

# Asparagus, a Love Story

## Healthier Eating Could Be Just a False Memory Away

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**Abstract.** In two experiments, involving 231 subjects, we planted the suggestion that subjects loved to eat asparagus as children. Relative to controls, subjects receiving the suggestion became more confident that they had loved asparagus the first time they tried it. These new (false) beliefs had consequences for those who formed them, including increased general liking of asparagus, greater desire to eat asparagus in a restaurant setting, and a willingness to pay more for asparagus in the grocery store. Ratings of photographs made after the suggestion reveal that the altered nutritional choices may relate to the fact that the sight of asparagus simply looks more appetizing and appealing. These results demonstrate that adults can be led to believe that they had a positive food-related experience as children, and that these false beliefs can have healthy consequences.

**Keywords:** false memory, belief, consequences

Human memory is subject to many types and levels of distortion. People's memories of the events of their own lives can be incorrect. Researchers have been able to plant false details for actual events (for a review, see Ayers & Reder, 1998) and even entirely false events (e.g., Garry & Wade, 2005; Hyman, Husband, & Billings, 1995; Loftus & Pickrell, 1995). These "rich false memories" (Loftus & Bernstein, 2005) have even included impossible events, like meeting Bugs Bunny at Disneyland (Braun, Ellis, & Loftus, 2002) or undergoing a very specific, made up, medical procedure (Mazzoni & Memon, 2003).

False beliefs and memories<sup>1</sup> can have real consequences for subjects. In one recent study (Bernstein, Laney, Morris, & Loftus, 2005b) we gave subjects false feedback that suggested they had gotten sick as children after eating either dill pickles or hard-boiled eggs. A substantial minority of subjects (25% in the "pickle" group and 31% in the "egg" group) believed the feedback. These believers were subjects whose confidence in the occurrence of the false event increased after the false suggestion, and who reported a specific belief or memory for the event. These false food beliefs had consequences for subjects, including reduced self-reported willingness to eat pickles or eggs, and lower self-reported levels of liking of these foods. There was also some avoidance of closely related foods like pickle slices

on a hamburger and egg salad sandwiches. In later research, we showed that false memories could be planted about having gotten sick eating a fattening food, and those who fell for the suggestion showed avoidance later (Bernstein, Laney, Morris, & Loftus, 2005a).

If a false belief that one had a negative experience with a food can lead people to avoid the food, could a positive false belief about a food lead people to want to eat the food more? The answer to this question is not obvious, because most rich false memory studies involve negative or neutral events. To our knowledge, no one has tested false beliefs for positive events and examined the associated consequences of these beliefs. Finding false beliefs for a positive experience and showing that such beliefs have positive consequences for one's attitudes and behaviors would have both theoretical and practical significance. First, this finding would demonstrate that it is possible to implant positive false beliefs and memories in people. Second, this finding could conceivably aid in the clinical treatment of certain disorders (e.g., generalized anxiety, phobias). Also, positive false memories could aid in the development of healthier eating habits or possibly even reverse food aversions associated with chemotherapy in cancer patients.

With these ideas in mind, we sought to test a positive false memory effect: We suggested to subjects that they had

<sup>1</sup> The field talks of beliefs versus memories (see Scoboria, Mazzoni, Kirsch, & Relyea, 2004). One way to make this distinction is to ask subjects whether they have a memory or belief about the critical false event. We do this as one of the normal steps of our false memory studies. Alternately, researchers might code subjects' responses for quantity or quality of detail or other characteristics. The data in the present paper represent some false memories and some false beliefs. But because it is awkward to say "false memories and false beliefs" repeatedly, we generally just use one term (either "false memory" or "false belief") to encompass the notion of planting a false entity.

loved a specific food (asparagus) as children. We then looked for consequences of these newly acquired positive beliefs, including increased liking of asparagus and intention to eat asparagus in a restaurant setting. We chose asparagus as our food item because it is a healthy vegetable with a rather sophisticated taste, and thus not a food that most children immediately like (or that most adults assume they liked as children). We expected that many subjects would enter the study with low confidence that they had liked asparagus the first time they tried it, and that our suggestion would increase that confidence. We explored whether those subjects who fell for the manipulation and developed false beliefs and false memories would show an increased intention to eat asparagus.

Although we expected to be able to implant memories of loving asparagus the first time it was tried, it was not a forgone conclusion that these false memories would lead to positive consequences for our subjects. In our previous studies, we convinced subjects that they had been *made sick* by a specific food (e.g., pickles or strawberry ice cream). We argued that these false memories created a sort of mental taste aversion in our subjects. Loving a particular food the first time one tries it does not have the same visceral element, so we were not sure that false memory consequences would follow in the same way.

## Experiment 1

### Overview

In this study, we gave subjects false feedback suggesting that they had loved to eat a specific food (“cooked asparagus”) as children. We determined whether subjects developed a false belief or memory and then we looked for consequences of these false beliefs and memories, including changes in general liking of asparagus and willingness to eat asparagus in a restaurant setting.

### Method

#### Subjects

The subjects were 128 undergraduates at the University of California, Irvine, who received course credit for their time. Subjects were mostly female (77%) and had a mean age of 20.8 ( $SD = 5.1$ ). Subjects were randomly assigned to the “Love” group ( $n = 63$ ) and the control group ( $n = 65$ )<sup>2</sup>. They were run in groups of up to eight.

### Materials and Procedure

On their arrival in the lab (at Session 1) subjects were told that they would be completing a series of questionnaires for a study of the relationship between “food preferences and personality.” Subjects were not told anything about false memories in order to limit the influence of demand characteristics. Subjects first completed a Food History Inventory (FHI), which contained 24 items, including the critical item “Loved asparagus the first time you tried it,” in the sixteenth position. Subjects were instructed to rate each item on a scale anchored at  $1 = \textit{definitely did not happen}$  and  $8 = \textit{definitely did happen}$  before the age of 10. Subjects also completed a Restaurant Questionnaire that assessed their desire to eat each of 32 separate dishes, including the critical item “sautéed asparagus spears,” in a restaurant setting. This questionnaire was formatted to look like a menu with five categories (appetizers, soups and salads, entrées, sides, and desserts). Subjects were asked to imagine that they were out for a special dinner, and then decide how likely they were to order each item on the menu, regardless of price. Subjects circled their ratings (anchored by  $1 = \textit{definitely no}$  and  $8 = \textit{definitely yes}$ ) for each item. Interspersed with these two questionnaires were three additional filler questionnaires designed to disguise the true nature of the experiment. These questionnaires included a personality measure, a subset of the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960), and a questionnaire that assessed eating habits.

Approximately one week later (Session 2), subjects returned and were given false feedback about their responses to the materials from Session 1. They were told falsely that we had entered their responses into a computer, which had generated a profile of their early childhood experiences with certain foods. The profiles were presented as if they had been individually tailored to the specific subject. A portion of the profile was identical for all: As a young child, “you disliked spinach,” “you enjoyed fried foods,” and “you felt happy when a classmate brought sweets to school.” The critical item, “you loved to eat cooked asparagus,” was embedded in the third position of the profile for subjects in the Love group. Control subjects’ feedback had only the three filler items and said nothing at all about asparagus. To ensure that subjects processed the feedback, all subjects responded to brief questions about the sweets at school item, and the Love group also answered these questions about the critical asparagus item. First, subjects were asked to “Imagine the setting in which this experience might have happened. Where were you? Who was with you?” Then subjects were asked, “To what extent did this experience affect your adult personality?” on a scale of  $1 = \textit{not at all}$  to  $9 = \textit{very much}$ . When the questions had been answered, the experimenter collected the profiles.

<sup>2</sup> Two additional groups (one of which received feedback that they had “hated asparagus the first time you tried it,” as well as an additional control for this group) were also run at the same time as the “loved asparagus” and control groups. These groups will not be addressed in the present discussion, because a failure of random assignment made these data hard to interpret.

Next, subjects completed the FHI and Restaurant Questionnaire a second time to assess changes from pre- to post-manipulation. Two additional postmanipulation measures followed. The first was a Food Preferences Questionnaire, where subjects rated 62 separate food items (including the critical “asparagus” item) on a Likert-type scale anchored at 1 = *definitely don't like to eat (for whatever reason)* and 8 = *definitely like to eat*. The second was a Food Costs Questionnaire where subjects indicated the most they would be willing to pay for each of 21 different food items at a grocery store (including the critical item “a pound of asparagus”) by circling a price. Several items besides asparagus (e.g., zucchini, tortilla chips, and rice) had appeared on earlier questionnaires. For each item, subjects were given seven different price choices, based on real grocery store prices, plus a “would never buy it” option. For asparagus, the price options were \$1.90, \$2.50, \$3.20, \$3.80, \$4.40, \$5.00, and \$5.70.

Finally, subjects completed a “Memory or Belief? Questionnaire” (based on that used by Bernstein et al., 2005b). Subjects were asked to respond to three items from the FHI, including the critical item, by indicating whether they had a specific memory for the event, had a belief that the event had occurred (but lacked specific memory), or were positive that the event had not occurred. Subjects were instructed to give as many detailed reasons as possible for selecting their choices. This distinction between “memories” and “beliefs” is similar to the distinction between “remember” and “know” judgments used by other researchers (Holmes, Waters, & Rajaram, 1998; Scoboria, Mazzoni, Kirsch, & Relyea, 2004; Tulving, 1985). “Memories” (or “remember” judgments) are specific structured units that may be quite detailed. “Beliefs” (or “know” judgments) are less specific and less tied to time and place.

When all materials were completed, subjects were fully debriefed and excused. Each day's procedures took less than ½ h for subjects to complete.

## Results

We addressed two main questions: First, did subjects form false asparagus-related beliefs? And second, did these beliefs have consequences? These questions will be addressed by exploring both within- and between-subjects differences.

### Food History Inventory

Did subjects fall for the suggestion that they loved asparagus the first time they tried it? Yes. Though the Love and control conditions rated their critical FHI items similarly before the manipulation, only the Love group's ratings changed after the manipulation (Figure 1). Because we are studying specifically *false* beliefs, we excluded from all analyses the 31 subjects (17 Love group subjects and 14

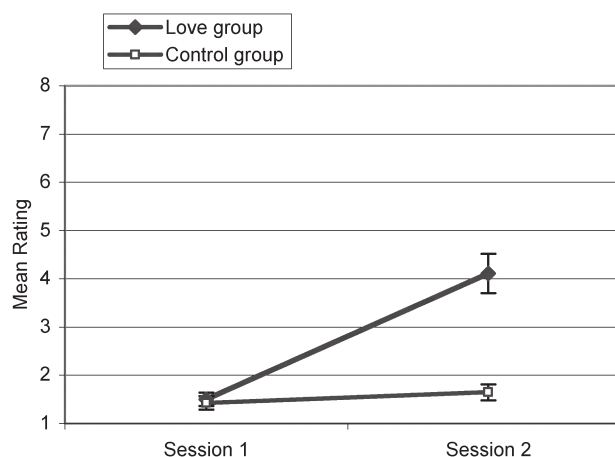


Figure 1. Mean ratings of the critical item (“Loved asparagus the first time you tried it”) on Food History Inventory, pre- and postmanipulation in Experiment 1. Error bars represent standard errors of the mean.

controls) who were reasonably sure that they had loved asparagus the first time they tried it *before the manipulation* (that is, those subjects whose beliefs are arguably “true”). Specifically, we excluded those subjects whose pre-manipulation rating of the critical item was five or greater on the eight-point scale of the FHI. Thus, the functional  $n$  for this study is 97. The mean ratings of the remaining 46 subjects in the Love group increased 2.6 points after the manipulation, indicating that they became more confident that they had loved asparagus the first time they tried it as a child. The mean ratings of the 51 remaining control subjects increased just 0.2 points.

According to a repeated measures ANOVA, there was a significant main effect of group on confidence ratings,  $F(1, 95) = 22.89, p < .001$ , partial  $\eta^2 = .19$ , as well as a significant interaction of group and time point,  $F(1, 95) = 33.43, p < .001$ , partial  $\eta^2 = .26$ .

### Memories or Beliefs?

Later in the study, subjects were asked whether they had specific memories of loving asparagus the first time they tried it, or believed that it had been the case in the absence of any specific memory, or were positive that it had not been the case. Nearly a quarter (22%,  $n = 10$ ) of Love group subjects (those manipulated on the critical item, “loved asparagus the first time you tried it”) indicated that they had a memory, and an additional 35% ( $n = 16$ ) indicated that they had a belief (44% [ $n = 20$ ] were positive that it had not been the case). In contrast, just 12% of control group subjects ( $n = 6$ ) reported a memory, 28% ( $n = 14$ ) reported a belief, and 61% ( $n = 31$ ) were positive that the event had not occurred. When these data are collapsed into positive that the event did not happen on the one hand and memory or belief that the event did happen on the other hand, the

difference was in the expected direction, though not statistically significant,  $\chi^2(1, n = 97) = 2.91, p = .09$ .

### Believers Versus Nonbelievers

Some subjects are necessarily more susceptible to a given manipulation than others, for a variety of reasons (e.g., individual differences in performance). This fact makes it desirable to differentiate between “believers” (i.e., those who were susceptible to the manipulation) and “nonbelievers” (those who were not).

According to our conservative definition of “believers,” subjects must meet certain criteria before they are judged to have fallen sway to our manipulation. (For a fuller discussion of “believers,” see Morris, Laney, Bernstein, & Loftus, 2006.) First, subjects must have given not only a low rating to the critical FHI item at Session 1 (as we have required of all subjects whose data we analyzed), but also increased their ratings at Session 2. For example, they might give a confidence rating of “2” before the manipulation and a “4” after it. Second, the subjects must have given a “memory” or “belief” response on the Memory or Belief? Questionnaire, indicating that they believed the event had occurred, or specifically remembered it occurring. Those in the Love group who failed to meet both criteria were called nonbelievers. Forty-eight percent ( $n = 22$ ) of all low-starting subjects in the Love group met the criteria to be labeled believers. Just two males (18% of males in the experimental condition) met the criteria to be labeled believers, while 20 females (57%) met the criteria.

The ratings of these 22 believers increased an average of 4.5 points from Session 1 to Session 2 on their FHI item. Nonbelievers increased an average of just 0.9 points. Of the 22 subjects classified as believers, 10 claimed to have an asparagus “memory” at the end of the study, and 12 claimed a “belief.” Those with “memories” increased an average of 5.5 points on the FHI item, while those with “beliefs” increased less (3.6 points on average). These differences were statistically significant,  $t(20) = 2.31, p = .03, r^2_{pb} = .21$ .

### Consequences of False Beliefs

In analyzing the consequences of false beliefs, our primary comparison groups were believers (those who developed false beliefs) and control subjects. We excluded nonbelievers (those who resisted false memory implantation) from analyses in the interests of clarity and brevity. Although the differences between believers and nonbelievers are more striking in many of our comparisons, we argue that our control subjects provide a more conservative test of false mem-

ory formation and resulting consequences. In both studies reported here, believers and controls were statistically indistinguishable on pretest consequence measures.

### Restaurant Questionnaire

The Restaurant Questionnaire, which was completed both before and after the manipulation, asked subjects to rate their likelihood of eating each of 32 dishes on a scale of 1–8. As shown in the right side of Figure 2, believers reported more desire to eat the critical asparagus item at Session 2 than controls,  $t(71) = 3.42, p = .001, r^2_{pb} = .14$ . A repeated measures ANOVA yielded both a significant main effect of condition,  $F(1, 70) = 8.01, p = .01, \text{partial } \eta^2 = .10$ , and a significant interaction of condition and time point,  $F(1, 70) = 5.50, p = .02, \text{partial } \eta^2 = .07$ , such that believers rated asparagus more favorably than controls, and believers’ ratings increased from pre- to postmanipulation, while controls’ did not.

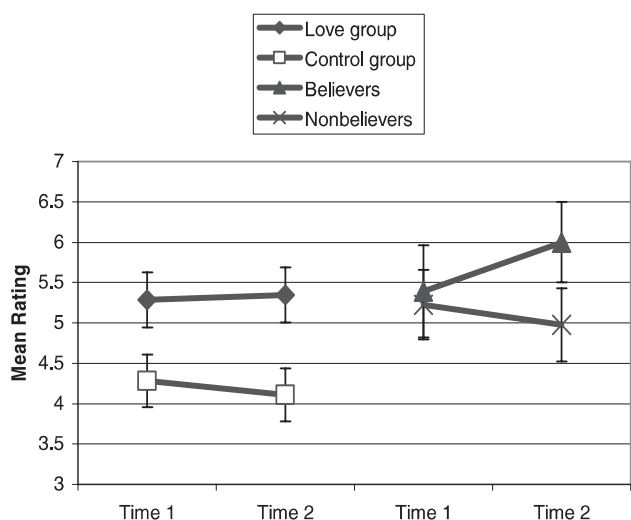


Figure 2. Mean ratings of the critical item (“sautéed asparagus spears”) on the Restaurant Questionnaire, pre- and postmanipulation in Experiment 1. The left-hand side of the graph refers to all subjects, split by group. The right-hand side shows Love group subjects only, split according to whether they met the criteria for “believers.” Error bars represent standard errors of the mean.

### Food Preferences

Two additional measures were used postmanipulation. The first was the Food Preferences Questionnaire, on which subjects rated food items using an eight-point scale. Relative to the control group ( $M = 3.84, SD = 2.69$ ), believers ( $M = 6.14, SD = 2.12$ ) reported liking asparagus significantly more  $t(50.01^3) = 3.42, p = .001, r^2_{pb} = .19$ .

<sup>3</sup> An adjustment to the *df* has been made in light of a significant Levene’s test for equality of variances. Additional adjustments have been made throughout the paper as necessary.

## Food Costs

Subjects also rated the most they would pay for numerous food items, including a pound of asparagus. As the price options were not at equal intervals, the nonparametric Mann-Whitney  $U$  test was utilized. Believers were willing to pay significantly more for asparagus than were those in the control group, Mann-Whitney  $U = 375$  ( $z = 2.33$ ),  $p = .02$ . In addition, over a quarter ( $n = 14$ ) of those in the control group said they would never buy asparagus, while none of the believers selected that response,  $\chi^2(1, n = 73) = 7.47$ ,  $p = .006$ .

## Discussion

The major finding of Experiment 1 is that subjects can be led to develop positively-framed false beliefs about experiences with foods, and that these beliefs can lead to increased liking of those foods. We were able to convince nearly half (48%) of our subjects that they had loved asparagus the first time they tried it as children, even though they began the study relatively confident that this was not the case. In addition, these false beliefs had consequences for subjects. After the manipulation, in comparison to control subjects, Love group believers reported greater intention to eat asparagus in a restaurant, greater preference for asparagus, and even a willingness to pay more for asparagus.

But why might false beliefs about having loved a healthy food the first time one tried it lead to increased liking of that food? Our second experiment was designed to begin to address the question of the underlying mechanisms of our current and previous findings of false memory consequences. One possibility is that just the thought of asparagus seems more appealing to subjects. If so, consider what might happen if the manipulated subjects were shown a photograph of asparagus. Would they rate the photograph as being more appetizing and less disgusting? These questions motivated Experiment 2.

## Experiment 2

### Overview

In Experiment 2, our first aim was to replicate and extend the results of Experiment 1. Our second aim was to make an initial attempt at examining a possible underlying mechanism of our false memory consequence effect by exploring whether, after our false asparagus manipulation, the very sight of asparagus is more appealing to subjects.

## Method

### Subjects

The subjects were 103 undergraduates at the University of Washington who received course credit for their time. Sixty-two percent of subjects were female, and their mean age was 19.9 ( $SD = 2.9$ ). These subjects were assigned to one of two conditions: Love ( $n = 58$ ) and control ( $n = 45$ )<sup>4</sup>.

### Materials and Procedure

On their arrival in the lab (at Session 1) subjects were told that their data would be entered into a computer that would generate a profile based on their answers. No cover story was given. Subjects completed a Food History Inventory (FHI) like that used in Experiment 1, which contained the critical item, "Loved asparagus the first time you tried it." Subjects also completed the Food Preferences Questionnaire and the Restaurant Questionnaire, as in Experiment 1 (in this study both of these measures were completed both pre- and postmanipulation). Interspersed with the three questionnaires were two filler questionnaires used to disguise the true purpose of the study. These were a personality questionnaire and the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960).

One week later (Session 2) subjects returned and received false feedback about their responses to the materials from Session 1. Just as in Experiment 1, they were told falsely that their responses had been entered into a computer, and that the computer had generated a profile of their early childhood experiences with certain foods. Again, the critical item was embedded in the third position of the profile. This critical item was slightly different from that used in the first experiment. Specifically, it said, "you loved asparagus the first time you ate it." As before, controls were told nothing about asparagus. Subjects in the experimental group (but not controls) then completed an elaboration exercise. They were instructed to answer questions about their memory for this event, or, if they lacked a specific memory, to imagine what *might* have happened. Specifically, they were asked for their age at the time of the event, the location of the event, what they were doing at the time, who was with them, and how it made them feel. All subjects then completed an additional exercise that asked them "What is the most important childhood, food-related event in your life that your food profile *did not* report? Please explain in the space below."

Subjects then viewed a series of 20 slides and completed four ratings of each slide. The slides were photographs of common foods (e.g., spinach, strawberries, pizza, and the critical item, asparagus). Each slide was displayed for 30 seconds. (See Figure 3 for samples of some of the photo-

<sup>4</sup> An additional 78 subjects were assigned to experimental and control groups with a critical item of spinach. Those data will not be addressed here.

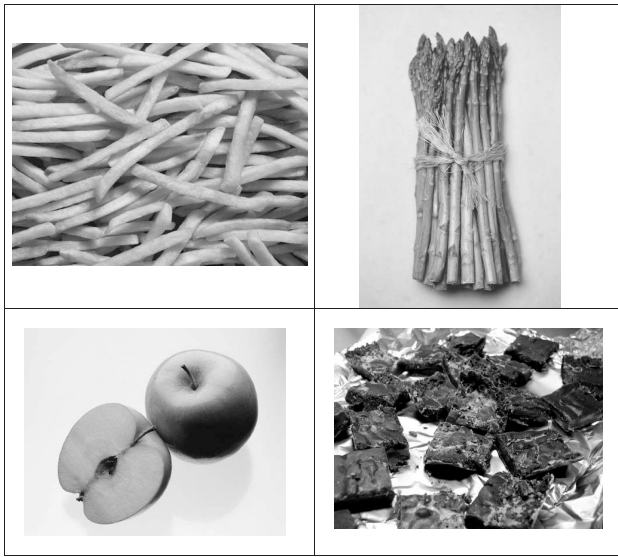


Figure 3. Sample pictures rated by subjects in Experiment 2. Note. Original pictures were in full color.

graphs that were rated.) During this time, subjects rated each photograph according to how appetizing they found the food depicted in the photo, how disgusting they found the food depicted in the photo, whether the photo was taken by a novice, amateur, or expert photographer, and the artistic quality of the photo. The first, second and fourth questions were rated on a scale from 1 = *not at all* to 8 = *very much*. Subjects then completed the Restaurant Questionnaire, Food Preferences Questionnaire, and the Food History Inventory for a second time. Finally, subjects completed the same Memory or Belief? Questionnaire as in Experiment 1. When all materials were completed, subjects were fully debriefed and excused.

## Results

### Food History Inventory

As in Experiment 1, the Love and control groups rated the critical item similarly before the manipulation, but differently after it. Once again, we excluded from all analyses the 30 subjects (18 Love group subjects and 12 controls) who were reasonably sure that they had loved asparagus the first time they tried it *before the manipulation* (with a rating of five or higher on the FHI). Thus, the functional  $n$  for this study is 73. The mean confidence of the Love group increased from 1.70 to 4.20 (2.5 points), while that of the control group increased less (moving from 1.45 to 2.52, just 1.1 points). According to a repeated measures ANOVA,

there was a significant main effect of group,  $F(1, 71) = 7.91, p = .006$ , partial  $\eta^2 = .10$ , and a significant interaction between group and time point,  $F(1, 71) = 5.97, p = .02$ , partial  $\eta^2 = .08$ .

### Memories or Beliefs?

As in Experiment 1, subjects were asked whether they had specific memories of loving asparagus the first time they tried it (as well as their memory for two other events), or believed that it had been the case in the absence of any specific memory, or were positive that it had not been the case. In the Love group, 11 subjects (28%) reported “memories,” 11 (28%) reported “beliefs,” and 18 (45%) were positive that it had not been the case. In the control group, just two subjects reported “memories” (6%), 12 reported beliefs (38%) and 18 (56%) were “positive” that it had not been the case.<sup>5</sup> These group differences reflected a trend in the expected direction,  $\chi^2(2, n = 72) = 5.45, p = .07$ .

We compared those believers who ended the study with a “memory” to those who ended the study with a “belief.” The confidence of the 10 believers who ended the study with a “memory” of the critical event increased significantly more (5.4 points, on average) than did that of the 10 believers who ended the study with a “belief” (3.5 points, on average),  $t(19) = 2.53, p = .02, r^2_{pb} = .25$ .

### Believers Versus Nonbelievers

We used the same definition of believers as in Experiment 1 – a subject must have given a higher rating at Session 2 than at Session 1, and given a “memory” or “belief” response on the Memory or Belief? Questionnaire. In the present data, 21 subjects from the Love group (53% of the 40 subjects who had initial low ratings of the critical item) met the criteria to be labeled believers. The confidence of believers increased dramatically from Session 1 ( $M = 1.95, SD = 1.12$ ) to Session 2 ( $M = 6.48, SD = 2.02$ ). Nonbelievers increased just 0.07 points, on average, from 1.42 ( $SD = 0.90$ ) to 1.68 ( $SD = 1.53$ ). In the present data, males ( $n = 6; 50%$ ) and females ( $n = 15; 54%$ ) were equally likely to form false memories,  $\chi^2(1, n = 40) = 0.43, p = .84$ .

### Consequences of False Beliefs

As in Experiment 1, the primary comparison groups here are believers and controls (though data for nonbelievers can be seen in Figure 4).

<sup>5</sup> The majority of comments associated with the control subjects’ responses indicated inferences more than specific beliefs (e.g., I like asparagus now, so this could have happened). One “memory” respondent only noted that she *couldn’t* remember *not* liking asparagus. Another said that he nearly threw up when he first ate asparagus, which would indicate a memory of *hating* asparagus, not of loving it.

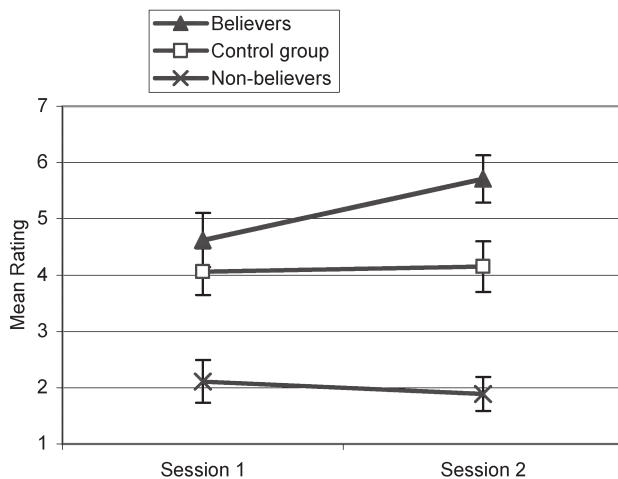


Figure 4. Mean ratings of the critical item ("asparagus") on the Food Preferences Questionnaire, pre- and postmanipulation, split by whether subjects believed the manipulation (believers), did not believe the manipulation (nonbelievers), or were not exposed to the manipulation (controls), in Experiment 2. Error bars represent standard errors of the mean.

#### Food Preferences Questionnaire

The Food Preferences Questionnaire (in which subjects were asked to rate their preferences for each of 62 foods on a scale of 1–8) was completed both before and after the manipulation. These data can be seen in Figure 4. Believers reported more desire to eat the critical asparagus item at Session 2 than did controls,  $t(52) = 2.40$ ,  $p = .02$ ,  $r^2_{pb} = .10$ . A repeated measures ANOVA yielded a significant main effect of condition,  $F(1, 51) = 4.07$ ,  $p = .049$ , partial  $\eta^2 = .07$ , with believers demonstrating more preference for asparagus than controls.

#### Restaurant Questionnaire

The Restaurant Questionnaire (in which subjects were asked to rate their likelihood of eating each of 32 dishes on a scale of 1–8) was also completed both pre- and postmanipulation. Neither believers' nor controls' ratings changed significantly from pre- to postmanipulation.

#### Photograph Ratings

Subjects in Experiment 2 were also asked to judge a series of photographs of food items (including a photograph of a bunch of asparagus) on four dimensions. Three dimensions (appetizing, disgusting, and artistic quality) were rated on 8-point scales.

As can be seen in Table 1, believers rated the asparagus photo as more appetizing than did controls (5.10 versus 4.00), and as less disgusting (1.81 versus 3.24). Statistical tests revealed that when asked to rate how appetizing each pictured food was, believers' ratings were marginally higher than those of controls,  $t(52) = 1.89$ ,  $p = .06$ ,  $r^2_{pb} = .06$ . When asked to rate how disgusting each pictured food was, believers ratings were significantly lower than those of controls,  $t(51.9) = 2.66$ ,  $p = .01$ ,  $r^2_{pb} = .12$ . Believers and controls did not rate the pictures differently on the dimensions of expertise,  $\chi^2(2, n = 54) = 3.00$ ,  $p = .22$  or artistic quality,  $t(52) = 0.36$ ,  $p = .72$ ,  $r^2_{pb} = .002$ .

#### Discussion

In Experiment 2, we showed once again that subjects can be given positive false food beliefs, and that these beliefs can have consequences. In addition, Experiment 2 demonstrated that subjects who believed our false feedback were more likely than control subjects to rate a photograph of the critical food, asparagus, as more appetizing and less disgusting. Our photograph measure provides a first step toward assessing the underlying mechanisms associated with false memory consequences. Specifically, our false feedback manipulation, combined with our photograph ratings show that the mere sight of our critical item, asparagus, in a photograph is sufficient to induce some people to rate asparagus more positively. We believe that the mechanism by which this occurs is that the false feedback primes subjects to process the critical item, asparagus, more fluently in subsequent encounters with the critical item, asparagus. Subjects interpret this enhanced fluency as familiarity, and misattribute it to childhood experience ("I did love asparagus the first time I tried it") and adult preference ("I love asparagus").

Table 1. Mean ratings of critical items on postmanipulation photographic consequence measures in Experiment 2

	Appetizing		Disgusting		Artistic quality	
	<i>M</i>	( <i>SD</i> )	<i>M</i>	( <i>SD</i> )	<i>M</i>	( <i>SD</i> )
Believers	5.10 <sup>a</sup>	(2.05)	1.81 <sup>a</sup>	(1.57)	4.95	(2.22)
Nonbelievers	2.63 <sup>b</sup>	(1.74)	3.84 <sup>b</sup>	(2.41)	5.16	(2.09)
Controls	4.00	(2.09)	3.24 <sup>b</sup>	(2.39)	4.76	(1.73)

Note. All three questions asked subjects to respond on a scale of 1–8. Believers were subjects who fell sway to the manipulation. Nonbelievers did not fall sway. Controls were not exposed to the manipulation. Means in the same column with the different notations are significantly different from each other,  $p < .05$ .

## General Discussion

In two experiments we showed that subjects could be led to believe falsely that they had a specific positive experience with a healthy food as children, and that this belief had consequences in their adult lives. Specifically, after being led to believe that they had loved asparagus the first time they tried it, subjects' attitudes toward asparagus were more positive. Those subjects who accepted the false feedback ("believers") preferred asparagus more than did controls (Experiments 1 & 2). Believers also expressed somewhat more interest in eating sautéed asparagus spears in a restaurant, and were willing to pay more for asparagus in a grocery store (both Experiment 1). These effects also spread to more ephemeral areas, such that, compared to control subjects, believers judged a photograph of asparagus to be less disgusting and somewhat more appetizing (Experiment 2).

Some have suggested that our consequence effects may instead involve a simple association between a food (e.g., pickles or asparagus) and a negative or positive thought, like "yuck" or "yum." Once this association is established, it need only be triggered by the presence of the particular food (pickles or asparagus) on subsequent questionnaires to produce the desired negative ("yuck") or positive ("yum") response. The data reported here argue against this explanation. If a mere positive association with asparagus were enough, then all subjects exposed to our manipulation should show approximately equivalent results on our consequence measures. Our two experiments yielded no significant group differences on consequence measures (posttest comparisons of Love and control subjects had *t*-values ranging from 0.42 to 1.83, *ps* from .68 to .07). Instead, significant differences were found between subjects who believed the manipulation (those who formed a false belief or memory of loving asparagus the first time they tried it) on the one hand and control subjects on the other hand. That is, subjects needed to have adopted the false belief about asparagus in order to show increased preference for asparagus and likelihood of eating it in a restaurant. In other, unpublished work, we tested this "simple association" hypothesis more directly by having participants generate sentences using a critical food item and several negatively-valenced words (e.g., strawberry ice cream – vomit; strawberry ice cream – feces). Again, we found no support for the idea that our consequence effects involve simple associations between a food and a positive or negative thought.

One ongoing concern in this line of research is demand characteristics (see Orne, 1962). Perhaps our subjects are merely telling us that they want to eat more asparagus because they assume that is what we would want to hear after we have told them that they loved it the first time they tried it. We took a number of steps in both experiments to minimize demand characteristics. We told subjects that we were studying the interactions of food preferences and

personality types, and then we administered questionnaires that made this appear quite plausible. In addition, asparagus-related items were never presented in isolation. Instead, they were always embedded in lists with as many as 61 other foods. Even in the false feedback, three additional food-related statements drew some attention away from the critical item.

More direct evidence arguing against a simple demand characteristics explanation for our results comes from the Marlowe-Crowne Social Desirability Scale data that we collected in both experiments. If subjects in our experiments were merely answering according to demand, then we might expect to see those subjects who believed our 'loved-asparagus' manipulation to also score highly on social desirability.

To test this, first we compared the mean Marlowe-Crowne scores of Believers and Nonbelievers in both experiments. These groups' scores were not significantly different in either Experiment 1,  $t(44) = 0.06$ ,  $p = .95$ , or Experiment 2,  $t(38) = 1.09$ ,  $p = .28$ . Next we performed a median split on our subjects' social desirability scores, and entered the resulting scores (High versus Low social desirability) as a second between-subjects factor besides our group manipulation (Experimental versus Control) in a  $2 \times 2$  ANOVA with confidence change on our Food History Inventory as the dependent measure. For the experiment 1 data, there was a significant main effect of group,  $F(1, 93) = 35.82$ ,  $p < .001$ , partial  $\eta^2 = .28$ , but not of Marlowe-Crowne score (social desirability),  $F(1, 93) = 1.65$ ,  $p = .20$ , partial  $\eta^2 = .02$ . There was a significant interaction of the two factors,  $F(1, 93) = 4.22$ ,  $p = .04$ , partial  $\eta^2 = .04$ , but further inspection revealed that the experimental subjects' average confidence change was *less* for subjects with high Marlowe-Crowne Scores ( $M = 1.96$ ,  $SD = 2.58$ ) than for those with low Marlowe-Crowne scores ( $M = 3.32$ ,  $SD = 2.71$ ). For the experiment 2 data, there was again a significant main effect of group,  $F(1, 69) = 5.56$ ,  $p = .02$ , partial  $\eta^2 = .08$ , but not of social desirability,  $F(1, 69) = 0.02$ ,  $p = .90$ , partial  $\eta^2 < .001$ . For these data, the interaction of the two factors did not reach significance,  $F(1, 69) = 0.51$ ,  $p = .50$ , partial  $\eta^2 = .01$ . These findings support our contention that false beliefs and false memories are real and not simply "simulated memories" of subjects who score highly on social desirability and who try to corroborate the experimenter's hypothesis.

In other related work in our laboratory, we used a more complex procedure to ensure that demand did not affect our results (see Laney et al., 2008). In addition to the cover story and item embedding techniques described above, we also planted hints to suggest that we were studying childhood obesity, and a majority of our subjects bought into our obesity "red herring." Moreover, those subjects who figured out they were in a false memory study were no more likely to demonstrate evidence of false memories, and thus demand was not a major contributor to our false memory effect.



## Limitations

In the present studies we were not able to assess how long the apparent consequences of false beliefs might last. Subjects completed consequence measures within a few minutes of receiving false feedback. Additional research is ongoing that will assess the longer-term consequences of false food beliefs.

In addition, it is worth noting that we do not know for certain whether these effects will translate to genuine eating behaviors. Completing paper-and-pencil tasks may not involve the same processes as choosing to eat (or not eat) a specific food in a restaurant setting, or buying that food in the grocery store. Future research may also attempt to address these issues by including truly behavioral dependent measures.

## Conclusions

These two experiments show that it is possible to implant false beliefs and false memories for a positive childhood experience, such as liking or loving asparagus the first time that one tried it. Moreover, these false beliefs and memories are associated with positive attitudinal and behavioral consequences, such as increased self-reported preference for asparagus, willingness to spend more for asparagus in the grocery store, and increased willingness to eat asparagus in a restaurant. The present study differs from other studies involving rich false memories in at least two ways. First, most rich false memory studies involve negative or neutral events, such as being lost in the mall (Loftus & Pickrell, 1995) or taking a trip in a hot air balloon (Wade, Garry, Read, & Lindsay, 2002). Second, most rich false memory studies stop after the false memory has been implanted. The present study departs from previous work in that we focus on positive false memories and explore the consequences of these positive false memories. We believe that the examination of positive rich false memories has both theoretical and practical significance for memory research in particular and the growing fields of health psychology and positive psychology more generally.

## Acknowledgments

This work was supported by the Grawemeyer Prize in Psychology (to EL) and the National Institutes of Health Institutional Training Grant T32 MH19958-06 (to CL). We would also like to acknowledge Jay Hyler, Soo O, Shari Berkowitz, Patricia Iluore, Angela Manapat, Tracy Nguyen, Jennifer Bondi, Neeta Patel, Seth Morgan, Natalie Barker, Sara Holderfield, and Phung Pham for their assistance in collecting data.

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Received February 20, 2007  
Revision received July 27, 2007  
Accepted July 27, 2007

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