Psychology of Eating: The Nexus of Nutrition, Brain, and Behavior

After reading this chapter, you will be able to
- Understand the relevance of many scientific disciplines to the psychology of eating
- Define the terms motivation, hunger, and satiety as they relate to eating
- Be able to relate the concept of body mass index to health and obesity
- Realize the economic burden that is borne by a society that is increasingly obese

INTRODUCTION

“You are what you eat” is a commonly heard slogan, and coincidentally the title of a 2006 best seller by Gillian McKeith. Although this slogan does contain elements of truth, it begs the central question of why you eat, with the immediate follow-up questions of what, where, when, and how much. This text is all about the science behind eating that tries to answer these questions. If you think about eating as a scientific problem, it very quickly becomes apparent that many branches of science are involved, including psychology, biology, nutrition, and neuroscience. We believe a well-rounded approach to eating behavior must include each of these elements and, further, that psychological science is an integrative discipline that is uniquely well positioned to bridge the streams of scientific thought that are relevant to eating and its problems (Figure 1.1). Whereas we do not assume or require an in-depth background in these areas, readers who believe they do not have an adequate preparation are invited to read the two short appendices that review a few basic principles of neuroscience and genetics.

Several books or monographs bear the title or subtitle “The Psychology of Eating,” including those by Capaldi (1996), Logue (2004), and Ogden (2010), as well as numerous nonacademic offerings in the field. The coverage in our book builds on these foundations, but with a new point of emphasis on obesity. Some texts focus on eating disorders such as anorexia and bulimia nervosa, and these are of particular interest and relevance to college-age readers. About 1% to 3% of the population suffer from these serious disorders (Hudson, Hiripi, Pope, & Kessler, 2007), but the prevalence of overweight (33%) and obesity (36%) in adults is each an order of
magnitude greater (Flegal, Carroll, Kit, & Ogden, 2012). Obesity is associated with emotional problems and reduced life expectancy (Luppino et al., 2010). Further, overweight and obesity have a devastating economic impact in direct (e.g., health care) and indirect (e.g., lost work days) costs, estimated in 2008 to be $147 billion in the United States (Finkelstein, Trogdon, Cohen, & Dietz, 2009), or about $500 per year for every man, woman, and child. These costs are rising rapidly—as we write this, it is probably nearer $1,000. Can you think of better ways to spend “your” $1,000 (Figure 1.2)?

Then there's the problem of deniability or “it won't happen to me” (Weinstein, 1984). In our own classrooms, we ask students (who are mostly about 20 years old and not overweight) how many of them think their parents are overweight or obese. About half say “yes.” Then we ask how many of them believe they will be overweight when they reach their parents’ current age. Almost no one believes that. How would you have answered these questions? The fact is that (U.S.) population statistics indicate that middle-aged people have at least a 65% chance of being overweight or obese, so what makes you so sure you will come out on the thin side of this coin toss? In many modern societies, obesity is widely considered to be an undesirable condition, but like many other undesirable conditions (e.g., poverty, drug addiction, fatal illness), almost no one aspires to it or believes that it will happen to him or her. So, right from the start, we are trying to convince you of something that you may not see as relevant. We hope to persuade you that obesity is a problem that will impact you, if not personally then certainly indirectly, for example, by paying higher health insurance premiums. That's where “your” $1,000 per year disappears: It's like a tax on all of us. Our call to you, the student, is to choose a career or lifestyle to prevent or fix this problem. Let's face it—your authors’ generation has been spectacularly unsuccessful in this endeavor!

This book is divided into several sections that we believe encompass the broad range of topics that are relevant to the title of our book. These need not be approached in a strictly sequential manner, although we find some logic in our organization. The first section examines food as an energy source (nutrition), as a stimulant of our senses (chemosensation), and as a commodity that has shaped our past physiology and behavior (evolution). The second section looks at factors that influence an individual’s eating such as learning, development, the sociocultural milieu, and emotions. The third section is focused on biology of normal and abnormal eating, including genetics, eating disorders, and treatments for
obesity. Finally, we will try to synthesize all of this diverse information to stimulate your thoughts about future approaches to inappropriate eating and obesity, including roles for business and government.

Before we embark on this journey, it seems appropriate to address two general questions. The first is “what is the goal of eating?” This will be considered in several chapters, but for now we should give you a little background on the theoretical concepts that have been advanced. The second question is “what is the definition of obesity?” Maybe you already asked yourself this question several paragraphs ago, and if you did, then you are already thinking like a scientist! Science requires precision of definition as well as precision in measurement, so, as you read this text, we challenge you to ask yourself “what do you mean by that” and “what’s the evidence?”

**FIGURE 1.2** The approximate per capita annual cost of obesity, as health care and lost work productivity, in the United States in 2012 dollars.

**WHAT IS THE GOAL OF EATING?**

Psychologists often talk about “goal-directed behaviors.” If you think about it, most behavior has a goal such as waiting for a bus to get you to a destination or developing some commercial material to present to a potential customer. But these examples are really steps along the way: What will you do at the destination and why do you need another customer? To help make this distinction more explicit, scientists have used the terms *distal* (or ultimate) and *proximate* to describe causes of behavior (Alessi, 1992) or, as we will use in the present context, *appetitive behaviors* that bring us from an environment with no food into the immediate vicinity of food and *consummatory behaviors* that deliver the food into our mouth and to our digestive system.
The concept of hunger has solved the problem of mechanism, right? No—and if it had, then this would be an extremely short text! Instead, it has reframed the question to “what is it that makes us hungry?” And there’s a second question: “If food is available all the time, do we eat only when we are hungry, or are there times we eat when we are not hungry?” This is an important question because if the answer is that there are times we eat when we are not hungry, or even that we start eating on different occasions at different levels of hunger (i.e., there is a different threshold), then there will not be a one-to-one or quantitative correspondence between hunger and behavior. Think again about the time when you were without food for an extended period of time. Did your sensation of hunger get more and more intense as time went by, or did it come and go in waves? In general, people rate their hunger as increasing with time since food and decreasing after eating (Barkeling, King, Naslund, & Blundell, 2007).

Many theories of feeding now talk about satiety or fullness rather than hunger. Satiety is often defined as the absence of hunger.

Aside from regulating sensations of hunger or satiety, is there any other goal to eating? To answer this, it is useful to step outside of ourselves for a moment and realize that all animals eat. We cannot be sure that all (or any) other animals experience hunger or satiety in the way that we do, or indeed that your subjective experience is the same for your parents, classmates, or anyone else. We do know that many aspects of animals’ feeding
This brings up another important point: Because all animals eat, the study of feeding behavior of animals can give us important insights into human behavior. Further, for animals that have similar feeding habits to our own (i.e., mammalian omnivores), there is every reason to believe that the physiological and brain mechanisms underlying feeding are similar to our own. Although many aspects of feeding and the brain can be directly studied in humans, and many examples will be given in this book, there are some scientific procedures and measures that we cannot do in humans but instead turn to suitable animal models to address the questions. Most such research uses rats or mice, and we will occasionally refer to some of these studies. All animal research is highly regulated and reviewed by both institutional and national entities with regard to rigorously humane treatment and scientific necessity.

The relatively new specialty area of evolutionary psychology considers how psychological traits (thoughts and behaviors) may have been molded by evolutionary forces in play at the time of the emergence of modern humans. Fossil records appear to show that the earliest hominids emerged about 4.5 million years ago; they were hunter-gatherers—food acquisition was central to their survival (Figure 1.4). In the next 4.3 million years of hominids’ existence, prior to

**FIGURE 1.3** Monkey eating a banana in its natural habitat.

behaviors are similar to our own (Figure 1.3). So why do animals eat? Chances are that you might answer this “in order to survive”; after all, that’s the message you’ve all seen on wildlife TV shows.

**FIGURE 1.4** The earliest hominids were hunter-gatherers and developed simple tools that allowed them to improve their hunting success.
the emergence about 200,000 years ago of modern humans (Homo sapiens), various species of Australopithecus and Homo evolved only to suffer extinction. A common theme of hominid evolution is the progressive alteration of body shape or size, including erect stature and the development of bigger brains. One major function of these brains must have been improved ability to garner and manage food resources. It follows that most of our psychological functions may be linked to food in one way or another!

In 200,000 years, Homo sapiens have developed complex societies (White, 1959). Culture and technology distinguish us from our distant ancestors and from other species of animals. Archaeological data suggest that from the earliest times, humans asked questions concerning the origin of life and the concept of mortality, but until recently they had only a religious or cultural context within which to consider these questions. Over the past few hundred years, the scientific method has emerged to provide a universal observation-based framework to advance knowledge, often with spectacular results. One consequence of scientific progress is the accelerated rate at which we can and do alter our environment, including food-relevant categories such as large-scale agriculture and transportation. In some ways, we have a stone-age body (and brain) living in an unforeseen world in which reality is now often virtual.

**WHAT IS THE DEFINITION OF OBESITY?**

In 1943, the Metropolitan Life Insurance Company published actuarial standard weight-for-height tables, giving ideal or healthiest weights for various heights and at three body-frame sizes (small, medium, and large, determined by bone size measured as breadth at the elbow—although most people self-categorize!) and for men and women separately. Select entries from its tables are shown in the top panel of Figure 1.5. In more recent years, **body mass index (BMI)** has been used. BMI = mass in kilograms divided by the square of height in meters (thus, the units for BMI are kg.m$^{-2}$). You can find your own BMI easily using any one of the many online BMI calculators or from Table 1.1.

It is evident that for a given frame size, BMI tends to be greater in men than women of the same height, and lower in tall compared with short people. BMI values that we derived from the Metropolitan Life ideals are shown in the lower panel of Figure 1.5. All values fall between 19.6 and 26.0 kg.m$^{-2}$, which are in or close to the range of BMI now classified as normal or healthy:

- BMI less than 18.5 = underweight
- BMI 18.5–24.9 = normal or healthy
- BMI 25–29.9 = overweight (also known as pre-obese)
- BMI 30 or more = obese (class I = 30–34.9, class II = 35–39.9, etc.)

Another way of viewing the data in Figure 1.5 is that the Metropolitan Life ideals recommend a lower BMI for tall people and women compared with short people or men. For this and other reasons, the Metropolitan Life standard has been abandoned in favor of BMI—but is BMI a perfect index? One assumption underlying the interpretation of BMI is that all weight change in adulthood reflects changes in body fat, and that too much fat is bad. This may often be the case, but there are certainly...
abdominal fat are waist circumference and the ratio of waist to hip circumferences. Bear in mind that when most health professionals use the term obesity, they have a precise BMI criterion in mind. BMI is a useful snapshot of population trends (as will be discussed next) or an individual’s changes across time. Thus, in an adult whose height does not appreciably change, deviations in his or her body weight will result in strictly proportional changes in BMI (see the following “do the math” exercise).

exceptions. For example, strength athletes have high muscle mass, hence high BMI, but this does not reflect excessive fat. Likewise, from a health perspective, not all fat is created equal. In particular, excess fat in the abdominal region (more common in males) imparts increased risk of cardiovascular disease, whereas the same extra fat in the hips (more common in females) does not carry the same risk (see Arsenault, Beaumont, Despres, & Larose, 2012, for review). Measures that specifically gauge abdominal fat are waist circumference and the ratio of waist to hip circumferences. Bear in mind that when most health professionals use the term obesity, they have a precise BMI criterion in mind. BMI is a useful snapshot of population trends (as will be discussed next) or an individual’s changes across time. Thus, in an adult whose height does not appreciably change, deviations in his or her body weight will result in strictly proportional changes in BMI (see the following “do the math” exercise).

DO THE MATH

Imagine a 5’2” female starting college at a weight of 120 pounds. Over the next year, she gains the mythical “freshman 15 (pounds).” Use an online calculator to compute BMI at the start and end of that year. The next year, she gains an additional “sophomore 15.” What are the new numbers, and how do they map onto the recommended BMI categories? Her friend is a 6’2” male weighing 160 pounds at the start of his freshman year, and he has the same weight gains of 15 pounds per year. What are his BMI numbers and categories? (Answers are at the end of this chapter.)
### Table 1.1: Body Mass Index Table

<table>
<thead>
<tr>
<th>HEIGHT in feet/centimeters</th>
<th>Underweight (&lt;18.5)</th>
<th>Normal (18.5-25)</th>
<th>Overweight (25-30)</th>
<th>Obese (&gt;30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5'0&quot; (152cm)</td>
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<tr>
<td>100 (45.4)</td>
<td>22</td>
<td>22</td>
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<td>22</td>
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<tr>
<td>95 (43.1)</td>
<td>21</td>
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<td>21</td>
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<tr>
<td>90 (40.8)</td>
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<td>19</td>
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<tr>
<td>85 (38.6)</td>
<td>19</td>
<td>18</td>
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<tr>
<td>80 (36.3)</td>
<td>18</td>
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<tr>
<td>5'2&quot; (155cm)</td>
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<td>60 (26.7)</td>
<td>15</td>
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<tr>
<td>5'6&quot; (165cm)</td>
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<td>115 (43.2)</td>
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<tr>
<td>95 (34.0)</td>
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<td>1</td>
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</tr>
<tr>
<td>90 (32.0)</td>
<td>1</td>
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</tbody>
</table>

Source: body-mass-index-chart.gif

Note: BMI values rounded to the nearest whole number. BMI categories based on CDC (Centers for Disease Control and Prevention) criteria. www.vertex42.com BMI = Weight(kg)/height(m)² = Weight(lb)/Height(in)² ©2009 Vertex42 LLC
The U.S. Centers for Disease Control and Prevention (CDC) publishes annual data showing the percentage of the adult population in each of the 50 states that falls within BMI classes (as well as related data, such as incidence of diabetes and stroke). These color-coded maps are easily found online and Table 1.2 is a summary. In 1994, all of the reporting states had less than 20% of their adult population with BMIs in the obese range (≥30), and the national mean was about 14%. Eleven years later, in 2005, most states were in the 20% to 30% prevalence category; for the first time, some states had more than 30%; and the national mean was 20%. The data from 2011 show a progressive increase in the fraction higher than 30% as well as in the national mean (27%). These data support the concept of an obesity epidemic, showing an additional ~1% of the population entering the obese category every year (see additional statistics in Flegal et al., 2012).

Obesity often has a negative connotation: Most of us would not like to have the word applied to us. Yet, by the CDC statistics, within 20 years, more of us will be obese (BMI >30) than not. Can we define obesity as abnormal if it is found in more than half the population? Can’t we just raise the criterion as the population gets heavier? Is obesity bad for you? And, if obesity is caused by eating too much, how do we know what is too much and why doesn’t our biology stop us? Many of these questions don’t have simple or clear answers and are the topics that we will discuss and challenge you to think about in the pages of this book. The fact remains that obesity causes distress for many individuals and detracts from physical health. Statistically, obesity is associated with increased risks of the so-called noncommunicable diseases: high blood pressure, stroke, diabetes, metabolic syndrome, and cancer (e.g., Wagner & Brath, 2012). Their treatment takes an enormous fraction of the health care budget, regardless of whether the funds are public or private. Uncontrolled growth of expenditure in health care is not a sustainable trajectory, and so prevention of poor health by minimizing risk factors such as obesity is a concern for all of us.

### BIOMEDICAL OR ENVIRONMENTAL OR BOTH?

Given that overeating and obesity are significant 21st-century problems for individuals and society, as are other eating disorders such as anorexia and bulimia, how do we solve these problems that are in essence problems of interactions between individuals and their food environment?

The biomedical approach advocates that these problems are best solved by direct manipulation or treatment of an individual, either because something internal is broken or malfunctioning or because the treatment will change the way in which the individual interacts with food. One example of this is the popular concept of taking drugs to suppress appetite: The mode of action of such drugs is to change some aspect of the physiology or brain so that food is more filling and/or less attractive. They are designed to change the body’s internal signals related to food; evaluating this approach requires a background in the physiology and brain mechanisms of feeding.
As we will review, many claims about diet drugs are unsubstantiated, so it is important that you are able to evaluate such claims critically.

A completely different approach is to consider that in most cases of obesity, nothing is fundamentally broken within individuals, but rather it is the environment—broadly defined—that is causing the problems. Indeed, the obesity epidemic has been fueled by increases in the energy content and amount of food available and decreases in physical activity—a so-called obesifying or obesogenic environment. But even if we could find completely safe and effective biomedical interventions to counteract this obesogenic environment, is it more ethical and/or cost effective to treat the environment? Do you think that businesses are eager to reduce the attractiveness of their food products (e.g., serve smaller portions, lower the taste quality by reducing fat and sugar content) to enhance the health of their customers? If not, should government take on this task? The mayor of New York, Michael Bloomberg, tested this issue by promoting legislation prohibiting the restaurant sale of very large (>16 ounces) portions of sugar-sweetened beverages, based on a body of scientific evidence supporting a link between consumption of sugary beverages and obesity-related health problems (Brownell et al., 2009; Vartanian, Schwartz, & Brownell, 2007). Some New Yorkers and other Americans supported Bloomberg’s initiative; others believed that people should be free to make their own food or beverage choices (even if they were bad choices). Some health advocates support increased taxes on sugary beverages and unhealthful snacks such as candy. What do you think about these issues? If you believe that individual liberties should not be limited, would you support the government restricting the access that children have to sugar-sweetened drinks and “junk” food, for example, in school? How about regulating the marketing of these types of foods to children? How else could we make our environment less obesogenic and, thus, reduce our risk of disordered eating? We hope that you consider these questions as you read this book and become more knowledgeable about the biological, psychological, and sociocultural aspects of eating. We will return to these issues in the final chapter.

**Do the math BMI calculation**

A 120 lb female has a BMI of about 22 (normal). One and two years later, her BMIs are 25 and 28, respectively: she has become substantially overweight.

A 170 lb male has a BMI of about 21 (normal). One and two years later, his BMIs are 22.5 and 24, respectively: he is still in the normal range.

*Note that despite the same initial BMI and the same weight gain of 30 pounds, the individual (female in this example) with the lower initial weight ends up as overweight.*

**Glossary**

**Appetitive behaviors** Actions that bring us from an environment without or remote from food (or other desired goal) into the immediate proximity of a desired food source, for example, hunting and foraging.

**Body mass index (BMI)** Body weight (in kg) divided by height (in m) squared: thus, the unit is kg.m$^{-2}$. This is the most commonly used clinical measure to define underweight (<18.5), normal body weight (18.5–24.9), overweight (25–29.9), obese class I (30–34.9), obese class II (35–39.9), obese class III (>40).

**Consummatory behaviors** Actions that deliver food from a nearby source into our mouths: for example, eating from a plate or shelling nuts to eat them.
**Fullness**  A subjective sensation relating one’s current state to the (comfortable) fullest that one could imagine after eating a large meal.

**Hunger**  Internal (unpleasant) sensation that diverts our thoughts and actions to acquiring and eating food; one cause of hunger is a prolonged period since last eating.

**Hunter-gatherer**  Term given by anthropologists to describe the dominant lifestyle of early hominids.

**Obesogenic**  Term used for an environment (or specific food) that promotes the development of obesity.

**Satiety**  The absence of hunger. It is closely related to the sensation of fullness.

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**References**


