The persistence of false beliefs

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ABSTRACT

Do false beliefs last? To explore this question, the current study planted false beliefs or memories of a childhood experience with asparagus. We found that these false beliefs had consequences for subjects, when assessed directly after the suggestive manipulation. Moreover, subjects were brought back two weeks later to see if their false beliefs persisted. After two weeks, subjects' confidence in their new memories and the consequences of those memories were diminished, but not extinguished. These false beliefs were found to be somewhat weaker than other subjects' true beliefs for the same events. Another novel finding was that the manipulation was sufficiently powerful to affect actual food choices.

1. Introduction

Previous research has demonstrated that people can become convinced, falsely, that during childhood they loved a particular food the first time they tried it or that they got sick after eating a particular food, and that these false beliefs can have consequences for subjects (Bernstein, Laney, Morris, & Loftus, 2005a, 2005b; Laney, Morris, Bernstein, Wakefield, & Loftus, 2008). But in these studies, the presence of false beliefs, and the consequences of those beliefs were assessed within the same experimental session as the false memory manipulation, so it is not clear how long the false beliefs might last. In addition, these studies have largely relied on paper-and-pencil measures of false memory consequences. This study further explores the consequences of false memories for real eating behavior, and also addresses a completely new question: Can false memories created in the laboratory last for weeks rather than merely minutes?

False memories have been studied using a variety of scenarios and methodologies. Researchers have planted false memories of being lost in a mall as a child, and of being rescued by a lifeguard, and even of having a very specific accident at a family wedding, all using a multiple interview procedure (Heaps & Nash, 1999; Hyman, Husband, & Billings, 1995; Loftus & Pickrell, 1995). Researchers have also used Photoshop to combine genuine childhood photographs with falsified backgrounds to get subjects to believe falsely that they had been in a hot air balloon, and used imagination tasks (in which the original events could be compared to the memories) to convince subjects that, for example, they had kissed a plastic frog or proposed marriage to a Pepsi machine (Seamon, Philbin, & Harrison, 2006; Thomas & Loftus, 2002; Wade, Garry, Read, & Lindsay, 2002). Researchers have even been able to get individuals to believe that they had experienced the entirely impossible events of having a made-up medical procedure or interacting with Bugs Bunny (a Warner Brothers character) at Disneyland, and to recall events from previous lives (Braun, Ellis, & Loftus, 2002; Mazzoni & Memon, 2003; Spanos, 1996).

Another procedure used to study false memories involves a simple false feedback manipulation designed to convince subjects that they had particular experiences with specific foods as children (Bernstein et al., 2005b). In particular, we suggested to some individuals, through false feedback, that certain foods (dill pickles or hard-boiled eggs) made them sick when they were children. A considerable minority believed the false feedback and subsequently reported beliefs or memories for these events. Often these false beliefs were coupled with decreased liking of and willingness to eat the relevant food items. We found that these false memory and consequence effects could also be achieved with some, but not
all, fattening foods (Bernstein et al., 2005a). In particular, false memories of getting sick after eating strawberry ice cream led to changes in food preferences.

More recently, we have focused on giving subjects false memories for loving or hating a specific food, asparagus, the first time they tried it (Laney et al., 2008). We chose asparagus because it has a rather sophisticated taste, but is a relatively common vegetable, such that people would not be expected to remember the first time they tried it. We found that false memories of loving asparagus as a child were associated with greater liking for asparagus, greater willingness to order asparagus in a restaurant, more positive, and fewer negative feelings about asparagus, and even fewer feelings of disgust when viewing a picture of asparagus.

The current study is an extension of previous research designed to determine whether or not false beliefs can have long-term consequences with respect to particular eating habits. If the consequences are only apparent in the very short term, the practical benefits of the manipulation would be limited. On the other hand, the influence of the manipulation might be longer lasting, and the concomitant practical benefits large. If it is possible to persuade someone that he or she enjoys a certain healthy food, there could be prolonged positive effects on dietary choices. This in turn may result in overall healthier eating and, in general, would be beneficial to the health outcomes of individuals. It is even possible that the observation that false beliefs could have longer-term effects on dietary choices might lead us to promising methods for “winning the war against childhood obesity,” the subtitle of a recent book published by the press of the National Academies of Science (Okie, 2005).

Although there have been many studies on the malleability of memory in general and false memory in particular, there has been very little research on whether or not false beliefs persist over time and what consequences such persistence may have. In fact, we could find just one such study of the persistence of false memories over time. Huffman, Crossman, and Ceci (1997) contacted 22 of the 96 children who had been given false memories two years prior, in another study (Ceci, Huffman, Smith, & Loftus, 1994). The false memories involved getting one’s hand caught in a mousetrap or going up in a hot air balloon ride with classmates. Though all subjects had been debriefed at the end of the prior study (with varying success), they still tended to demonstrate false memories, albeit at a lower rate, in the delayed interview. Specifically, these 22 subjects had assented to 22% of false events by their tenth interview in the original study. After the two year delay, they assented to 13% of false events, and 50% of subjects assented to at least one false event. These results are intriguing, but cannot answer the full range of possible questions about the persistence of false memories. In particular, these results do not address whether false memories created in the laboratory will persist in adults, who are less suggestible than children (Brainerd & Reyna, 2005). These results also have nothing to say about the persistence of false memory consequences.

In an effort to bridge these gaps in the literature, the current study addressed some of these questions about the consequences of false beliefs. Based on our previous work, we hypothesized that a substantial minority of subjects would be susceptible to the false memory manipulation that they either loved or hated asparagus the first time they tried it. We also hypothesized that the individuals who fall sway to the manipulation (and adopted false beliefs) might show consequences, including changes in their preference for asparagus and willingness to order asparagus at a restaurant. But would they show consequences over a longer period? And would the consequences shown extend beyond a mere stated preference to actual selection of particular foods that the individuals expected to eat?

2. Method

2.1. Overview

In the first of three sessions, pre-manipulation data were collected from subjects, and they were told that their data would be used to produce individualized profiles. In a second laboratory session, some subjects received false feedback about loving or hating asparagus when they were children. The researchers then assessed whether or not subjects who received false feedback developed false memories about the critical event (loving or hating asparagus the first time they tried it), and also whether these false memories had immediate implications for their feelings about asparagus. Between the second and third sessions, subjects were asked via email to report their preference for foods that would be served at the third session. Data from the third session were used to assess whether the false beliefs and consequences persisted over time.

2.2. Subjects

The subjects were 368 undergraduate students from the University of California, Irvine, who received course credit for their participation. The subjects were mostly female (79.6%), and had a mean age of 20.3 (SD = 3.3) years. Subjects were randomly assigned to four conditions before they arrived in the lab: loved asparagus (n = 111), hated asparagus (n = 114), and controls for each of these (n = 73 and 70, respectively).

Subjects who started the study extremely confident that they had experienced the critical event (that is, those who could be said to have a “true memory” for their critical event) were analyzed separately. A total of 21 subjects had “true” memories for loving asparagus the first time they tried it, and another 27 had “true” memories for hating asparagus the first time they tried it. With these subjects removed, there were a total of 102 subjects in the Loved asparagus condition, 98 in the Hated asparagus condition, 61 Love controls, and 59 Hate controls.

2.2. Materials and procedure

Subjects were in the lab for three separate sessions, over a total of three weeks. Sessions 1 and 2 were separated by a week, and Sessions 2 and 3 were separated by two weeks. Fig. 1 shows the critical measures that subjects completed during each of the three sessions.

2.2.1. Session 1

During their first visit to the laboratory, subjects first provided informed consent. They were told that they were participating in a study of food preferences and personality, and that their responses to the questionnaires would be analyzed using specialized software. They were told that this software would produce a personality profile that they would receive during their second session. Subjects then completed a series of questionnaires.

The most critical of these questionnaires was the Food History Questionnaire (see Bernstein et al., 2005b). Subjects were asked to rate their confidence that each of 19 food-related events had happened to them before the age of 10, on a scale of 1 = definitely did not happen to 7 = definitely did happen. One of two different critical items was placed in the eleventh position. For Love group subjects and Love controls, the eleventh item was “Loved asparagus the first time you tried it.” For Hate group subjects and Hate controls, the eleventh item was “Hated asparagus the first time you tried it.” All of the other items were identical across groups. These items included, for example, “Baked a pie with your mother” and “Sold chocolate bars for a school fundraiser.”
For the Recent Food Experiences Questionnaire, subjects were asked to rate how long it had been (from 1 = today to 6 = years ago, or 0 = never) since they had done each of 18 food-related behaviors, including “ate breakfast,” “drank more than 5 servings of alcohol in a single sitting,” and, critically, “ate asparagus.” For the Food Preferences Questionnaire, subjects were asked to rate their preference, from 1 = definitely do not like to eat (for whatever reason) to 8 = definitely like to eat, for each of 63 different foods, including “zucchini,” “cheddar cheese,” “doughnuts,” and, critically, “asparagus.”

Interpersed with these questionnaires were two individual difference measures. The first was the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960). For this 33-item True/False self-report measure, subjects are asked to respond to statements like “I sometimes feel resentful if I do not get my own way” and “I never resent being asked to return a favor.” The measure is designed to identify those subjects who are likely to produce socially desirable responses. The second measure was the Vividness of Visual Imagery Questionnaire (Marks, 1973), a 16-item scale, which asks subjects to rate the quality of their imagination and to visualize certain scenes such as a sunrise and then rate their ability to clearly imagine such scenes on a scale anchored at 1 = perfectly clear and as vivid as normal vision and 5 = no image at all, you only “know” that you are thinking of the object. In this study, these questionnaires did not predict any meaningful differences between subjects, so they will not be discussed further.

2.3.2. Session 2

Upon arrival in the laboratory for their second session, subjects first received their personalized personality profiles. The profiles, which had subjects’ names printed at the top in a shaded box (as if generated by the software program) reminded subjects that their data had been entered into a special software program, and told them that the results of the program’s analysis were listed below. All subjects were told that “as a young child”: “you disliked eggplant,” “you enjoyed eating pasta,”2 and “you were happy when a classmate brought sweets to school.” Experimental subjects had an additional profile item in the third position. For Love group subjects, the item was “you loved to eat cooked asparagus.” For Hate group subjects, the item was “you hated to eat cooked asparagus.”

Attached to the profile was a short elaboration exercise. Subjects were told that the “software” had randomly chosen one profile item on which they should elaborate. Subjects in the experimental groups were asked to elaborate on the item “you loved/hated to eat cooked asparagus;” while subjects in the control groups were asked to elaborate on the item “you were happy when a classmate brought sweets to school.” Specific elaboration prompts were given to subjects (e.g., “Who were you with?” and “Describe what happened”). If subjects did not have clear memories of the relevant events, they were asked to imagine these items and report on them. Prior research has shown that imagination can affect memory for events (e.g., Garry, Manning, Loftus, & Sherman, 1996). Thus, we expected that the imagination instructions might enhance the likelihood that subjects would be influenced by the suggestive manipulation.

After subjects completed their profiles, they were given a set of questionnaires. The first questionnaire was a different version of the Food History Questionnaire that subjects had completed during their first session. The new version of the form was formatted differently, but had the same critical items. The second questionnaire was a Restaurant Questionnaire, where subjects rated their likelihood of ordering each of 19 dishes, including “portobello mushrooms stuffed with mozzarella,” and, critically, “sautéed asparagus spears,” on a scale anchored at 1 = definitely no and 7 = definitely yes. The third questionnaire was the same Food Preferences Questionnaire completed in Session 1. The fourth questionnaire was called the Food Feelings Task, and asked subjects to rate each of six foods, including “chicken noodle soup,” and “asparagus” in nine different categories: delicious, fattening, salty, sweet, unpleasant, flavorful, bland, disgusting, and comforting. Subjects were asked to rate each adjective as “0” if it did not describe their feelings toward that particular food well, as “1” if it described their feelings somewhat, or “2” if it described their feelings well. Finally, the Food Costs Questionnaire asked subjects the most they would be willing to pay for each of 21 different food products, including “a frozen pepperoni pizza,” “a gallon of milk,” and “a pound of asparagus,” at the grocery store. Each food item was followed by seven different possible maximum prices (for asparagus, these were: $1.00, $1.50, $1.90, $2.50, $3.20, $3.80, and $4.40), plus a “$0 and never buy it” option. When subjects had completed the full set of questionnaires, they were excused for the day.

Email reminder. Approximately one week after Session 2, and one week before Session 3, subjects were sent email reminders of the time and location of their final laboratory sessions. This email message also included one of the study measures. Subjects were told (falsely) that the final session of the study was much longer than the first two sessions, and that the experimenters wanted to compensate subjects for this by feeding them during the final session. The subjects were told that the experimenters wanted their input on the best food to serve. Subjects were asked to rank order their preference for each of eight different sandwiches (e.g., “turkey,” “tomato and mozzarella”) and nine different vegetable tray contenders (e.g., “baby carrots,” “green olives,” and “asparagus spears”). This task was designed to measure, if not actual behavior towards the specific food item, then at least behavior towards the threat of the specific food item. Subjects believed that their food choices would affect the availability of actual food in the laboratory, such that their choices may have been a closer reflection of their actual eating behavior than more traditional questionnaire items. Rank-orders were reverse-coded (so that higher numbers would represent greater preference for a food, as in our other measures). Food choices were analyzed like

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1 Because there were no group differences on the asparagus item from this measure, F(3, 316) = 1.64, p = .18, it will not be addressed further.

2 These first two items were used because the preference ratings of subjects in previous studies for these items were particularly strong and stable. That is, members of our undergraduate population tended to be quite sure that they hated eggplant and loved pasta.

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other questionnaire measures. No food was actually provided in the third session.

2.3.3. Session 3
During the third and final session in the laboratory (approximately three weeks after the initial session) subjects again completed a series of questionnaires. The first of these was a Food History Questionnaire identical to that completed in the first session. Next the Restaurant and Food Preferences Questionnaires were completed again. Then subjects completed a Memory or Belief? form (see Bernstein et al., 2005b). On this form, subjects are asked to rate their experience of each of three events (including their critical asparagus event) as a specific memory, a less specific belief, or neither of these (i.e., they were "positive" that the listed event did not occur). If a subject reported a memory for the event, they were asked to give as many details as possible. Subjects who reported a belief that the event happened were asked to explain why they thought that the event happened to them. Subjects who reported being positive that the event had not occurred were asked to explain how they were so sure that the event had not happened.

After the Memory or Belief? form, subjects completed three additional questionnaires, all designed to assess underlying factors that may have affected subjects’ earlier responses. The first of these informed subjects that the study had employed deception, and that they were not, in fact, participating in a study of food and personality. They were asked to describe any theories or guesses they had about the true nature of the study (see Laney et al., 2008 for a further discussion of this measure). Next subjects were prompted to recall the three or four items that had been listed on their profiles during Session 2. Subjects were also asked which of the items, if any, had seemed strange to them. Finally, subjects were asked (in a series of “yes” or “no” questions) whether they had come into contact with any information about the study or the topic of false memories before their participation.

When all the questionnaires were completed, subjects were fully debriefed and excused. The full time commitment for subjects was less than 90 min, over the three sessions.

3. Results

Did subjects form false memories of loving or hating asparagus the first time they tried it? Did these false memories last beyond the initial laboratory session in which they were formed? Were there any meaningful consequences of these false memories, and did any consequences last beyond the first few moments? We addressed all of these questions by examining both within-subject and between-subject differences. All statistics are two-tailed, unless otherwise noted.

3.1. False memories

How do we determine which subjects have false memories? Our first step, as described above, was to remove those subjects (n = 48) who entered the experiment already quite confident that they had loved or hated asparagus the first time they tried it. Because we are interested specifically in false memories, we want to compare those subjects who have developed false memories as a result of the manipulation to a group of comparable control subjects. As such, we removed subjects with arguably “true” memories (defined as: those subjects whose pre-manipulation and post-manipulation confidence were over the mid-point of the confidence scale) from both the experimental and control groups.

We have developed a set of criteria whereby we judge whether a specific subject has developed a false memory (see Morris, Laney, Bernstein, & Loftus, 2006). According to our conservative definition, subjects can be said to have developed false memories (and be labeled as “believers”) if they begin the study with low confidence that they have experienced their critical event (less than 4 on the 7-point scale), but that confidence increases by at least one point after the manipulation, and they report a “memory” or “belief” on the Memory or Belief? form (in the present study, these data were collected two weeks post-manipulation).

Note that we do not have any special tools that allow us to say, with absolute certainty, that a particular subject has developed a false memory rather than had an existing true memory cued by some aspect of our procedures. But to allay the concern that none of our memories are truly false, we refer readers to other similar studies, mentioned above that have produced false memories for impossible events – that is, in cases where there could not have been true memories to cue (Braun et al., 2002; Mazzoni & Memon, 2003; Spanos, 1996).

In some cases it may be important to distinguish between memories and beliefs (see Scoboria, Mazzoni, Kirsch, & Relyea, 2004). We acknowledge that beliefs are when a person “knows” that something happened but has no real details or sense of recollection, and memories are beliefs with additional sensory details added. Our data represent some false “memories” and some false “beliefs,” with the latter being more common. Rather than repeatedly discussing “false memories and false beliefs,” we sometimes use the term “false memory” and other times use the term “false belief.”

Of the 102 subjects in the Love group, 35 (34%) formed false memories of loving asparagus the first time they tried it. These subjects’ confidence increased an average of 3.43 points (SD = 1.61) on the 7-point scale from pre- to post-manipulation. See the left side of Fig. 2. Love believers’ post-manipulation confidence was significantly higher than that of Love controls, t(94) = 8.84, p < .001, r² = .45. The whole of the Love group increased significantly from pre- (M = 2.38, SD = 1.58) to post-manipulation (M = 3.77, SD = 2.16), t(99) = 5.75, p < .001. Seven Love believers (20%) reported “memories” on the Memory or Belief? form, while the remaining 28 reported “beliefs.” The Love control group’s confidence did not change significantly from pre- (M = 2.32, SD = 1.66) to post-manipulation (M = 2.24, SD = 1.51), t(58) = 0.37, p = .71. Three Love control subjects (5%) reported “memories” and 25 (44%) reported “beliefs.”

In the Hate group, 46 of 98 subjects (47%) formed false memories of hating asparagus the first time they tried it, and these subjects’ confidence increased an average of 4.02 points (SD = 1.69).
Hate believers' post-misattribution confidence was significantly higher than that of Hate controls, *t*(102) = 7.24, *p* < .001, *r* _pb_ = .34. The whole of the Hate group increased significantly from pre- to post-manipulation (*M* = 4.59, *SD* = 2.31), *t*(97) = 7.79, *p* < .001. Seventeen Hate believers (37%) reported “memories” on the Memory or Belief form, while the remaining 29 reported “beliefs.” The Hate control group also increased significantly from pre- to post-manipulation (*M* = 2.27, *SD* = 1.77) to post-manipulation (*M* = 3.20, *SD* = 2.07), *t*(58) = 2.79, *p* = .007. This was unexpected. Seven Hate control subjects (12%) reported “memories” and 29 (48%) reported “beliefs.”

3.2. Lasting false memories

Did the confidence of subjects with false memories return to its original, pre-manipulation level after two weeks? No. The confidence of Love believers decreased significantly from immediately post-manipulation to two weeks post-manipulation (*M* = 3.86, *SD* = 1.82), *t*(34) = 3.83, *p* = .001, but the final mean confidence rating was still significantly higher than that reported pre-manipulation, *t*(34) = 6.83, *p* < .001. See the right side of Fig. 2. A repeated-measures ANOVA (across all three time points) for Love believers and Love controls produced a significant main effect of time, Wilks’ *Lamda* = .51, *F*(2,87) = 42.38, *p* < .001, partial *η* _2_ = .49, and a significant interaction of time and condition, Wilks’ *Lamda* = .49, *F*(2,87) = 45.18, *p* < .001, partial *η* _2_ = .51.

Likewise, the confidence of Hate believers decreased significantly from post-manipulation to two weeks post-manipulation (*M* = 4.48, *SD* = 1.91), *t*(45) = 3.75, *p* < .001, but the final confidence rating was still significantly higher than that reported pre-manipulation, *t*(45) = 9.46, *p* < .001. A repeated-measures ANOVA for Hate believers and Hate controls produced a significant main effect of time, Wilks’ *Lamda* = .44, *F*(2,102) = 65.98, *p* < .001, partial *η* _2_ = .56, and a significant interaction of time and condition, Wilks’ *Lamda* = .67, *F*(2,102) = 25.50, *p* < .001, partial *η* _2_ = .33.

Another way to assess whether the effects of the manipulation endured is to examine the percentage of subjects whose confidence was still elevated over their initial confidence levels. Among Love believers (that is, those subjects whose post-manipulation confidence was higher than their pre-manipulation confidence, and who reported a memory or belief at the end of the study), 27 of 35 subjects (77%) still had increased confidence at two weeks post-manipulation. Among Hate believers, 39 of 46 subjects (85%) still had increased confidence at two weeks post-manipulation.

3.3. Consequences of false memories

In this section, we address whether subjects showed consequences of their newly developed false memories in the few minutes immediately following the manipulation as well as two weeks later. The primary comparisons for all our measures of false memory consequences are between Love believers and Love controls and Hate believers and Hate controls. That is, we compare those who formed false memories after exposure to our suggestive manipulation to those not exposed to our suggestive manipulation. This is a more conservative test than comparing believers to non-believers (that is, those subjects who were exposed to the suggestive manipulation, but did not meet the criteria to be labeled as believers). We note that our two control groups were statistically equivalent with respect to consequences. The Love controls and Hate controls did not differ on any of our consequence measures, either immediately post-manipulation (*ps* .16 to .84) or after the two week delay (*ps* .18 to .74).

3.3.1. Preference for asparagus

Although Love believers, Hate believers, Love controls and Hate controls all reported equivalent levels of preference for asparagus before the manipulation, *F*(3,195) = 0.92, *p* = .43, this similarity did not continue after the manipulation, *F*(3,195) = 6.42, *p* < .001, *η* _2_ = .09. See the left side of Fig. 3. Immediately after the manipulation, Love believers professed greater preference for asparagus than did Love controls, *t*(92.9) = 4.50, *p* < .001, *r* _pb_ = 18, or Hate believers, *t*(71.7) = 4.80, *p* < .001, *r* _pb_ = 24. Hate believers and Hate controls did not differ significantly immediately after the manipulation, *t*(102) = 0.38, *p* = .71.

Because we have both pre- and post-manipulation preference data, we can also look for within-subject changes in asparagus liking. Love believers’ liking of asparagus increased significantly from pre- to post-manipulation, *t*(34) = 5.00, *p* < .001. Hate believers’ liking of asparagus decreased significantly from pre- to post-manipulation, *t*(44) = 2.40, *p* = .02. Control subjects’ (collapsed across Love and Hate) liking did not change, *t*(116) = 0.60, *p* = .55.

Love believers’ liking of asparagus decreased from immediately post-manipulation to two weeks post-manipulation, *t*(34) = 2.44, *p* = .02, but still remained significantly higher than it had been at pre-manipulation, *t*(34) = 2.69, *p* = .01. Hate believers’ dislike of asparagus did not diminish at all over the two weeks post-manipulation, *t*(45) = 0.60, *p* = .56. As such, it remained significantly lower than it had been pre-manipulation, *t*(44) = 3.04, *p* = .004. Control subjects’ preferences did not change relative to their post-manipulation ratings, *t*(112) = 0.07, *p* = .94, or to their pre-manipulation ratings, *t*(113) = 0.78, *p* = .44.

3.3.2. Willingness to eat asparagus in a restaurant

We also assessed, at both post-manipulation and two weeks post-manipulation, subjects’ desire to order asparagus in a restaurant. See Table 1. Immediately post-manipulation, Love believers expressed greater desire than did Love controls, *t*(88.8) = 2.66, *p* = .01, *r* _pb_ = 0.7. Hate believers expressed desire that was equivalent to that of Hate controls, *t*(103) = 0.16, *p* = .88. These ratings

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1. Adjustments have been made to the degrees of freedom because of unequal variance in this and other relevant calculations throughout this paper.

2. We note that, among believers (Love believers and Hate believers combined), pre-manipulation ratings of “1” followed by post-manipulation ratings of “7” were twice as common as any other combination of ratings.
remained relatively stable over the two weeks after the manipulation. Love believers’ ratings dropped, but not significantly, \(t(33) = .58, p = .12\). Hate believers’ ratings increased, but not significantly, \(t(45) = .99, p = .33\). And control subjects’ ratings likewise remained consistent, \(t(114) = .07, p = .95\).

### 3.3.3. Feelings about asparagus

Subjects’ responses to the asparagus item on the Food Feelings Task (at immediately post-manipulation) were collapsed into two index variables: good feelings (sum of ratings on “delicious,” “flavorful,” and “comforting”; Cronbach’s \(z = .77\)) and bad feelings (sum of ratings on “unpleasant” and “disgusting”; Cronbach’s \(z = .79\)). Love believers professed more good feelings, \(t(91) = 3.90, p < .001, r^2 = .19\), and fewer bad feelings, \(t(78.9) = 4.53, p < .001, r^2 = .21\), than Love controls. Hate believers were no different from Hate controls with respect to good, \(t(103) = .53, p = .60\) or bad feelings, \(t(103) = .05, p = .96\).

The other measure completed at post-manipulation (only) was the measure of how much subjects were willing to pay for various foods, including asparagus, at a grocery store. This item did not produce significant differences between Love believers and Love controls, Mann–Whitney \(U = 865 (z = -.087) p = .38\), or between Hate believers and Hate controls, Mann–Whitney \(U = 895 (z = -.72) p = .47\).

### 3.3.4. Behavioral measure

This study also included a longer-term false memory consequence that was more behavioral in nature. Subjects were asked, via an email sent out between their two post-manipulation sessions, to rank asparagus among a list of nine vegetables they might want to see on a platter at their final laboratory visit. As predicted, Love believers were somewhat more enthusiastic about eating asparagus than Love controls, \(t(79) = 1.70, p = .045\), one-tailed, \(r^2 = .04\). Hate believers and Hate controls gave asparagus statistically equivalent rankings, \(t(77) = .19, p = .86\). When rankings were split into the categories of favorable (re-coded range = 5–9) and unfavorable (re-coded range = 1–4), Love believers were more likely to give favorable ratings than Love controls, \(\chi^2(1, n = 81) = 3.28, p = .035\), one-tailed, but Hate believers were not more likely to give unfavorable ratings than Hate controls, \(\chi^2(1, n = 79) = .03, p = .87\).

### 3.4. Demand characteristics

As in our previous studies (see Laney et al., 2008), we were very careful to reduce the demand present in the current study, and to assess the possible effects of demand after the study. And as in previous studies, demand did not prove to be a substantial causal factor in the present results. After being told that they had been deceived (see Laney et al., 2008), a total of 59 subjects (16%) in the present study gave responses that suggested they understood the true nature of the study, and thus could possibly be subject to demand characteristics. When these 59 subjects were excluded from our analyses, none of the findings of the study changed. Thus, demand characteristics did not affect our results in any measurable way.

Two all new procedures were included in the present study. After subjects were asked to guess the true nature of the study, they were asked to recall what the items on their profiles had been, as well as whether any of these items had seemed strange to them at the time. Experimental subjects were quite likely to remember that their profiles had contained something about asparagus (93% correctly reported the word “asparagus” somewhere on the profile memory task form), though they were less likely to remember what it was the profile had told them about asparagus (just 58% of subjects correctly reported that they had been told positive or negative information about asparagus). Of the 151 experimental participants who reported that they found one or more of the profile items to be “strange,” 119 (79%) named the “asparagus” item as strange. Within this subgroup of 119 subjects, 33% of Love group subjects met the believer criteria, as did 43% of Hate group subjects. Some 27% of these experimental subjects were able to guess the true nature of the study, compared to 21% of experimental subjects overall.

Finally, participants were asked whether they had come into contact with any information that could have influenced their participation. Just 2% of subjects claimed that they had heard anything about the study. Eleven percent claimed to have seen media reports of this or similar studies. A full third of participants stated that they had learned about false memories in university lectures. Interestingly, though, just 19% of these subjects had given responses on the previous questionnaire suggesting that they had noticed that this study had anything to do with false memories.

### 4. Discussion

The current study provides further evidence that subjects form false memories for specific events and that such memories may have immediate consequences for those who develop them. More novel are the results of the present research that suggest that false memories may have long-term consequences, lasting (at least) weeks after the suggestive manipulation.

In this study, a large minority (41% overall) of manipulated subjects fell sway to the suggestion that they had loved or hated asparagus the first time they tried it. These “believers” were subjects who initially displayed low confidence that they had loved or hated asparagus the first time they tried it, but whose confidence increased after the manipulation and who later claimed to have a “belief” or “memory” of loving or hating asparagus as children. Similar proportions of false memories have been created in the previous studies of false memory consequences (Bernstein et al., 2005b; Laney et al., 2008). Although these confidence levels did tend to drop off in the two weeks following the manipulation, they did not return to their original, pre-manipulation, levels. That is,
subjects’ confidence in their false memories persisted for weeks after the false memory manipulation.

Love believers’ false memories had marked consequences immediately after the manipulation. Relative to Love controls, Love believers showed greater preference for asparagus, greater willingness to eat asparagus in a restaurant, more “good” feelings toward asparagus, and fewer “bad” feelings. Again, these findings line up well with those of previous studies of false memory consequences (e.g., Laney et al., 2008). Hate believers demonstrated fewer immediate consequences. Although they showed less preference for asparagus than Hate controls, these groups were not significantly different with respect to willingness to eat asparagus in a restaurant, or good or bad feelings about asparagus. Neither Love believers nor Hate believers were significantly different from their controls with respect to willingness to pay for asparagus at the grocery store.

What might account for the lack of differences between Hate Believers and Hate controls? Prior research examining false memories and food have used false feedback such as “you got sick after eating hard-boiled eggs when you were a child” and concluded that food avoidance for the critical food items occurs, and subjects also show avoidance of related food (Bernstein et al., 2005b). Although one of the false feedback items used in the current study, “you hated asparagus the first time you tried it,” did result in the creation of false memories based on increased confidence immediately and two weeks post-manipulation, our results indicated that these particular suggestions may not elicit food aversion or avoidance as a specific consequence. There may be some fundamental difference between individuals’ reactions to believing that they got sick on a food the first time they tried it versus they hated the food the first time they tried it. The suggestion that one got sick from a certain food is perhaps more visceral, and thus more likely to result in food avoidance than is the suggestion that one hated that same food the first time he or she tried it. We note, however, that although Hate believers did not generally demonstrate consequences that were significantly different from those of Hate controls, they also did not generally differ from True Haters (i.e., those subjects who were confident all along that they had hated asparagus the first time they tried it). So it may be that hating asparagus the first time one tries it simply has fewer long-term consequences than does loving asparagus the first time one tries it, or getting sick after eating asparagus the first time one tries it.

This study was different from previous studies of false memory in two ways. First, rather than merely asking subjects to rate their feelings about our critical food item on standard paper-and-pencil measures (as for example Bernstein et al., 2005a did), we elicited food choices from subjects who actually thought they would have a chance to eat their chosen foods. In other words we “threatened” them with real food. Specifically, we told them (falsely) that they would be given food at their final session, and asked for their input as to which food options would be best. Although Hate believers did not react to this threat differently from Hate controls, Love believers did react differently from Love controls. Faced with the opportunity to actually eat asparagus, Love believers ranked asparagus more favorably than did Love controls.

As we were submitting this paper for publication, we learned of another study that had used consumption of a real food (peach yogurt) to test for consequences of a false suggestion (Scoboria Mazsoni, & Jarry, in press). Scoboria et al. falsely suggested to their experimental subjects that they had likely become sick after eating contaminated peach yogurt as children. One week after the false suggestion, these subjects participated in an additional phase of the study (which was disguised as a separate, taste-test study). The subjects reported less preference for peach yogurt and ate less of three different flavors of yogurt than did control subjects.

The second way that this study was different from previous studies of false memory consequences was that we tested for both the presence of false memories and false memory consequences weeks after the false memory manipulation. The confidence of both Love believers and Hate believers in their false asparagus events decreased significantly in the two weeks after the manipulation, but neither of these groups returned to their pre-manipulation levels. That is, subjects’ false memories were diminished but not extinguished with the passage of time. Like confidence, false memory consequences were partially, but not fully, alleviated with the passage of time. Specifically, Love believers’ preference for asparagus dropped off relative to immediately after the manipulation, but it did not return to its pre-manipulation levels. Hate believers did not fully maintain their newfound dislike for asparagus, but this likewise remained significantly different from pre-manipulation. Both Love and Hate believers’ willingness to eat asparagus in a restaurant also remained relatively stable at two weeks post-manipulation.

Another recent research effort in the Netherlands also produced longitudinal effects with a real food (Geraerts et al., in press). Geraerts et al. used the same false feedback procedure as that in the present study to suggest to their experimental subjects that as children they had gotten sick after eating egg salad. A significant minority of subjects developed false beliefs about getting sick on egg salad. These subjects ate fewer egg salad sandwiches both immediately following the false feedback manipulation, and in follow-up session (disguised as a separate study) four months later. So taken together, these other efforts provide additional support for the long lasting effects of false suggestions. We maintain that these persistent false memories and their consequences are important for both theoretical and applied reasons. First, the current study importantly shows that false memories persist. These results replicate and extend prior work showing that false memories can persist over time in children (Huffman et al., 1997). Here, we show that false memories can persist in adults, despite the fact that adults are less suggestive and have better source monitoring skills than children (Brainerd & Reyna, 2005). Moreover, the persistence of false memories, created in the laboratory, in turn, relates to false memories outside the laboratory. False memories can have negative and even devastating consequences in the real world, for example, when a person falsely accuses another person of a crime that the latter person did not commit (Scheck, Neufeld, & Dwyer, 2000).

4.1. Limitations and future directions

We conducted the current work as a first step towards addressing some of the questions raised in our prior work relating to the formation and consequences of false memory. Although several research groups have begun to answer some of these questions, we argue that more work remains to be done. For example, we still do not know which foods we can make people like more or less, nor do we know the boundary conditions for false food memory consequences. Also, we still do not know whether there are other types of false beliefs, besides food-related beliefs, that have behavioral consequences.

Where do we go from here? We propose to extend this research by addressing other types of false memories, including false memories for emotionally rich events. The present experiment used false memories about food to determine the persistence of false beliefs. These memories did begin to dissipate after two weeks; however it is important to address that the persistence of a false memory may be affected by the subject matter of the memory. For instance, a false memory that creates a strong emotional response may be integrated into one’s identity and therefore persist longer than a false memory pertaining to food preferences or other
novel events. Therefore a study examining the persistence of emotionally charged false memories might profitably be explored in the future.

References


