Nutrition & Behavior

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Proceedings of the Franklin Research Center's 1980 Working Conference on Nutrition & Behavior: New Research Directions, sponsored by The National Science Foundation under grant PFR-7920650; Barbara E. Hindman, Principal Investigator.

1981

THE FRANKLIN INSTITUTE PRESS℠

Chapter 1

The Study of Human Food Selection and the Problems of "Stage 1 Science"

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Abstract

Basic issues in the understanding of human food selection are discussed through allegory and example. It is argued that cultural factors are the predominant determinants of food preferences and attitudes in humans, and that biological variables account for a relatively small percentage of the variance. Descriptive work and research within social science paradigms is necessary for major advances in our understanding. Primary adherence to high standards of elegance and rigor in supporting research in this area will assure that most of the important phenomena go uninvestigated.

If a worried parent asked me, as an "expert" in food selection, "How can I get my little Herman to like green vegetables?", I wouldn't be able to help. Perceptive parents and grandparents could probably give advice as good as the advice that I could offer. We just don't know very much about how people come to like and dislike foods. And we ought to, for food selection is a basic part of nutrition. Yet, research on basic aspects of human food selection is not generously supported.

I ask the reader's indulgence to read the following allegory, which is designed to highlight what I believe is a major problem in the support of research on human food selection. It is admittedly an exaggerated and provocative piece, but it has a basic message that I believe is valid.

An Allegory

The Martian Institute or Foundation for Furthering Science (MIFFS) Earth Sport Section (MIFFSESS) was convening for its tenth year. Up to this time the Research Program had been entirely devoted to a thorough study of one simple earth sport, that earthlings call tennis. Progress was rapid and many laboratories were engaged in the enterprise. Thus, it was quite a shock when a few scientists at

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the ninth MIFFSESS meeting suggested that MIFFSESS support research on the uninvestigated sport of football, at some expense to the tennis program. The tennis researchers pointed out, with some justice, that they had made great progress and now understood the scoring, physics, and other aspects of the sport. Yet there were still many problems to be tackled in the microanalysis of the game. There was, for example, the well-known "yellow ball problem." A yellow ball was used on only *some* occasions, and no one could predict this distinct occurrence. Pigment analyses of the yellow ball were just beginning. "Why," asked the tennis workers, "commit money to the murky enterprise of football when such good problems remain with tennis?" Nonetheless, in year nine, a small amount of money was budgeted for the following year for the investigation of football. And now, the Committee had to evaluate the proposals.

The Committee was faced immediately with some fundamental disagreements among the applicants. Some claimed that the essential elements of the sport were some six creatures with black and white striped costumes. They were the only participants who appeared to be on the field at all times. Others focused on the more than 50 creatures, some sitting, some running, each with his own number. Some claimed that the ellipsoidal object noted in some observations should be the focus of study, but others pointed out that this object was rarely visible, and probably didn't matter. In the end, the Committee agreed that the numbered creatures might be the best bet for study: Since they had numbers, they could form the basis of precise quantification. For unnumbered participants, one might have to make up arbitrary numbers.

One proposal suggested correlating two measurable variables: the number of the player, an incontrovertible datum, and the percent fat, of known biological importance. Other proposals suggested electrical rather than biochemical analyses. One group proposed use of the standard electroencephalogram (EEG) technique. Each player would be wired up, and the total set of generated potentials for all of the players would be measured with a computer. The investigators worried about tripping on wires, but came up with the clever idea of using a blimp over the stadium, from which all wires could be suspended. Yet more clever proposals did away with the individual EEG, and proposed a total integrated reading, taken from the ellipsoidal extremes of the stadium itself. Another set of investigators proposed to set up animal models of football.

One group encouraged the search for invariances, and impressed the committee with the preliminary finding that the summed numbers of the players remained roughly constant through the game, although players came in and out. In the search for order, they pointed out that one should begin with what was apparently the most structured aspect of the game: the grouping of players in a circle, in fixed order, every minute or so. This was followed by another ordered formation, and then by an apparently disordered set of movements, probably the players "letting off steam." Plots of position in the circle against player's number seemed reliable, and a good point of departure. It was proposed that these observations be followed by detailed analysis of foot and hand positions of the players, in the circle and after, in order to build up the elements of the game.

There was one proposal that was easy to reject. It stood out as the one that failed to follow the basic scientific dicta of objectivity and quantification. The authors (from the fringe of science, at best) proposed to simply observe the general flow of the game, and to supplement and guide these observations with interviews of the players, in an attempt to find out what the game was about. They proposed to ask players such open-ended questions as: What is the purpose of this

game? Is the ball important? and Why do the players move toward one end of the field for a while, and then to the other? The Committee unanimously agreed that this approach was not quantifiable, and that it relied on verbal reports, which were of questionable scientific status. Why, for example, should one believe a player's claim that he moved to the right to misdirect other players, or that the rarely visible ball was the center of activity?

There was another proposal asking for funds to explore books in libraries on earth, in the hope that some information on the game would be unearthed. Since work on earth libraries was in its early stages, the proposers would need a year or more of support to try to find the material. The proposal was rejected. Although most Committee members agreed that it might uncover valuable information, it could not be funded because it did not involve the discovery of *new* facts through research. After all, the proposed findings were *already* in books, somewhere.

And so it was that a decade of studies of the arrangment of players in the football huddle was begun, along with an analysis of the biochemical and electrical events underlying this circular event.

Lessons of the Allegory

Description as the First Stage of Scientific Study

This allegory admittedly overstates the problems faced by some investigators of human food selection, but the problems are real. The area is at the fringe of natural science; it is a budding "stage 1 science." At early points in the scientific study of any phenomenon, there is a loose and descriptive phase in which the central problems must be identified and brought into focus. This "prescientific" research is necessary in order to steer later, more precise and more experimental research into productive channels, and to assure that subsequent work is not only rigorous and elegant, but directed at explaining important and relevant phenomena. It is particularly difficult for "stage 1 science" practitioners to compete for funds against workers in more advanced and quantified disciplines. The latter are, as perhaps they should be, in major positions of influence in the scientific community. They are usually proponents of science at more advanced stages, and are skeptical about the fuzzier work in less developed areas.

The goal of science is to solve significant problems in understanding the world; approaches that will optimally facilitate answers to such problems should be supported. For some important problems, preliminary observation, basic description, or literature search might be the most fruitful line of investigation and should be eligible, even favored, for financial support.

A great deal of progress can be made with social science research paradigms, working largely at the descriptive level. For example, descriptive work by Lolli and co-workers[18] on the ways in which alcohol is used in traditional Italian culture has led us to a better understanding of alcohol use and abuse. These researchers found that reliance on wine, association of alcohol with the meal (a family event), and the "natural" introduction of wine to young children as part of family life, establish alcohol in the context of family and food. This seems to account for a relatively low level of alcohol abuse in Italians, in comparison to the amount of alcohol intake. The same authors have documented the breakdown of some of these traditional uses in Italian-Americans.[18]

It should be very clear by now that many aspects of alcoholism are uniquely human. And yet, I believe that studies such as the above would be less successful in competing for research funds than yet another (for the most part unsuccessful) study attempting to establish an animal model of alcoholism. In fact, the development of strong likings for innately distasteful substances (including alcohol-containing beverages) is extremely difficult to establish in nonhumans.[28] In my own research on the acquisition of a liking for chili pepper (another innately distasteful substance), it has been easier to get funding for (unsuccessful) study attempting to establish an animal model than to get funding for a study of the natural history of the development of liking in a traditional culture in which all children become chili-likers.[29]

There is probably no fully adequate description of food habits, preferences, and attitudes, or of the rules and practices of food preparation and ingestion for any culture. We might describe these rules and practices by the general term *cuisine*, which represents a high level of organization that determines many individual acts and choices, in the same sense that the description of the basic rules and strategies of football is a fundamental first step in coming to understand the game. Beginning steps have been made in the description of cuisine, for example in terms of sequencing of foods in a meal,[7] and analysis of culinary products into components such as basic foods, preparation techniques, and basic flavorings.[20,21]

Our surprising ignorance at the level of cuisine is paralleled by the lack of information on the psychological categorization of edibles and inedibles by individuals. We are just beginning to make fundamental distinctions, as for example between things eaten because their flavor is liked and those eaten because of the anticipated consequences of eating (e.g., medicines, cottage cheese for dieters), or between foods rejected because of a bad taste (e.g., chili pepper) and those rejected because of the idea of what they are or where they come from (e.g., insects) (see references [26] and [27] for more details on psychological taxonomies of potentially edible substances). It would be hard to do meaningful studies on food preference when the phenomena to be explained are in fact a heterogeneous set of behaviors and attitudes. The rejection of insects is not the same sort of thing as the rejection of carcinogenic foods or bad-tasting foods.[26,27] Thus, we should group substances that are accepted or rejected for common reasons before we perform analytic studies.

The Dangers of Premature Quantification

Counting and quantification are ultimately central to science, but not necessarily in early stages. The uncontrollable urge to count can turn one away from central phenomena and on to phenomena of less interest simply because they can be counted.

Unfortunately, the discovery of a quantifiable variable often leads behavioral scientists to concentrate only on that variable, and ultimately to forget about other variables. Worse yet, the very existence of currently nonquantifiable variables may be denied. We must try to describe the lay-of-the-land in frontier areas, so we will know *what* to explain and *what* to count when the time comes for rigorous analysis. Science, especially in the early stages, is more than assigning numbers to phenomena and describing quantitative laws relating these numbers. It is not science, but pseudoscience, to believe that by simply assigning numbers to something one has *ipso facto* made progress.

The hyperquantification urge has had its effect on food selection. I believe it is partly responsible for the great emphasis on research on obesity, an eminently measurable state of affairs. Food selection pathology, represented, for example, by diet faddists or by three-year olds who refuse all but a few types of foods, is rarely studied. The pathological consequences of these "deviant" types of food selection are much more subtle than changes in body weight. They may, in large part, affect the quality of life, rather than some easily quantifiable variable. For example, the three-year-old's food rejections may disrupt family relationships. Now quality of life is hard to measure, but we cannot afford to ignore it on these grounds (see Campbell and co-workers[6] for a serious attempt to measure and deal with quality of life). Similarly, while it has been difficult to establish a relationship between easily quantified behavioral variables (IQ, learning ability) and malnutrition, it cannot be doubted that malnutrition has enormous effects on behavior. However, these effects are probably less caused by damage to the nervous system than by the concern for adequate supplies of food which may come to dominate day-to-day life among malnourished peasants in some underdeveloped countries.

The centrality of *affect* in interaction with food (i.e., liking or disliking the flavor of food)[24,36] has been neglected because of the difficulty in measuring this variable. *Preference* has come to stand for affect, as preferences can be objectively measured. Yet a moment's thought would indicate that preference is only a moderately good correlate of affect; a dieter who prefers cottage cheese (in a choice) with ice cream, would probably like ice cream better.[24] The fact is that while food (and many other) preferences can be based in substantial part on anticipated consequences, affect is an almost invariable attribute of foods.

Verbal reports, such as hedonic ratings, provide the basis for much work on affect in humans. Such reports are probably the best index we have of liking, and yet are, with some legitimacy, the subject of distrust by many investigators. However, these reports represent an aspect of food selection that is so fundamental that we dare not ignore them. Furthermore, as we develop better measures of affect (as with measurements of human facial responses),[8] we may ultimately have to validate them against these same verbal reports.

Multidetermination, Context, and Different Levels of Organization

Just as in the case of football, understanding food selection involves consideration of different levels of organization, including the "social" level and the operation of multiple causative factors.[17] It is vital to remember that *Mother Nature did not design organisms so that they would be easy for scientists to study.* Neither was she maliciously deceptive or intentionally subtle. Once the complexity of a phenomenon is recognized, some simplification within this framework can be carried out. The trick is to describe the phenomenon well and break it into pieces that are easier to analyze, yet still encompass some essential properties of the phenomenon.[35] For the case of food selection, we must recognize that:

1. *Primary determinants of food selection operate well before any actual choice of food is made.* The availability of specific foods (mediated by cultural, geographic, and seasonal factors) is the major determinant of what the choices will be. Economic and other factors further influence the choices actually presented to an individual eater. Within the family (or other nurturant group) structure typical of many cultures, certain individuals, usually mature females, play a special role in what is offered to other members of the family by

selecting and preparing the foods to be served. Some members of any group, often the very young and the very old, have most of their food selection decisions made by others.

2. *Food selection occurs in a rich context.* First, there is a temporal context, including the life history, daily or weekly cycles (e.g., in the US different foods are appropriate for different meals), as well as the local context of the individual meal (e.g., in the US sweets are typically served at the end of a meal). Second, there is a social context for food choice. Food often has moral or social significance and food choices may change as a function of the social situation, as when a teenager who really prefers coca cola will drink beer with peers. Finally, there is the set of available alternatives. What is eaten, or whether to eat, is largely a function of the food alternatives and the relative attractiveness of available activities or objects unrelated to food.
3. *Much as one would prefer to study uni-causal systems, multiple factors are involved in the motivation of food choice.* Restricting ourselves to the food preferences and likes of any particular individual, we know that different pathways can lead to the same end point. Thus, a number of different processes can lead to development of a liking for the burn of chili pepper[29] or other foods. Also, preferences for any particular food can be motivated in different ways. For example, cigarette smoking[15,30] or coffee drinking[11] can be motivated by social pressure, by liking for the sensations involved, by escape from addictive withdrawal symptoms, by anticipation of positive pharmacological effects, or by various combinations of these factors. In analyses of these and related phenomena (including obesity), a meaningful subcategorization should precede analyses. Surely, someone who smokes because of pharmacological effects and doesn't particularly enjoy the sensations of smoking is likely to have a different history (and be susceptible to different types of smoking cessation therapy) than someone who smokes primarily because of the good feeling produced by the smoke in the mouth, pharynx and lungs. There are two basic options for exploring these multidetermined phenomena: multivariate analysis or simplification by detailed study of individuals with relatively pure motivation or causation.

Virtues and Pitfalls of Emphasizing Biological Determinants

It goes without saying that food selection is determined by biological factors, individual experience, and cultural factors. Food selection occupies a substantial portion of the waking hours of most animals, and is a major force in evolution. Of course, for something so important, one would expect a great deal of biological or "genetic" determination.[22] However, for those "generalist" species that eat a wide range of foods, the amount of genetic determination is minimized. It is just not possible to genetically specify, through receptor identification systems, what is a source of nutrition and what is not, as would be necessary to distinguish walnuts from stones, or edible mushrooms from poisonous ones.[22] So it is a part of the biology of the human omnivore to leave most of food selection to experience. Of course, there are some known genetically determined universals, such as the avoidance of bitter or irritant tastes, or the attraction to sweets, as well as certain pre-wired abilities to learn about food.[10,22,34] There may also be other universals, such as attractions to the flavor or odor of amino acids or proteins, as in the form of meat.

Some individual differences in food preferences and attitudes also have a

biological basis. For example, genetically based differences in taste sensitivity to one class of bitter compounds seem to relate to preference for bitter foods.[13] However, there are not many well-documented examples of this sort. Much more common are genetically based metabolic differences that influence the acquisition of preferences by establishing conditions under which learning to accept or avoid certain foods can occur. For example, there are cultures in which milk is not drunk because the great majority of people are lactose intolerant.[19,31,32] Presumably, milk ingestion is discouraged by the unpleasant lower gastrointestinal symptoms following consumption of substantial amounts of milk.

Biological factors are more influential in food choice over the short term than the long term. Hunger and thirst are major determinants of ingestion, and influence the type of substances ingested. However, the emphasis in this paper is on longer term and more stable preferences and attitudes, and, in this domain, biological factors play a minor role.

Where the Variance Is: The Dominant Role of Culture

Faced with the problem of predicting the food preferences and attitudes of an individual adult human being, what is the most informative question to ask? There is no doubt that one should determine his ethnic group or culture. Most other helpful questions would relate in some way to these factors. But, as mentioned above, we are only at the earliest stages in describing what culture specifies and how it operates. We do know that the basic categorization of the world into edible and inedible items is transmitted through culture, as is the apparently universal rejection of certain animal foods (e.g., excretory products).

It seems that exposure is a necessary, if not sufficient, condition for the development of food likes.[37] Culture provides a mechanism to allow or prevent exposure to certain potential edibles. If there is any resistance to acceptance (as for some strong-tasting items), culture provides "forced" exposure through social pressure, which may give other processes time to take control over ingestion. For the initially unpalatable substances that have become popular in many cultures (e.g., alcohol in its various forms, tobacco, coffee, and pungent spices),[23] the culture acquisition process may be divided into two stages:[25] *1.* ingestion imposed by external forces, such as peer pressure, and *2.* internalized motivation for ingestion, such that explicit cultural pressures are no longer necessary. Internalization can result from the development of a desire for the consequences of eating (e.g., pharmacological effects), and/or from the development of a liking for the flavor of the item, as happens with chili pepper.

Again, we can see the importance of the neglected area of affect. Affect can be mobilized to get people to like what their culture values and to dislike what it rejects, and is a particularly potent way to produce internalization of cultural values. I have suggested elsewhere that the surprising excess of positive affect and relatively easy acquisition of liking for all sorts of items by humans (as opposed to other animals) may be an adaptation to the acquisition of culture.[25]

Biology and culture interact in many ways, and a number of anthropologists have emphasized the ways in which biological factors determine cultural institutions.[14] However, it is also important to realize that culture produces significant and lasting biological effects. The development of cultured milk products is probably an example of a way in which cultures have adapted to the inability of most humans to digest lactose in milk: the culturing process breaks down much of the lactose. However, the evolution of lactose tolerance in humans, a genetically

based trait, was established by selection pressures produced by *cultural* forces associated with the introduction of dairying and the availability of milk.[33]

There are many basic phenomena of human food selection that cannot be analyzed outside of a cultural context. A clear example is the intricate involvement of cooking, eating, and food transactions with the social and moral order in India.[16] A social science perspective seems most appropriate for these phenomena.[12]

The Role of Individual Experience

We presume that many of the universal or near universal uniformities in human food selection have biological roots, and that invariances among individuals within a culture represent the action of cultural forces. There remains, however, a great deal of within-culture variation in attitudes to food and food preferences. One need only compare oneself with family members or friends to realize that this is so. What question, then, can we ask an individual, outside of questions relating to culture, to learn about his food preferences and attitudes? I know of no very useful question to ask. Age is of value, but primarily to distinguish the very young and very old. Sex, differences in taste sensitivity, specific enzyme levels, body weight . . . none seem to account for much of the variance. Even the food preferences of family members, a most likely predictor, have, overall, very little predictive value.[3] So, we are faced with a lot of variation, often represented in terms of *strong* attitudes and preferences, and no obvious explanations. Of course, it is possible that many weak effects (e.g., family preferences, individual differences in taste sensitivity) might seem to explain the variance. It is also possible that seemingly minor "accidental" interactions with foods may have major effects on preference. Or, it is possible that some major principle remains to be discovered. A possible candidate would be exposures to a particular food (or food attitude) at critical periods in early development, but there is no compelling evidence that early experience with food has a particularly potent effect.[1,22]

We know almost nothing about how an individual acquires particular attitudes toward foods. In the domain of preferences, we really only understand two things:

1. When threatened with physical or social harm, people are less likely to eat something — an entirely straightforward relation. This accounts for the avoidance of poisonous mushrooms, for example, but not for the continued smoking of cigarettes.
2. Unique experiences of ingesting a food followed by nausea and/or vomiting lead to an affectively based aversion (disliked taste) for this food.[2,9,10,24,27]

We are particularly ignorant of the fundamental principles that account for acquisition of affective involvements with foods, e.g., why knowledge about insects leads people in many cultures to be disgusted by the thought of eating them, whereas "negative" information about sand as food leads only to avoidance; or why most "foods" come to be liked , and why orally administered medicines rarely become liked.[24,26]

A recent line of research offers promise to enlighten us on some of these fundamental issues. Birch and co-workers,[4,5] in a nursery school setting, have been carrying out controlled studies on the effects of a variety of manipulations on changing food preferences of children. These are studies of preference, rather than of affective change, though they may well involve affective shifts. The investigators have reported substantial and long-lasting preference shifts in response

to exposure to peers whose preferences differ from those of the subject.[4] Socially mediated interactions with food seem to induce preferences, whereas "mere exposure" ingestion outside of a social context does not seem effective.[5]

Summary

It is time for the field of nutrition to acknowledge the importance of food selection in nutrition and daily life, and to recognize how little we know in this area.

We must recognize that much of the basic research required in this area will fall into "social science" rather than "natural science" paradigms. We do not have to choose sides; worthwhile studies should include well controlled research on the biological determinants of food selection, in which the smaller part of the variance in food selection is explained with some elegance and certainty. But, we should realize that the tools and knowledge we have at present limit our power in analytical explorations of cultural and individual determinants of food selection. More open-ended and exploratory research is needed to advance our understanding of the cultural and individual factors that account for most of the variance in food selection. We should want neither elegant studies of insignificant phenomena, nor totally subjective and unreplicable studies of central phenomena. There is plenty of room in the middle for both natural and social scientists.

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[38]The preparation of this paper, and some of the research described in it, was supported by National Science Foundation Grant BNS 76 80108 and National Institutes of Health Grant RD1 HD AM 12674-01.