direction, but has varied.

SUMMARY

An account is given of an investigation concerning the effect of a psychic factor on the secretory rate of the parotid gland in connection with gustatory stimulation. The results show that, besides the strength of the stimulus expressed in terms of the hydrogen-ion concentration, the individual's sensation of the acidity of the stimulus also acts upon the secretory rate of the gland.

RÉSUMÉ

L'INTENSITÉ DE LA SÉCRÉTION DE LA GLANDE PAROTIDE, CONSIDÉRÉE COMME UNE PARTIE DU MODE D'ADAPTATION DE L'INDIVIDU.

L'auteur rend compte d'une étude concernant l'action d'un facteur psychique sur l'intensité de la sécrétion de la glande parotide lors de l'excitation gustative. Les résultats montrent que l'intensité de la sécrétion de la glande dépend non seulement de l'intensité du stimulus, exprimée par la concentration en ions hydrogène, mais aussi de la sensation de l'acidité du stimulus éprouvée par l'individu.

ZUSAMMENFASSUNG

DIE SEKRETIONSMENGE DER PAROTIS ALS TEIL DES INDIVIDUELLEN ANPASSUNGSVERMÖGENS

Es wird über die Untersuchungsergebnisse betreffend eines psychischen Faktors auf die Sekretionsgeschwindigkeit der Parotis bei gustatorischer Stimulation berichtet. Die Ergebnisse zeigen, dass ausser der Stärke des Stimulus in Wasserstoffjonenkonzentration ausgedrückt, auch das subjektive Säureempfinden des Individuums einen Einfluss auf die Sekretionsgeschwindigkeit der Drüse hat.

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