Chapter 107
The False Memory Diet: False Memories Alter Food Preferences

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Abbreviation

FBPQ Food and beverage preferences Questionnaire

107.1 Introduction

Consider this scenario. You are hunched over a toilet bowl (or flower pot), throwing up. You ate something that did not agree with you, and now you are suffering the consequences of it. As you are busy vomiting, you realize, or think you realize, what it was that made you sick: It was the egg salad. There is a good chance that you will avoid egg salad for a short time after the event. There is also a chance that you might altogether avoid egg salad permanently. Studies show that animals that repeatedly get sick after eating a particular food will avoid that food, and that even a single sickness experience after eating food can lead to a strong aversion to that food (Garcia and Koelling 1966; Gustavson et al. 1974; Gustavson and Nicolaus 1987). If a true food-related memory can produce these consequences, can a false memory do so too? We present evidence that false memories regarding food and alcohol can affect eating and drinking behavior.

In this chapter, we review new research, conducted over the last half decade, showing that we can plant false memories about a past experience with a particular food or alcohol. These have consequences for people; if the false memory is unpleasant, people avoid the food or drink. If the false memory is pleasant, they want the food or drink more. We discuss possible explanations for these findings. Moreover, we explore which kinds of people are more susceptible and which foods are particularly amenable to forming false food memories. We end with a discussion of applications to other areas of health and disease.

107.2 False Memory Primer

Memory is reconstructed, not a faithful replay of the past (Bartlett 1932). As a reconstruction, memory is prone to distortions, omissions, and deletions of details as well as construction of entire events that never occurred. We distinguish between two main types of false memories – those pertaining to

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details (which we call false "detail" memories) and those pertaining to entire events (which we call *rich* false memories) (see Loftus and Bernstein 2005). False detail memories are commonplace. In fact, every memory of every event invariably contains some false detail memory. When recalling the past, we virtually never get all the details exactly right. We either subtly alter some details (we misremember that the culprit in a robbery wore a black shirt when, in fact it was grey) or grossly alter other details (we misremember that the culprit had a beard when, in fact, he was clean-shaven; for a discussion of false detail memory tasks, see Bransford and Johnson 1973; Loftus et al. 1978; Roediger and McDermott 1995). In contrast to such false detail memories for an event, we also sometimes wholly reconstruct memories for entire events that never occurred (we think we remember seeing an entire robbery when the robbery never actually occurred). Findings from studies on rich false memories demonstrate that simply imagining that an event happened in one's past makes one believe that the event actually happened (Garry et al. 1996; see also Hyman et al. 1995; Lindsay et al. 2004; Loftus and Pickrell 1995). Although less common than false detail memories, rich false memories do occur. Moreover, false detail memories and rich false memories likely share some of the same underlying processes; whatever makes us misremember details from the past also is responsible for making us misremember entire events.

Most research to date has focused on how false memories form. What has been less studied is the question of what happens after a false memory forms. False memories in the real world have real consequences for one's behavior (e.g., an adult who falsely remembers being abused by her grandfather may confront the grandfather, refuse to speak to the grandfather, or even sue the grandfather). Recent research in our laboratory has examined the behavioral consequences of false memories. In this research, we planted false memories about food and alcohol in order to provide a plausible and convenient context in which to explore the attitudinal and behavioral consequences of false memories.

107.3 False Food and Alcohol Memories

Using a combination of procedures, we and others have completed more than 20 experiments investigating false food and alcohol memories. Our studies show that people can be led to believe that they had either positive or negative experiences with food or alcohol in their past, and that these false memories affect not only their attitudes and preferences but also their behavior toward those foods and alcoholic beverages. We review this work here, starting with our basic procedure for planting memories and assessing attitudes and preferences. Next, we discuss several potential explanations of our findings. How do we know that our subjects really believe they got sick on a key food; perhaps they have guessed the true nature of our studies and are acting in accordance with how they think we want them to act? This is the age-old problem called demand characteristics. Another issue involves figuring out which subjects are most prone to developing false food memories. This refers to what is called individual differences. Finally, we discuss theoretical mechanisms involved in the formation of false food memories. For simplicity, we use the term *false food memories* to refer to both false food memories and false alcohol memories. We also use the term *false memory diet* as a shortcut to refer to the formation and consequences of false food memories. We are not proposing that this is a bona fide dieting technique, although our methodology might eventually be used for dieting purposes.

Basic procedure. Our basic procedure involves two sessions separated by 1 week, and a combination of different questionnaires designed to measure one's past experience with and preference for various foods and alcoholic beverages. We have used different combinations of these questionnaires in different studies, but here we present a comprehensive list of questionnaires to provide a broader picture of our studies to date. Briefly, in Session 1, subjects complete a series of questionnaires

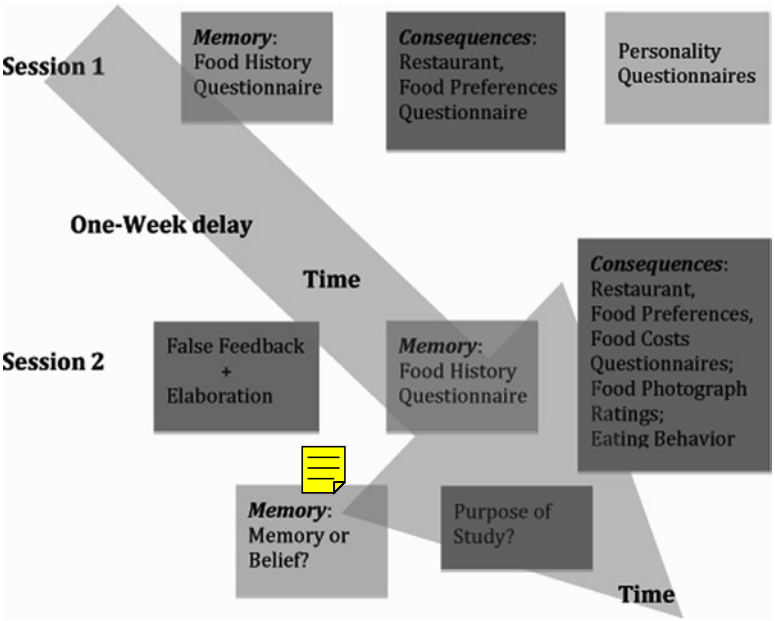

Fig. 107.1 General procedure used in our false food memory studies. Subjects complete tasks over a 2-week period, in a fixed order (read from left to right). False memory formation is indicated with the word *Memory*, and is measured using the Food History Questionnaire and the Memory or Belief? Questionnaire. *Consequences* are measured using the Restaurant, Food Preferences, and Food Costs Questionnaires, in addition to the Food Photograph Ratings and Eating Behavior measures. See text for details

aimed at measuring their childhood experiences with and current preference for various foods and beverages. In Session 2, typically conducted a week later, subjects receive false feedback about their Session 1 responses that leads them to believe that they likely experienced a variety of food- and alcohol-related events in their past. Subjects then complete some of the same measures that they completed during Session 1. Figure 107.1 depicts our procedure.

In this research, we have been interested in two intertwined issues. First, we examine the formation of false food memories. Second, we examine the consequences of these memories. To answer the first question, we see if receiving false feedback about a critical food-related childhood event (e.g., "You got sick eating egg salad") increases subjects' confidence that they experienced that event sometime in their past. To answer the second question, we see if receiving false feedback about the critical food-related event alters subjects' attitudes and behaviors. We now explain our procedure in more detail.

In Session 1, subjects complete a series of questionnaires designed to measure one's food and beverage history and preferences. Specifically, to measure food and beverage *history*, subjects complete a Food and Beverage History Questionnaire in which they rate their confidence that various food and alcohol-related events occurred sometime in their childhood. Sometimes we ask about events occurring before the age of 10 or 12 years, and sometimes (particularly in the alcohol studies) we ask about events occurring before say the age of 16 years. To measure food and beverage *preferences*, subjects complete a Food and Beverage Preferences Questionnaire (see Fig. 107.2) in which they rate how much they like each of a large number of different foods and beverages (including some alcoholic drinks) and a Restaurant Questionnaire in which subjects rate the likelihood of their ordering various foods and beverages at an imaginary restaurant (see Fig. 107.3). All rating scales used are 8-point. Whatever our critical item is for a given study (e.g., "you got sick from egg salad") that food item appears on all food and beverage history and preference measures. This allowed us to

Food & Beverage Preferences Questionnaire

Please rate each of the following food and beverage items in terms of how much you enjoy it. Put your rating in the space to the left of the item.

1 = 'definitely don't like' (for whatever reason) to 8 = 'definitely like'

___Watermelon	___Tofu	___Coke
___Lemonade	___Apple pie	___French fries
___Taffy	___Chocolate bars	___Salad
___Steak	___Pepsi	___Rum
___Vanilla Ice Cream	___Celery	___Black beans
___Deviled eggs	___Bananas	___Doughnuts
___Iced-Tea	___Rice	___Red Wine
___Zucchini	___Tequila	___Asparagus
___Pasta	___Spinach	___Almonds
___Chocolate cake	___Granola	___Cranberry Juice
___Carrots	___Onion rings	___White Wine
___Vodka	___Orange Juice	___Mango
___Potato salad	___Cheetos	___Sprite
___Cole slaw	___Omelet	___Crackers
___Tortilla chips	___Garlic	___Potato chips
___Diet Coke	___Beer	___Diet Pepsi
___Tacos	___Ginger	___Roasted eggplant
___Pizza	___7-UP	___Gin
___Broccoli	___Cheddar cheese	___Pickled herring
___Kool-Aid	___Whiskey	___Vanilla pudding
___Egg salad	___Brownies	___Root beer

1 = 'definitely don't like' (for whatever reason) to 8 = 'definitely like'

Fig. 107.2 Food and Beverage Preferences Questionnaire (FBPQ). Food and beverage preferences questionnaire used in Clifasefi et al. (submitted). This is a modification of a task used previously in several studies (e.g., Bernstein et al. 2005b)

compare scores on the critical item before and after the manipulation, in order to discover any change in food preference.

During Session 1, subjects also complete several filler questionnaires purported to measure their personality and eating habits. We have used these questionnaires for different purposes in different studies. We have used these to disguise the true nature of our studies, and make the false feedback manipulation more credible. Toward the latter purpose, we recruit subjects for a Food and Personality study, and most subjects report at the end of the studies that they thought the study was about food and personality. Occasionally the questionnaires tap demographic or other information about the subjects, which we can use for our analyses of individual differences.

One week later, subjects return to complete Session 2. At the beginning of Session 2, subjects receive false feedback regarding their responses to the Session-1 questionnaires. In particular, we tell subjects that we entered their Session-1 responses into a computer with a sophisticated program that generated an individualized profile of their childhood experiences with food. All subjects receive the same feedback about three events that we chose (specifically because these events likely occurred in anyone's childhood, e.g., you disliked spinach). Moreover, experimental subjects receive one additional and critical piece of feedback. Depending on the study, experimental subjects might read in their profile that they became ill after eating dill pickles as a child or that they loved asparagus the first time they tried it, to take but two examples from different studies.

a

Restaurant Questionnaire

Imagine that you are at a nice restaurant for a special dinner. How likely are you to order each of the items on the menu below, assuming that price is not an object?

Le Restaurant

Appetizers

	definitely no				maybe			definitely yes
Wok-seared chicken strips and lettuce wrap	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Portabella mushrooms stuffed with mozzarella	1	2	3	4	5	6	7	8
Fried calamari rings with spicy sauce	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Hand-breaded tiger shrimp	1	2	3	4	5	6	7	8
Seasoned potato skins with cheddar and green onions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**

Soup and Salad

	definitely no				maybe			definitely yes
Homemade minestrone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
French onion soup	1	2	3	4	5	6	7	8
Spicy tortilla soup	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Peppered corn chowder	1	2	3	4	5	6	7	8
Caesar salad	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Oriental chicken salad	1	2	3	4	5	6	7	8
Honey mustard chicken salad	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Mixed baby greens vinaigrette	1	2	3	4	5	6	7	8

Fig. 107.3 Restaurant questionnaire. Restaurant questionnaire described by Laney et al. (2008a)

b

Main Entrees

	definitely no				maybe			definitely yes
Roasted salmon fillet	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Grilled fillet mignon	1	2	3	4	5	6	7	8
Chicken scaloppini with white mushroom caps	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Grilled polenta with steamed spinach and tomatoes	1	2	3	4	5	6	7	8
Linguine with wild mushrooms, eggplant and snow peas	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Pork ravioli with marinara sauce	1	2	3	4	5	6	7	8
Veal with white wine, lemon and capers	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**

Sides

	definitely no				maybe			definitely yes
Steamed summer squash	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Baked potato with butter and sour cream	1	2	3	4	5	6	7	8
Broccoli and cauliflower casserole	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Wild mushroom risotto	1	2	3	4	5	6	7	8
Sautéed asparagus spears	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
White rice	1	2	3	4	5	6	7	8

Desserts

	definitely no				maybe			definitely yes
Chocolate cake with caramel hazelnut sauce	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Peach sorbet with glazed pecans	1	2	3	4	5	6	7	8
Five layer chocolate fudge cake	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Meyer lemon cheesecake with orange sauce	1	2	3	4	5	6	7	8
Tiramisu	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Pumpkin cheesecake	1	2	3	4	5	6	7	8

Fig. 107.3 (continued)

Next, control subjects read that the computer randomly selected one event for them to consider in greater detail, e.g., that they felt happy when a classmate brought sweets to school. Experimental subjects receive the same false feedback about the sweets item, in addition to a critical item. Control subjects are asked to imagine the sweets event and experimental subjects are asked to imagine the sweets event and the critical event in great detail, as indicated in the instructions, "Think about your memory of this experience. If you don't have a specific memory, imagine what *might have* happened. Then answer the following

questions, in some detail, regarding the item listed above: (1) How old were you? (2) Where did it occur? And what were you doing at the time? (3) Who were you with? (4) How did it make you feel?"

Immediately after receiving the false feedback and elaborating on it, subjects complete some of the same questionnaires that they completed in Session 1 – specifically, the Food and Beverage History Questionnaire, the Food and Beverage Preference Questionnaire, and the Restaurant Questionnaire. Subjects also complete what we call a Memory or Belief? Questionnaire in which they report on several events from the Food and Beverage History Questionnaire, including the critical item. Subjects choose one of the following for each event: Whether they have a specific memory for the event, believe that the event occurred but lack specific memory, or are positive that the event did not occur in their past. Subjects are also instructed to provide detailed reasons for making their selections. In many of our studies, we finish by asking subjects to report what they think the study's purpose was. In all of our studies, we run subjects in groups ranging in size from 2 to 40 people. This is our basic procedure that we have followed; however, in our most recent work on this topic, we add behavioral measures either at the end of Session 2 and/or to another session occurring up to 4 months later (Geraerts et al. 2008). In these studies, we give subjects actual foods or alcohol (including the critical item) to consume, and we measure how much they consume. At the end of all studies, we fully debrief subjects.

False food memory studies done to date. Using the aforementioned procedure, we can explore both the formation and consequences of false memory. To explore false memory formation, we compare subjects' responses to the critical item on the Food and Beverage History Questionnaire before and after receiving false feedback. In all of our studies thus far, we find that experimental subjects tend to increase their ratings more than control subjects do, indicating that the false feedback affected their confidence that the critical event happened in their childhood. Next, we examine subjects' responses to the critical item on the Memory or Belief? Questionnaire. We divide our experimental subjects into two groups, Believers versus Nonbelievers. To be considered a Believer, subjects must increase their confidence in the critical event after receiving the false feedback. Moreover, they must indicate on the Memory or Belief? Questionnaire that they have a memory *or* belief for the critical event. If they fail to meet both criteria, we consider them Nonbelievers.

To explore the consequences of false memory, we can compare Believers to Nonbelievers and controls (those subjects who did not receive false feedback about the critical item) in terms of their attitudes and behaviors toward the critical item. Specifically, we measure how much subjects increase or decrease their preference ratings, or the likelihood of ordering the critical item in a restaurant, or how much of the critical item they consume. In some studies, we have included additional measures to assess the consequences of false memory. These include ratings of photographs depicting various foods and beverages, and ratings of how much subjects would pay for various foods at a local grocery store.

Now that we have described our procedures in detail, what did we find? In our first study, we used two critical items, hard-boiled egg and dill pickle (Bernstein et al. 2005a). We told half the subjects that they "got sick" after eating a hard-boiled egg, while we told the remaining subjects that they "felt ill" after eating a dill pickle. As expected, those subjects who received the hard-boiled egg feedback increased their confidence in this event, while those who received the pickle feedback increased their confidence in this event. Importantly, the egg group did not increase their confidence in the pickle item, and the pickle group did not increase their confidence in the egg item. Thus, our false feedback manipulation worked, as intended. But did false memories have any measurable consequences for subjects' food preferences? The answer is yes. Subjects who met our definition of Believer (25% of Pickle subjects and 31% of Egg subjects) indicated less willingness to eat the "offending" food as adults. These findings show that people can be led to believe that they got sick after eating a particular type of food, and that they later appear less interested in eating that food.

Next, we wished to know if we could extend these effects to fattening foods, or foods that weight-conscious people might want to avoid. We first attempted to do this with potato chips (unpublished

data). We had little trouble getting subjects to believe that they had become sick after eating chips as children, but they didn't seem inclined to avoid chips now. Perhaps, we thought, this was because people eat potato chips too often. Perhaps, we could find consequences with more novel foods (also see Martins and Pliner 2005). We set out to test this idea on two fattening foods, one that is commonly eaten (chocolate chip cookies) and one that is not as commonly eaten (strawberry ice cream) (Bernstein et al. 2005b). Confirming our hunch, we could not convince many people that they had gotten sick eating chocolate chip cookies. Moreover, the false feedback about cookies had no impact on our subjects' self-reported preferences for chocolate chip cookies.

In stark contrast, the procedure worked with strawberry ice cream, the more novel food. In this study and all subsequent studies, we used a slightly different definition of Believer than we used in our first study. We added one more constraint to our criteria before labeling someone a Believer; subjects had to provide low confidence during Session 1 on the Food and Beverage History Questionnaire. In other words, subjects had to begin the study relatively confident that they had *not* gotten sick eating strawberry ice cream as children. With this new definition, nearly 40% of our subjects became Believers and indicated that they had gotten sick eating strawberry ice cream. In addition, Believers reported less willingness to eat strawberry ice cream at a party and reported lower general preference for strawberry ice cream. These results indicate that people can be led to avoid a fattening novel food like strawberry ice cream but not a fattening common food like chocolate chip cookies. These results also indicate that stronger manipulations may be needed to make people believe that they got sick eating a familiar food and make people avoid that food.

Given that our false food feedback technique made our subjects less willing to want to eat a fattening food (a potentially healthy consequence of a false memory), we wondered whether we could use this same technique to get people to eat *more* of a healthy food (also a healthy consequence of a false memory). We chose asparagus as the critical item, because it has a distinct flavor and is relatively novel and unfamiliar.

In our first study to examine the consequences of false memory for a positive, rather than a negative food-related experience, we told some of our subjects that they loved asparagus the first time they tried it (Laney et al. 2008a). We found that approximately 50% (48% in Experiment 1 and 53% in Experiment 2) met our definition of Believer. As in our previous studies, we wished to know whether there were consequences associated with believing our false feedback. In this study, we added two new tasks to our arsenal of consequence measures. These new measures included a Food Costs Questionnaire and a Food Photograph rating task. On the Food Costs Questionnaire, subjects indicated how much they would pay for a variety of foods at the grocery store, including the critical item, "a pound of asparagus." Subjects indicated their answers by circling one of seven price options. In the Food Photograph task, subjects rated photographs depicting a variety of foods and beverages (see Fig. 107.4).

Recall that half our experimental subjects in this study came to believe that they loved asparagus the first time they tried it. In comparison to control subjects (those not exposed to false feedback), Believers indicated (a) greater preference for asparagus, (b) greater willingness to pay more for asparagus at the grocery store, and (c) that photographs of asparagus were more appetizing and less disgusting. Thus, false positive memories about a food also had consequences. Specifically, coming to believe that one loved asparagus the first time one tried it had positive and healthy consequences for one's attitudes toward asparagus. These encouraging result left us with two unanswered questions: How long do the false memories last? Do false food memories affect what people actually eat, as opposed to what they think they might want to eat?

To address these questions, we used two experimental groups, a "love" and a "hate" group who received false feedback about either loving or hating asparagus the first time they tried it, respectively. We found that our basic false food memory formation and consequence results persisted up to

Fig. 107.4 Food photographs. Photograph task used in Experiment 2 by Laney et al. (2008a). Subjects rated each food in terms of how appetizing and disgusting it was. Subjects also rated the artistic quality of each photo and whether a novice, amateur, or expert photographer took the photo. *Note*: original photographs were in color

2 weeks after subjects received the false suggestion. We also contacted subjects by email 1 week after they had completed Session 2, telling them that we would feed them during their final laboratory visit 1 week later. We asked them to rank order a list of sandwiches and vegetables (including asparagus) that they would like us to provide during their final visit. Subjects did, in fact, return to the laboratory for the final session, but we did not feed them as promised. Instead, we asked them to complete our standard self-report consequence measures during this final session. We found that Believers in the Love group (34% of Love experimental subjects) indicated via the email questionnaire that they wanted to eat asparagus upon returning to the lab (Laney et al. 2008c).

Although the subjects in these previous studies changed what foods they reported wanting to eat, we never examined what they actually ate. Two studies have since examined actual eating behavior. Each study was conducted without knowledge of the other, further lending credence to the results. In one study, we suggested to some subjects that they had gotten sick after eating egg salad as children (Geraerts et al. 2008). We then measured actual behavior at two different time points. The first occurred shortly after subjects completed our standard Session 2 measures.

Subjects were taken to another room where they received a bogus debriefing. Subjects learned that the researchers wanted to thank them for participating by providing drinks and sandwiches. The sandwiches contained five different fillings, including egg salad, tuna salad, chicken salad, cheese, and ham. While the subjects listened to the bogus debriefing, they helped themselves to the food. An experimenter recorded the type of sandwiches the subjects chose. The second way that we measured behavior was that we re-contacted subjects 4 months later and invited them to participate in what they thought was an unrelated study. Eighty-five percent of subjects returned and completed a taste test in which they tasted and rated five drinks and five sandwiches in terms of appearance, smell, flavor, and preference. After this rating exercise, subjects learned that we would be throwing away the food. We invited them to eat as much as they liked. After 15 min, the experimenter removed the food, and re-administered our Session 2 materials in a different format so as to disguise the link between this session and Session 2.

In comparison to control subjects, subjects who received and believed the false feedback about egg salad (35% of subjects) ate fewer egg salad sandwiches (a) shortly after receiving the false feedback *and* (b) 4 months later (see Fig. 107.5). Believers also gave lower ratings to the appearance and

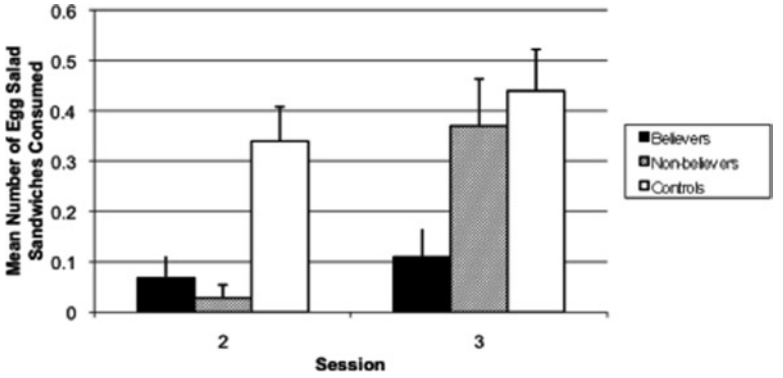

Fig. 107.5 Mean number of egg-salad sandwiches consumed by Believers, Non-Believers, and control subjects in the second and third sessions. Error bars represent standard errors of the means (Figure and caption reprinted from Geraerts et al. (2008). With permission from publisher)

flavor of egg salad than did control subjects. These results show that subjects can be led to create false food memories with real and long-lasting behavioral consequences.

Another study conducted in a different country also demonstrates the power of false suggestion in shaping actual eating behavior (Scoboria et al. 2008). Experimental subjects received both a personalized profile indicating that they very likely became ill after eating peach yogurt as children, and they received a bogus government report indicating that numerous people had become ill after eating peach yogurt that had been contaminated by *E. coli* bacteria. Experimental and control subjects then returned 1 week later for what they thought was an unrelated multi-site marketing study. During this later session, subjects completed an elaborate taste test of different crackers and yogurts in which they rated each in terms of appearance, odor, taste, and texture, in addition to how much of each food they would like to eat (food perception scores). At the end of the taste test, subjects were told that all remaining food would be discarded, so they were free to eat as much of it as they wished. After 10 min, the experimenter removed the food and weighed it to determine how much of each type of cracker and yogurt was consumed by the subjects. As expected, subjects who were exposed to the false suggestion about peach yogurt indicated lower food perception scores for peach yogurt only, in comparison to controls. More importantly, experimental subjects ate less yogurt overall (of all types presented) than did controls, even though the two groups ate equal amounts of crackers. Thus false food memories affect what people actually eat.

False alcohol memory. Because false suggestion worked so well with food, we wondered whether it also would work with alcohol. To find out, we suggested to some subjects that they had become sick after drinking rum (or vodka) in the past (Clifasefi et al., submitted). Many of these subjects came to believe the false feedback and indicated less preference for drinks containing rum (or vodka) in comparison to control subjects.

In another project involving wine, we examined real behavior by measuring actual wine consumption after subjects received false feedback concerning their past experience with white wine. We suggested to some subjects that they previously got sick after (or loved) drinking white wine. As expected, both types of false suggestion (sick, loved) increased subjects' confidence that this event occurred in their past. Moreover, false positive memories were accompanied by increased self-reported and acutal preference for white wine (Wudarzewski et al. 2009) Thus, false alcohol memories, just like false food memories, affect attitudes and behaviors.

False beliefs versus false memories. Several important questions arise from these studies. One question involves the extent to which our findings relate to memory or mere suggestion. It is possible that merely suggesting to people that they got sick on a particular food in the past is sufficient to alter preferences and eating behavior. Perhaps they don't need to develop a false memory. We have data that speak directly to this question. In nearly every experiment that we have conducted on this topic, we find that Believers show more consequences than do Nonbelievers or controls. If the suggestion itself is sufficient to elicit attitudinal and behavioral consequences, then the Nonbelievers should also show consequences because they too received the false suggestion. Thus, mere suggestion does not seem sufficient to produce the kinds of results we typically see.

In discussing our results we have used the terms "belief" and "memory." Most investigators distinguish between these constructs as follows. Beliefs pertain to ideas (which may or may not be accurate) that we have about the past in the absence of specific detail that can be recalled. For example, we know and believe that we were born, but we do not remember the event itself. Memories, in contrast to beliefs, pertain to recollected details of past experiences. For example, many of us can recall details about our first kiss. Using this distinction, we can examine the formation of false beliefs and false memories. At the end of our studies, we ask subjects whether they have a general belief in or a specific memory for the event. In our studies, the vast majority of subjects (sometimes more than 90%) report a belief rather than a memory (see Table 107.1). Thus, most subjects are forming false beliefs rather than false memories in our studies. The reason that we have not distinguished these subgroups in this chapter is because the two groups are largely indistinguishable in terms of their confidence that the critical event occurred (as measured by their responses to the Food and Beverage History Questionnaire) or the consequences that we measure. Thus, because false beliefs and false memories similarly affect attitudes and behaviors in our studies, we combine false beliefs and false memories into Believers and then compare these subjects to Nonbelievers and control subjects (but see Table 107.1 to differentiate the percentage of Believers who reportedly form a false memory and the respective context).

Table 107.1 Key features of false memory studies: proportion of believers who reported memory rather than a belief for a given critical item, across studies

Aversion vs. preference	Critical item	Believers reporting memory		Study
		Proportion	Percent (%)	
Aversion	Exp 1: Ill from strawberry ice cream	1/7	14	Bernstein et al. (2005a)
	Exp 1: Ill from chocolate chip cookies	0/4	0	Bernstein et al. (2005a)
	Exp 2: Ill from strawberry ice cream – Elaboration Group[a]	1/24	4	Bernstein et al. (2005a)
	Exp 2: Ill from strawberry ice cream – Scenario Group[a]	1/13	8	Bernstein et al. (2005b)
	Exp 2: Ill from dill pickles	4/22	18	Bernstein et al. (2005b)
	Exp 2: Ill from hard-boiled eggs	5/28	18	Laney et al. (2008a)
	Ill from egg salad	3/35	7	Geraerts et al. (2008)
	Hated asparagus	17/46	37	Laney et al. (2008c)
Preference	Loved asparagus	7/35	20	Laney et al. (2008c)
	Exp 1: Loved asparagus	10/22	45[b]	Laney et al. (2008a)
	Exp 2: Loved asparagus	11/21[b]	52	Laney et al. (2008a)
Total		**60/257**	**23**	

Exp experiment

[a]Elaboration group was asked to elaborate on and answer questions about the suggested critical event (sick from strawberry ice cream); Scenario group was asked to choose between two possible scenarios depicting the suggested critical event

[b]Believers reporting a memory differ from Believers reporting a belief on Food and Beverage History Questionnaire (False Memory subjects also rate asparagus photo as more appetizing than False Belief subjects)

One last question arises concerning whether we can know that our manipulation produced a false memory or whether it triggered a true memory of the food experience. Without knowing the actual past of each of our subjects, we cannot be sure. However, there is a clue in one study that argues against the idea that we triggered a true memory. In that study, parents of subjects were contacted and asked to verify whether the critical event (got sick eating egg salad) did or did not occur in their child's past. Notably, of those subjects who entered the study denying the event and postmanipulation developed a memory for it, none of their parents corroborated the event. Readers might wonder whether parents would be expected to recall this event even if it had happened. In fact, many subjects who appeared to have true memories of getting sick on egg salad had parents who corroborated this event (Geraerts et al. 2008).

Demand characteristics. Demand characteristics correspond to situations in which subjects try to guess the true nature of the experiment, and in turn, act according to how they think they should act to be "good" subjects (Orne 1962). If our subjects figure out the true nature of our experiments (investigation of false food memories and their consequences), then they might pretend to form false memories for the suggested event and show consequences of those false memories. Several lines of evidence argue against this possibility. First, we ask subjects at the end of our studies what they think the purpose of the study was. Very few subjects guess the true nature of our studies. When we exclude subjects who guessed the purpose of the study, our overall findings do not change (see Laney et al. 2008b). Second, in some of our studies (e.g., Bernstein et al. 2005b) our false feedback works for one item (e.g., strawberry ice cream) but not another (e.g., chocolate chip cookies). If subjects are responding to demand, one would think they would form false memories for both events. Thus, we do not think that demand characteristics are responsible for our effects.

Boundary conditions. So, false memories can be planted and they have consequences for people. For some foods, like potato chips and chocolate chip cookies (two commonly eaten, and perhaps overeaten junk foods), our procedure did not seem to work. Thus, our false food memory technique does not work with all foods. Just as our technique does not work with all foods, it doesn't work for all people. Typically fewer than half of our subjects come to form false memories (i.e. become Believers). Thus, some subjects are more prone than others to forming false memories (Hyman and Billings 1998). Although we have frequently included measures of individual differences in our studies, they generally have not been related to the likelihood of developing a false memory.

Theoretical considerations. What is the mechanism behind the false memory diet? In two unpublished studies, we ruled out the possibility that behavioral consequences were due to simple positive or negative associations with target foods. When subjects trained to merely *associate* certain critical foods (e.g., asparagus, broccoli) with positive or negative words (e.g., love, hate), self-reported preference for the critical foods did not change, unlike when false memory procedures were used.

Mazzoni, Loftus, and Kirsch (2001) proposed a three-step model to account for the formation of false memories. Elsewhere, we have expanded on aspects of this model (Bernstein et al. 2009). Here, we extend the model to include the consequences of false memories. According to the original model, (1) an event comes to be seen as plausible in the culture of the rememb  (Plausibility); (2) one obtains a personal belief that the event likely occurred to him/her (Autobiographical Belief); and (3) one interprets thoughts and images about the event as memories (Autobiographical Memory). Mazzoni and colleagues have added a step to this model in which a person views an event as personally plausible before believing that the event likely occurred to her/him (Scoboria et al. 2004).

We hypothesize that the probability that an individual comes to believe that an event is generally plausible and that it likely occurred in his/her remote past depends partially on the ease with which the event is processed. Researchers typically define ease of processing as speed, and speed of processing as fluency, because processing speed is easily measured with reaction time. However, fluency can also be the integration, coherence, or well-formedness of perceptual detail, or the perception of ease

independent of the speed of processing (Whittlesea and Leboe 2003). Fluency can be enhanced by different stimulus variables such as repetition, clarity, and presentation duration (see Alter and Oppenheimer, in press 2009). When people are unaware of the source of their fluency, they may mistake that fluency for familiarity. Put another way, when people experience fluent processing of some material, they sometimes mistakenly believe that the material is familiar to them.

We propose that fluency and familiarity precede plausibility in the formation of autobiographical beliefs and memories (see Fig. 107.6). Moreover, we argue that the consequences that we have observed in our work depend on the formation of autobiographical beliefs and memories, although it is possible that consequences like food and alcohol preferences and eating behavior also link directly to fluency, familiarity, and plausibility. For example, Scoboria et al. (2008) demonstrated such a link between plausibility and eating behavior. In their study, subjects ate less peach yogurt after reading a phony government report aimed at boosting the plausibility that they got sick eating peach yogurt as children. In fact, in that study, eating behavior was unrelated to false autobiographical beliefs and memories, thus providing further evidence for a direct link between plausibility and eating behavior.

Why should the plausibility of a food-related experience matter? The more familiar a person is with a food, like chocolate chip cookies, the more difficult it is to make that person believe that she/he got sick from eating chocolate chip cookies in the past and the more difficult it is to change her/his preference for chocolate chip cookies. From an evolutionary perspective, familiar objects tend to be more preferable, likely because familiar things are perceived as safer than unfamiliar things (see Bornstein 1989; Bronson 1968). It is less plausible that a familiar food would be unsafe and capable

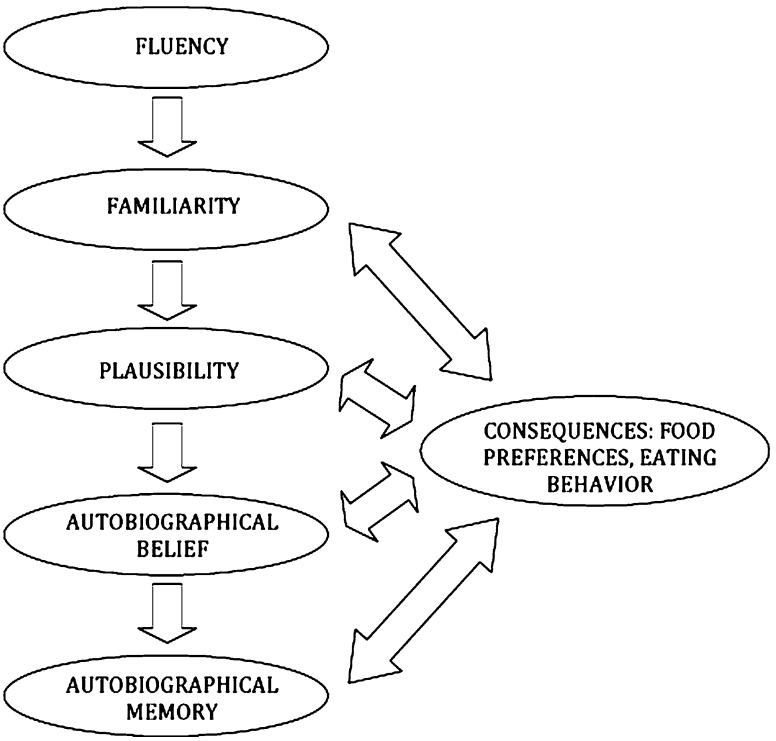

Fig. 107.6 Hypothesized steps in false memory formation and consequences. Fluency (ease of processing) produces feelings of familiarity, which increase plausibility, autobiographical belief and autobiographical memory pertaining to a food-related experience (e.g., one loved or hated asparagus in childhood). Familiarity, plausibility, autobiographical belief, and autobiographical memory affect and are affected by food preferences

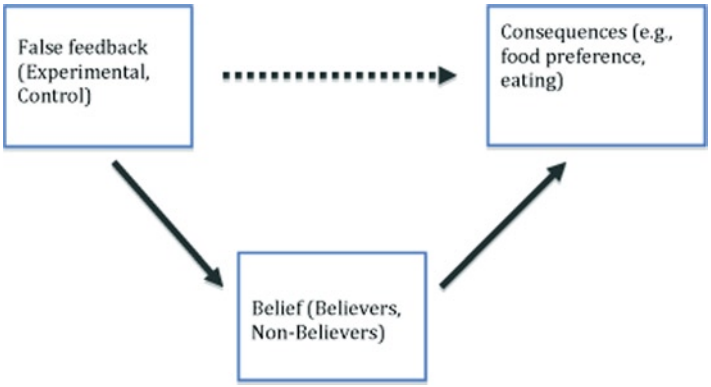

Fig. 107.7 Hypothesized model of the effect of false feedback on food preferences and eating behavior. False feedback (experimental versus control subjects in our studies) may produce consequences directly. Belief in the false feedback (Believers, Nonbelievers) partially mediates this effect. Believers and Nonbelievers are those who do and do not believe the false feedback, respectively. *Dashed arrow* denotes a weaker link than a *solid arrow*

of causing sickness. Thus, if a food is more familiar, it will be more preferred (Loewen and Pliner 1999; Mennella et al. 2001; Pliner 1982; Sullivan and Birch 1994). This explains the observation that familiarity of a food (how frequently it is eaten) enhances preference for it, apparently making it more difficult to develop false memories for having become sick from that food (Bernstein et al. 2005b). These mechanisms can help us understand food preferences, which, as we will see, is useful when it comes to therapeutic applications.

We end this section with a hypothetical model to explain the consequences of false food memories. Figure 107.7 depicts a model whereby exposure to false feedback (e.g., you got sick eating egg salad in the past) has consequences for eating behavior (e.g., you eat less egg salad now). Moreover, we propose that belief in the false feedback partially mediates this link between false feedback and consequences. Work is underway to test this model.

107.4 Applications to Other Areas of Health and Disease

In this section on applications of false memory research to eating behavior, we outline how false food memories could be utilized to influence our eating habits. We then discuss neophobia, lack of dietary variety, and obesity, followed by a therapy called covert sensitization, as well as several ethical concerns. We suggest possible applications of implementing false memories of food experiences for therapeutic means. However, we emphasize that such suggestions are cautious, in light of the scant literature on the ethics and safety of utilizing false memories for eating behavior.

There are two general ways by which false food memories could be utilized to positively influence our general eating habits. One is to increase preference for healthy foods and the other is to introduce aversion to unhealthy (junk) foods. Regarding the former, ideally people would come to believe that they enjoyed a range of food items, or at least, as in the "asparagus love" study, that they enjoyed a particular vegetable. This method would be beneficial for people who do not already consume enough vegetables and fruits in general.

In order to reduce or eliminate certain foods from the diet, aversion to those foods via false food memories could be implemented. Both preference-inducing and aversion-inducing applications of false food memories could be especially useful for people who have a tendency to avoid novel foods (neophobia) or

have health conditions requiring them to be vigilant about their diets. Obesity is one such condition, and may actually be related to neophobia. In each case, a goal is to increase healthy food intake and simultaneously decrease junk food consumption. We now consider the problems of neophobia and obesity.

Food Neophobia and Obesity. Food neophobia is the fear of trying new foods. Having evolved as omnivores with an interest in novel foods, humans historically avoided novel foods because such foods could be dangerous (Rozin 1976; Rozin and Fallon 1987). However, novel foods are rarely dangerous in our current society, reducing our need for neophobic tendencies. Furthermore, by definition, food neophobia has a constraining effect on dietary variety (Falciglia et al. 2000). This could limit the variety of nutrients consumed (Martins 2002), reducing overall health. Indeed, neophobic children tend to have poorer overall diets than non-neophobic children, consuming less vitamin E and more saturated fat (Falciglia et al. 2000). Increased dietary variety in early life increases willingness to try novel foods (Mennella et al. 2001). Thus, if a neophobic or other person who had limited childhood dietary variety formed false memories of having tried different foods as a child, they might increase their food variety in general, alongside the new penchant for eating the food for which they have the false memory.

Evolutionarily speaking, humans are presumably adapted to seek out high fat, sugary, salty foods (Galee 1996). When neophobia is coupled with the abundance of these foods, as found in North America, such foods would conceivably become the mainstay of neophobic people (Birch 1999). Indeed, as mentioned, neophobic children have higher saturated fat intake (Falciglia et al. 2000). This suggests that one answer to the burgeoning problem of obesity may lie in addressing not only the food preferences in obesity itself, but also the underlying neophobia (if present). To this end, a false memory diet (the formation and consequences of false food memories) could be used by training individuals to avoid eating fatty, sugary foods while simultaneously increasing vegetable intake.

Despite memory modification's prospects, Pezdek and Freyd (2009) object to the generalizability of Geraerts et al.'s (2008) findings, including the efficacy in treating obesity. Pezdek and Freyd assert that false memories probably will not be able to produce aversion to (a) foods that do not naturally elicit disgust already and (b) commonly eaten and enjoyed foods. Regarding obesity, they rightly remind us that no one food is responsible for obesity. Moreover, because becoming sick would be a rare occurrence for many of the culprit foods (which tend to be familiar, fatty, and sugary or salty), this event would be implausible. Thus people would be more likely to resist false memory formation for the target event (Pezdek et al. 1997). However, these objections may not be as widely applicable as Pezdek and Freyd suggest.

With regard to (a) and (b), the following foods have been used to date in published false food memory studies: Hard-boiled eggs, dill pickles, strawberry ice cream, chocolate chip cookies, asparagus, egg salad, and peach yogurt. With the exception of chocolate chip cookies, the rest of these foods produced consequences such as lowered food preference, taste ratings, and actual consumption. With the exception of hard-boiled eggs and egg salad, none of the other foods listed here is typically associated with a disgust reaction. Moreover, two of these foods are eaten regularly, including ones that do not naturally elicit disgust (i.e., peach yogurt, dill pickles), yet subjects still formed false food memories for these foods.

What we can say so far is that foods *most* amenable to the false memory diet seem to be less common foods (Bernstein et al. 2005b) – and by extension, less preferred foods, as well as foods that are naturally more disgusting. Prima facia, the potential ease of applying a false food diet to disgusting foods appears related to the plausibility of those foods inducing illness (Pezdek and Freyd 2009). Considering disgust in particular, people tend to be disgusted by meat or fat (Martins and Pliner 2006, 2005; Martins et al. 1997; Scott and Downey 2007), and bitter vegetables (Scott and Downey 2007), as well as certain textures, such as slimy substances (Martins and Pliner 2006; Scott and Downey 2007). With this in mind, we could take advantage of the disgust factor for reducing fat intake, since disgust-inducing foods – with the exception of bitter vegetables – often tend to be animal-based which are usually higher

in fat that non-animal-based foods. Regarding other fatty foods in general, the non-disgust-inducing common ones seem to be resistant to memory modification. In addition, a possible solution to modifying those tenacious memories for less common foods may be to use stronger manipulations such as photo-doctoring, whereby subjects see themselves eating the culprit food (see Wade et al. 2002). There is, however, another tentative method for the modification of nutritional behavior, called covert sensitization. Unlike the false memory diet, it does not include false belief or memory formation per se, though like the false memory diet, it is based on detailed visualization of a given script.

Covert Sensitization: A solution to alcoholism and obesity? First introduced by Cautela (1966), covert sensitization is a modification of aversion therapy, which originally used physical conditioning by way of chemical or electrical means to induce nausea and disgust associated with a particular behavior (see Davidson 1974 for review). In covert sensitization, the physical stimulus and undesirable stimulus are actually absent (hence "covert"), and are instead imagined by the patient. Sensitization occurs as the aversion intensifies across sessions (see Table 107.2). When this reaction remains consistent over time, therapy is considered successful.

Covert sensitization is supposedly rapid and has appeared useful in treating some forms of overeating, including snacking between meals, and chocolate addiction (Kraft and Kraft 2005). However, other studies have brought its efficacy into question (Little and Curran 1978). Whereas the false food memory diet that we discuss here often modulates the overall amount of food consumed, covert sensitization (assuming that it works) requires complete abstinence; this is fine if one's goal is to completely eliminate, say, cookies from one's diet. However, this is not ideal if one still would like to enjoy the occasional dessert; strawberry ice cream and vomit do not make an appealing combo. Furthermore, there may be ethical issues to consider in applying covert sensitization or false memory diets to individuals suffering from eating disorders such as anorexia or bulimia. The same could be said for false memory diets.

Ethical considerations. As asserted by Davidson (1974), whenever a therapy involves intentional change in behavior, ethics must be considered carefully. In this chapter we suggest not only solutions for eating behaviour alteration, but a possible, new way of doing so via memory modification. We know that memories are naturally fluid, subject to reconstruction, including false details. Yet when it comes to purposeful, complete fabrication of memories, one must ponder the ethics involved and whether the potential benefits outweigh the costs. A few false memories of loving asparagus or getting sick from strawberry ice cream may or may not outweigh the ethics involved in planting these memories.

Table 107.2 Procedure for covert sensitization (amalgamated from various sources – Anant 1967; Cautela 1967; Cautela and Kearney 1986)

1. Physical relaxation and deep breathing
2. 3 steps in the imagined scene
   (a) Imagine setting
   (b) Imagine taking 1 or 2 drinks
   (c) Imagine taste changing, nausea, and vomiting
3. Incrementally introduce aversion to alcohol
   (a) 1st stage: Imagine 3 steps (above), in certain settings, and at home
   (b) 2nd stage: Imagine more scenes, different settings (Cautela 1967; Anant 1967)
   (c) 3rd stage: Imagine smell of liquor inducing nausea and vomiting
   (d) 4th stage: Imagine that the desire to drink leads to sickness
   (e) 5th session: Learn differentiation between liquor (as sickness inducing) and nonalcoholic beverages (as comfort-maintaining)
4. Session stops when therapist notices that patient's appearance becomes indicative of "disgust and nausea" (e.g., facial discoloration) (Anant 1967, p. 20)
5. Patient repeats critical procedure 10–20 times, twice per day (Cautela and Kearney 1986)
6. Patient advised to implement procedure whenever temptation arises (Cautela and Kearney 1986)

This table lists the covert sensitization procedure, using alcohol as the example target substance

Summary Points

- Thesis: False memories for a food or alcohol-related experience can affect diet and food preferences.
- Some foods are more amenable than others to false memory formation.
- Uncommonly eaten foods, even if fatty and sugary (e.g., strawberry ice cream) appear to be more amenable to false memories of sickness.
- Commonly eaten foods (e.g., cookies) seem less amenable to false memories of sickness, yet some commonly eaten foods have been shown to be amenable to false memories of sickness (e.g., yogurt, pickles).
- By definition, "Believers" tend to develop false food memories that result in attitudinal and behavioral consequences.
- By definition, "Nonbelievers," tend not to develop false food memories that show attitudinal and behavioral consequences.
- In nearly every experiment, Believers show more behavioral consequences than do Nonbelievers or control subjects.
- A minority of subjects develop false food memories.
- A "false memory diet" (i.e., false food memories and their consequences) may be applied to (a) increasing preference for healthy foods, such as asparagus and (b) creating aversion to potentially unhealthy substances like alcohol and fatty foods.
- A false memory diet could be applied to several food-related health issues such as neophobia, obesity, alcoholism.
- Covert sensitization, like false food memories, may be useful in manipulating food preferences.
- Unlike covert sensitization, false food memories can generalize to other types of similar foods.
- Future research may identify (a) a larger range of foods amenable to memory modification, (b) why some foods are more amenable than others, (c) new methods to accommodate the difficult foods, and (d) who could benefit from a false memory diet.
- Ethical considerations include (a) misuse of covert sensitization or a false memory diet by sufferers of anorexia or bulimia, (b) the sensitive nature of purposefully modifying someone's memory, and (c) the notion of intentional behavioral modification in general.

Key Terms

Believers: Subjects who incorrectly believe that a suggested event occurred to them in the past.
False belief: Incorrect belief that an event occurred, but inability to recall specific details about the event.
False food memories: Refers here to both false food memories and false alcohol memories.
False memory: Memory for a particular event that never actually occurred.
False memory diet: The formation and consequences of false food memories.
Food neophobia: Fear of trying new foods.
Food neophilia: Seeking and enjoying new foods.
Fluency: Ease of processing, which can mean speed (operationally defined as reaction time), integration, coherence, or well-formedness of perceptual detail, or the perception of ease independent of the speed of processing.
Nonbelievers: Subjects who correctly believe the false feedback to be false.
Subject: A person who participates in a research study. Participation is always voluntary, as monitored by research ethics boards.

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