Can We Make Healthful Foods Taste Good, or Even

April 01, 2010

Linda Bartoshuk

Losing weight and eating healthier are national obsessions. Good psychological science helps us understand why the foods that are the healthiest are often not those we like the best. We understand that our food preferences are acquired by mechanisms that evolved to solve short-term nutritional problems. We are hard-wired to love sweet and salty because those preferences save our lives before experience can equip us to protect ourselves. We learn to love flavors that are paired with those experiences our brains are hard-wired to view as good. The result: we are quick to learn to love flavors associated with the energy dense foods that give us fuel to live. Sweet, salty, and fat — the triumvirate of substances that spell survival when we are young — ironically spell chronic disease as science gives us the tools to survive long after we produce our children.

Evolution may not care much about us when we are no longer needed for our young to survive, but we care very much about those wonderful years. We try to manage our weight, but for many of us it is a losing battle. We are fighting the very biology that ensured our early survival. Most of our efforts are directed at changing ourselves. However, we can also use science to try to change our food. Can we make healthy foods more palatable and, thus, turbocharge our efforts to eat healthy?

Science Meets Tomatoes

The Tomato Project at the University of Florida (UF) is a current, ongoing attempt to increase the palatability of a healthy food. Assembling a group of scientists that synergize to create a whole that is greater than the sum of its parts is not always easy. But sometimes luck intervenes. Tomatoes are a case in point. At UF, the Tomato Project began when the head of the Institute for Food and Agricultural Sciences (IFAS) suggested that those of us doing chemosensory research get acquainted with IFAS
horticulturists. The cast of characters comes from different worlds. David Clark (PhD in Horticulture from Pennsylvania State University) is an expert on floral volatiles. Harry Klee (PhD in biochemistry from the University of Massachusetts) is an expert on tomato volatiles. Elizabeth Baldwin (PhD in horticulture from the University of Florida), who works with the U.S. Department of Agriculture, is an expert on variation in fruit and vegetable volatiles (incidentally, she chairs the 2010 Postharvest Gordon Conference). Charlie Sims (PhD in food science from the University of Arkansas) is an expert on food chemistry as well as sensory evaluation of foods/beverages. David Smith (PhD in psychology from the University of Michigan) is an expert on olfactory animal psychophysics. My expertise is in human chemosensory psychophysics.

At our first meeting, Klee and Clark explained an important part of their intellectual world. They proposed the possibility that some plant volatiles are chemically related to important nutrients; hard-wired love of the olfactory sensations evoked by those volatiles would thus ensure intake of those important nutrients (Goff & Klee, 2006). However, the mantra from my world is “taste affect is hard-wired; olfactory affect is learned.” I started to defend this point of view when an old memory popped up. Aristotle in De Sensu (“On Sense and the Sensible”; Beare, 1906) divided odors into two classes. The first class seems akin to learned olfactory affect but the second class “consists of those agreeable in their essential nature”; those are odors of flowers. Artistotle noted that “the perception of the second class of odors … is confined to human beings.”

Flowers may be beautiful but they are not generally associated with biological benefits…so just why do we like their smells? I asked Klee and Clark, “What do the plant volatiles associated with nutritional benefits smell like?” They answered, “floral.” The feeling that came over me can best be described as “joy” (more about scientific joy later). Could our love of floral odors be a manifestation of that rara avis, hard-wired olfactory affect evolved to ensure the intake of healthy plants?

Edible plants contain a large number of volatiles; my colleagues in IFAS know this world and identified the tomato as ripe for improvement. Tomatoes have become less and less tasty. They have been bred mercilessly for ease of shipment and shelf life. However, we are moving into a new era where consumers are rebelling. We already know that sweetness is one of the most important drivers of tomato palatability, but can we identify a combination of volatiles that will drive this palatability even higher?

Enter Psychology, Specifically Psychophysics

This column wouldn’t be complete without psychology, of course. Our UF study group sponsors visits by experts who share our interests. One of them, Howard Moskowitz was trained by S.S. Stevens, the Harvard psychologist who triggered a rebellion against Fechner’s psychophysics in the 1950s and 60s. Moskowitz’s first job was at the Natick Army Labs; my first job was also at Natick, so we overlapped there in the 1960s. Friendship as well as great respect for his work kept us in touch. Moskowitz left to found a company (Moskowitz Jacobs, Inc.) that is now one of the world leaders in market research. Moskowitz has won many awards, one of the most recent being the 2010 Sigma Xi’s Walter Chubb Award for innovation in research across disciplines. I still remember hearing Moskowitz describe one of his early projects at a meeting of Institute of Food Technologists (IFT) in the early 1990s. His project: using science to improve chocolate cake mixes. He created an array of cakes by systematically varying each of the ingredients. A group of subjects tasted and rated liking, as well as each of the key perceptions associated with the cake (e.g., chocolate, sweet, moistness, etc.). Regression analyses
produced a “surface,” at the top of which was the formula for the “ideal chocolate cake.” This approach ultimately moved from products to ideas, and especially the algebra of ideas rather than ingredients.

One of the company’s big successes was the identification of an unfilled niche in the spaghetti sauce world; Prego’s Extra Chunky was the result (Gladwell, 2004). The logic of this approach is formally the same logic needed to identify the ideal tomato. We need only substitute chemical analyses of the constituents of a variety of tomatoes for the experimental variation of the chocolate cake constituents. We explained our tomato project to Moskowitz, who was delighted to apply his approach to a natural product (the first time this has been done).

Incidentally, the success of the tomato depends on hedonic ratings. These are the subject of my lab’s most recent work. We are using a new generation of scaling tools designed to improve on earlier sensory/hedonic comparisons. Across-group comparisons in the past were flawed because the labels on conventional scales denoted different perceived intensities to different groups (Bartoshuk, Fast, & Snyder, 2005). For example, “extremely intense taste,” a common label on taste scales, actually denotes a much more intense taste to supertasters than to those with fewer tastebuds. Finding a standard that is independent of the domain of interest permits the valid comparisons across subjects/groups that eluded those using conventional scales. Using our new scales, we can identify groups of subjects that differ in what they can sense as well as what they like in a tomato. The Tomato Project is just the beginning. We hope to create a set of tools that can be applied to any vegetable or fruit. How much can this accomplish toward the goal of creating a world of healthy foods that are very palatable? Time will tell.

The possibility of hard-wired flavor preferences was our starting point, but what if the chemosensory mantra is right and flavor preferences are actually all learned? Our approach will still work; even if we end up with a range of ideal tomatoes depending on different learning, we will still be way ahead of the many plastic tomatoes now available in our supermarkets.

Recently, Moskowitz and I had a reunion with a third colleague, Herb Meiselman, who was also at Natick in the 1960s. Natick has an illustrious history in the food world motivated by the need to feed our servicemen. Concern with purchasing high quality food for rations generalized into laboratories expert not only on food processing (basic research on freeze-drying, irradiation for preservation, etc.) but also on sensory evaluation.

Meiselman began as a basic researcher (just as Moskowitz and I did). He remained at Natick and did a variety of projects aimed at solving military feeding problems. For example, he worked on the team that redesigned a ship-board food service for the Navy and turned cafeterias with long inefficient lines and only modestly desirable food into localized food stations much like the fast food so common to the age group in the military (but with much healthier versions of burgers and fries). His work with a variety of military feeding situations led him to study contextual influences on eating. His successes led to his promotion to Senior Research Scientist (this made him the highest ranked experimental psychologist in the government) and earned him the freedom to explore a broad range of research interests. These generalized to the social nature of eating behavior: the meal (Meiselman, 2000, 2009). In 2005, he received a Presidential Citation for his work.

Meiselman’s interests in eating behavior span geographical and political boundaries and focus on variation in situations (schools, military environments, cafeterias, fast food restaurants, ethnic
restaurants) as well as variation in type of individual (age, race, ethnicity, gender). My lab looks at genetic variation in taste as well as common pathologies that alter taste (Bartoshuk, Snyder, et al., 2005). For example, one of the nerves that conveys taste information to the brain (chorda tympani) passes through the middle ear where it can be damaged by ear infections. This damage in turn intensifies sensations evoked by fats (through a central release of inhibition mechanism), leading to an increase in the palatability of high fat foods and potential weight gain (Snyder & Bartoshuk, 2008). All of this variation means that increasing palatability of healthy foods like the tomato will be complex — one tomato is not likely to fit all.

Thus, the careers of three psychophysicists with common training diverged into industry, government, and academia. As we reflected on lessons learned from these three different career paths, we found ourselves in agreement about the value of observational studies to describe natural eating behavior in a variety of settings. This kind of research is undervalued in the “hypothesis-driven,” reductionist model of scientific explanation often favored today. James Battey, head of the National Institutes of Deafness and Other Communication Disorders (NIDCD) put it very well. He noted the importance of “hypothesis-generating” as well as “hypothesis-testing” research.

The Joy of Science

The chance for three old friends to reminisce about psychophysics was a source of great pleasure for all of us. Interestingly, that pleasure itself became a topic of discussion. As we reminisced, we found ourselves talking about joy in science. “Aha” or “peak experiences,” are essentially esthetic experiences. Individuals in many domains report these but the three of us realized we had never talked about this before. I was reminded of a quote from my mentor, Carl Pfaffmann, concerning the first time he recorded from single fibers of the chorda tympani taste nerve (Bartoshuk, 1995). “I remember my first thrill on hearing the discharge of impulses in the audio monitor. I have never extinguished the ‘gut feeling’ when I hear the crackle of single unit discharges.”

Not surprisingly, psychologists have studied what makes science a “calling” for some but only a job for others. Amy Wrzesniewski (PhD in Organizational Psychology from the University of Michigan) did undergraduate work with Paul Rozin (e.g., Wrzesniewski, McCauley, Rozin, & Schwartz, 1997). Wrzesniewski found two factors of special importance to those with a “calling” for the work they do. First, the work was enjoyable in and of itself. Second, the person felt that the work contributed to the world in a positive way. In an interview with Wrzesniewski, I asked what her field knows about callings in science and more specifically, callings in psychology. As of yet, there is little information about these specific fields. In general, though, her work across a number of occupations suggests that callings are related to important benefits like satisfaction and well-being. Whether science and psychology draw more calling-oriented folks is an open question. We would love to hear from readers about what gives them joy.

References


