Psychological Effects of Substantial and Appetizing Menus for Submarine Personnel

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Comparing the feeding capabilities of a modern submarine with those of a projected spaceship is, to a large degree, like comparing a good-sized restaurant with a standup coffee shop. At this stage of development there is little to invite comparison other than that in both the submarine and the space vehicle there are men confined who display the usual human trait of enjoying good food and being unhappy if their food is unpalatable.

In the Navy ships are described as "taut ships," "happy ships," and "good-feeding ships." Needless to say, a happy ship is also a good-feeding ship because, as we all know, food tastefully prepared and in comparative abundance is quite a morale factor insofar as all military men are concerned whether ashore or afloat.

The modern submarine has rather complete hotel facilities, which include a kitchen, a fresh meat freezer, an ice cream machine, a bakery with bakery goods available daily, sufficient storeroom space to carry large amounts of food stores, relatively adequate dining space, and even background music. The ship's cooks have the French chef attitude; that is, they try to titillate and stimulate the appetites of the crew. When we compare this with the present day spaceship and its inconveniences, plus the disadvantages that the weightless state imposes on the eating process for the astronauts, we have a rather weighted case for the submarine, which will require many years of further development of spaceship technological engineering to equalize.

Some reports of the feeding habits of submariners have been rather disquieting. Two reports, one as early as 1949, and one in 1951, said that submariners were great between-meal snackers and that their diet was largely carbohydrate with a great preference for sweets. These reports were not supported by data, and, in fact, were merely narrative observations of professional men riding in submarines on a temporary basis.

Although, given an open icebox 24 hours a day, there is a great tendency for fat boys to get fatter, certain feeding patterns appear to modify the feeding format of the average submarine sailor. As an example, while a submarine is a relatively large vessel, the cubic space for each man is definitely limited. The space for a man is 5 cu yd on an FBM type and only 2 cu yd on a fleet type. This relatively constricted space can very well affect the individual's physical exercise habits significantly so as to reduce his energy output, and in turn, reduce food requirements. A relatively old study conducted in 1949 which used oxygen consumption as an index of calorie requirements reported that 2400 calories per man was needed during a temperate-zone cruise in a

fleet-type submarine. Shulte in 1951 (ref. 1) reported from the Submarine Medical Research Laboratory that an Arctic cruise of 42 days and a complement of 80 men utilized 4480 cal/man/day. Actually, a 5200 calorie equivalent per man of food had been provided. The average weight gain per man was $\frac{1}{2}$ pound.

Another factor that could have some influence in modifying eating habits on a submarine is the shifts in carbon dioxide concentration. Carbon dioxide tends to build up in a submarine between air scrubbings. There are some 200 particulate substances in the air which, with the day-to-day slight pressure variations of the various gaseous substances, may have some unknown effects upon appetite and food preferences.

Still another factor that may affect food intake by the individual is that in submarines the olefactory stimulus is relatively high. The difference threshold (JND, "just noticeable difference") is correspondingly high so that it takes a "wallop of odor" for the submariner to say, "I smell something." The odors of stale cigars or freshly peeled onions are not ordinarily noticed because the denominator of Weber's fraction is so high:

$$\frac{\text{Delta I}}{\text{I}} = \frac{\text{(Noticeable increment)}}{\text{(Absolute level of smell)}}$$

An interesting research area that has not been fully exploited is, what effect does the high absolute olefactory stimulus level have upon gustation in view of the intrinsic relationship of the two sensory modalities?

PSYCHOLOGICAL RELEVANCE OF FOOD

When asked why they volunteered for submarine service, 221 enlisted men gave the following reasons (ref. 2): Identification with a better class of men, 80 percent; extra pay, 61 percent; good food, 34 percent; educational opportunities, 25 percent; and thrills and excitement, 24 percent. Data pertaining to the prevailing beliefs and opinions related to food have been collected. For example, the response distributions of 185 officers and 256 enlisted men to the statement, "I believe the chow the submariners eat is the best you'll find anywhere in the Navy," indicated that 85 percent of the officer sample and 90 percent of the enlisted sample responded "true" (ref. 3). Along similar lines, when enlisted men who were qualified submariners and those who failed to qualify were asked what aspects of submarine life they most liked, the percentage distributions listed in table I resulted (see ref. 4). (The number of responders is indicated by f.) It can be seen in table I that the fifth most frequently mentioned "most liked" aspect of submarine life was the food served aboard the submarine. It should be noted that a larger portion of the sample of 175 men who were disqualified or failed to qualify for any number of reasons indicated that the food was a "much liked" aspect of submarine life than of the sample of 186 men who qualified.

TABLE I. -ASPECTS OF SUBMARINE LIFE REPORTED AS MOST LIKED BY QUALIFIED AND DISQUALIFIED SUBJECTS

Most-liked aspect	Qualified group		Disqualified group	
	f	%	f	%
Close interpersonal relations	49	26	32	18
High-caliber personnel	27	15	34	19
Good duty	27	14	15	9
Money	26	14	17	10
Food	13	7	22	13
Friendship	8	4	14	8
Travel and adventure	5	3	8	5
Working conditions	4	2	9	5
Operations	4	2	8	5
Morale	7	4	1	1
Other things	16	9	15	9
Total	186		175	
Chi square	18.52			
p (9 df)[a]	< 0.05			

[a] Since one of the expected values for morale was less than 5, the last two categories were combined, leaving 9 df.

FOOD PREFERENCES OF SUBMARINERS

Amounts and Kinds of Foods Consumed

The laws of physics relating the submarine's buoyancy to its mass and volume require that approximations of the expected consumption rate of foods of various weights be available prior to a long-submerged cruise. Examples of data of this kind are available. For example, in an older, diesel-powered Guppy II type submarine during a 42-day patrol, 87 men consumed 3547 lb of meat (21 percent of total), 6219 lb of vegetables (38 percent), 2137 lb of cereal (13 percent), 1132 lb of dairy products (7 percent), 943 lb of fruit (6 percent), 1038 lb of sweets (6 percent), 445 lb of legumes (3 percent), 356 lb of fatty foods (2 percent), and 726 lb of miscellaneous food products (4 percent). Although total food-consumption data from modern nuclear submarines are not available, on the 85-day submerged world circumnavigation of the Triton, the 225 officers, enlisted men, and civilian scientists consumed most of the 38 tons of provisions, including 1300 lb of coffee, 10 tons of meat, 935 lb of ice cream mix, 460 lb of cake mix, and lesser amounts of canned vegetables, bread, and so on.

Changes in Appetite and Food Preferences During Prolonged Submerged Cruises

Reference 5 contains individual subjective estimates of the daily food consumption of a random sample of the Nautilus crew during a 2-week submerged cruise. From the plots of averages for this sample of 30 men it appears that food consumption remained relatively constant although there was a great deal of individual variability within the group from day to day as the cruise progressed.

In the decade since 1959, more than 40 Fleet Ballistic Submarines (FBM's) have been commissioned. Manned by two crews of approximately 125 officers and enlisted men, this class of submarines has become the central focus for a great deal of research, including appetite and dietary research. Therefore, the rest of the paper will present data collected from FBM's during protracted submerged cruises in excess of 50 days.

When a dietary study was conducted on board the USS Nathan Hale (SSBN623) during one patrol, 50 enlisted volunteers provided data concerning daily food intake, daily meal and snack distributions, weekly appetite changes, weekly food preferences, pure taste thresholds and body weight values. These data (abstracted and slightly modified from ref. 6) are given in table II.

TABLE II.-SUBJECTIVE EVALUATION OF APPETITE DURING EACH WEEK OF STUDY

Week	Appetite										Number of subjects, N
	Much better		Better		Same		Worse		Much worse		
	f	%	f	%	f	%	f	%	f	%	
1	1	2	7	15	37	79	2	4	0	0	47
2	2	4	5	11	30	64	10	21	0	0	47
3	0	0	2	3	51	84	8	13	0	0	61
4	1	2	5	10	31	63	12	24	0	0	49
5	0	0	5	10	33	67	9	18	2	4	49
6	1	2	5	10	32	67	8	17	2	4	48
7	1	2	3	6	37	75	7	14	1	2	49

It is seen that, in general, from two-thirds to three-fourths or more of the crew reported that their appetite remained the same. However, as the cruise progressed disproportionately more of the sample reported their appetite to be worse than reported it to be better. Responses to a

a direct question pertaining to which meals a man characteristically ate indicated that as the submerged cruise progressed more people missed the noon and evening meals while fewer missed breakfast.

Some rather gross information pertaining to changes in specific food appetite during extended periods of submergence can be inferred from a comparison of the relative frequency with which the same sample of crew members indicated the "best" and the "least liked" foods at different times during a 7-week cruise. These data pertaining to food preferences (abstracted and slightly modified from ref. 7) are contained in table III.

TABLE III.-BEST AND LEAST LIKED FOOD SELECTIONS

Foods	Prepatrol (control)		Second week		Fifth week		Seventh week	
	f	%	f	%	f	%	f	%
Best liked selections								
Meats	115	74.2	117	81.8	119	90.9	108	78.3
Green-yellow veg.	19	12.3	9	6.3	10	6.8	11	8.0
Carbohydrate veg.	14	9.0	13	9.1	12	8.2	11	8.0
Legumes	2	1.3	2	1.4	2	1.4	2	1.4
Desserts	5	3.2	2	1.4	4	2.7	6	4.3
Total Selections	155	- - -	143	- - -	147	- - -	138	- - -
Least liked selections								
Meats	23	16.8	18	13.6	0	0.0	16	12.9
Green-yellow veg.	82	59.9	65	49.3	66	57.4	57	45.9
Carbohydrate veg.	23	16.8	37	28.0	38	33.0	40	32.3
Legumes	9	6.5	12	9.1	11	9.6	11	8.9
Total Selections	137	- - -	132	- - -	115	- - -	124	- - -

The authors point out that the "most liked" and "least liked" foods are consistently meat and vegetables, in that order. Mentioned also is the possibility that carbohydrate-type vegetables are less liked as the cruise progresses.

In short, the report concluded that in general the hunger motivation of submariners is not remarkably changed on patrol. The changes that do occur are difficult to relate to any one aspect of the environment, but, in any event, are of a nature not considered alarming.

Additional data bearing on the question of specific food preferences are contained in an FBM study already mentioned (ref. 6). The authors simply asked the 50 men to answer the question, "If you could order dinner from (this) menu, what would your choices be?" Frequency distributions of these choices for each week of the course are abstracted in table IV.

TABLE IV.-ANSWERS TO QUESTIONS "IF YOU COULD ORDER DINNER FROM (THIS) MENU, WHAT WOULD YOUR CHOICES BE?"

Food item	Number of men choosing item in week-						
	1	2	3	4	5	6	7
Appetizer							
Kadota figs	3	6	4	4	5	5	4
Seafood cocktail	35	36	38	41	37	36	37
Herring with sour cream	3	2	3	0	4	4	4
Salad							
Tomato aspic	16	13	16	17	16	17	16
Avocado	16	17	15	17	17	17	18
Red kidney bean	11	14	15	13	14	12	12
Soup							
Cream of tomato	13	16	15	17	21	14	14
Beef broth	23	20	21	23	18	20	26
Potato	8	9	10	9	10	13	7
Entree							
Spaghetti	22	24	26	25	24	22	27
Cold cuts	15	14	15	16	16	15	14
Pork sausages	7	7	6	8	9	10	7
Vegetables (2 choices)							
Rice	8	8	6	9	10	8	9
Spinach	15	15	18	11	11	13	13
Carrot	7	5	3	7	7	7	5
Cabbage	5	8	7	10	11	8	8
Corn	29	24	26	24	23	29	28
Broccoli	10	15	13	16	16	16	16
Potato	7	8	12	12		7	10
Beverage							
Black coffee	20	22	22	25	27	26	26
Coffee with sugar	16	15	13	15	14	13	15
Coffee with cream	5	7	10	6	7	5	6
Coffee with cream and sugar	2	11				1	
Dessert							
Banana pudding	28	31	28	29	26	31	29
Assorted cheeses	11	9	13	13	14	10	12
Assorted nuts	6	5	5	5	9	6	7

CONCLUDING REMARKS

It can reasonably be assumed from a review of the data presented in the present paper that:

(1) The Navy apparently has done well by its submarine sailors in the matter of supplying abundant and appetizing food on prolonged cruises.

(2) Although food does not seem to be a major concern to the submarine sailor, it is one in which critical attitudes could arise should it degenerate from its present high quality. One rarely compliments Mom's Sunday dinners because they are supposed to be good.

(3) Except for moderate deviations, the ingestion of food aboard a submarine seems to be not immoderate even though the icebox is always open. Choice of foods seem to be of a normal and satisfactory character. Between-meal snacking is not overdone.

(4) No specific submarine literature has been unearthed detailing erotic eating habits and preferences such as may be found in some confirmed neurotics. This, no doubt, is due to the procedure for the selection of potential submarine sailors, which is quite thorough.

It would appear that, until NASA is capable of engineering a rotating space ship which can provide a moderate G loading in its outer periphery, feeding in space will be unsatisfactory. Hopefully, residence on the Moon will provide a more congenial atmosphere for eating.

The results of the study in reference 6 are best presented by quoting the abstract of that report:

"Some previous reports indicated that submarine crewmen eat abnormally high amounts of carbohydrates and that their diet habits include many between meal snacks. If true, these facts would lead one to expect great oral health problems in submariners; particularly in those on patrol for long periods. A detailed dietary and oral health study was done aboard the USS Nathan Hale (SSBN623) to evaluate the problem. The findings essentially disprove the previously reported beliefs. It was found that the FBM crew ate an essentially well-rounded diet with only a moderate amount of between-meal snacking."

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