False memories, but not false beliefs, affect implicit attitudes for food preferences

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Abstract

Previous studies have found that false memories and false beliefs of childhood experiences can have attitudinal consequences. Previous studies have, however, focused exclusively on explicit attitude measures without exploring whether implicit attitudes are similarly affected. Using a false feedback/imagination inflation paradigm, false memories and beliefs of enjoying a certain food as a child were elicited in participants, and their effects were assessed using both explicit attitude measures (self-report questionnaires) and implicit measures (a Single-Target Implicit Association Test). Positive changes in explicit attitudes were observed both in participants with false memories and participants with false beliefs. In contrast, only participants with false memories exhibited more positive implicit attitudes. The findings are discussed in terms of theories of explicit and implicit attitudes.

Keywords: false memories, false beliefs, explicit attitudes, implicit attitudes, false-feedback.

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False memories, But Not False Beliefs, Affect Implicit Attitudes For Food Preferences

1. Introduction

Since the pioneering work of Bartlett (1932), it has been known that human memory involves reconstructive processes that give rise to false memories and false beliefs of events that did not occur. Recently, researchers have begun to focus on the behavioural consequences of false memories and beliefs. For example, Bernstein, Laney, Morris and Loftus (2005) found that aversions to particular foods can be created by implanting a false memory or false belief that, as a child, one was sick after eating the food. False memories and beliefs have also been found to have *positive* effects on attitudes towards certain foods. For example, Laney, Morris, Bernstein, Wakefield, and Loftus (2008) induced positive attitudes towards asparagus by implanting the false suggestion that participants had enjoyed asparagus the first time they tried it.

These studies, and others (see Bernstein, Pernat, & Loftus, 2011, for a review), demonstrate that false memories and beliefs can have significant effects on our attitudes. A recent meta-analysis by Bernstein, Scoboria and Arnold (2015) of studies eliciting false memories and beliefs of childhood food-related events found that false beliefs (i.e. a belief in the event's occurrence without accompanying recollective experience) and false memories (belief in the event's occurrence *with* accompanying recollective experience) resulted in roughly equivalent changes in attitude measures, leading the researchers to conclude that false autobiographical belief (a common factor in both false memories and false beliefs) is the driving factor behind attitude change. A limitation of these studies, however, is that they have focussed exclusively on the effects of false memories and beliefs on *explicit* attitudes. Many contemporary models of social cognition acknowledge the importance of both explicit and implicit attitudes in determining behaviour (e.g., Fazio, 1990; Wilson, Lindsey, & Schooler, 2000). Whereas explicit attitudes are considered to be consciously controlled, rational, and

deliberative, implicit attitudes are assumed to be activated automatically outside conscious awareness. Implicit attitudes are thought to reflect associations in memory between an item/concept and an attribute, and are typically measured through some form of response-latency based paradigm (see Bar-Anan & Nosek, 2014 for a review of the most commonly used measures). An advantage of this type of measure is that it circumvents the potential for demand characteristics (Fazio & Olson, 2003); an issue which has been a common critique of studies investigating the attitudinal consequences of false memories and beliefs (Laney, Kaasa, et al., 2008). There is also strong evidence that implicit attitude measures predict a significant amount of variance, unique from that which is predicted by explicit attitude measures, in a wide range of behaviours (see Jost et al., 2009 for a review). A meta-analysis by Greenwald, Poehlman, Uhllman, and Banaji (2009) found that the greater the convergence of explicit and implicit attitude measures, the greater their predictive value of subsequent behaviour. Given the body of evidence from the social psychological literature on the importance of implicit attitudes in social cognition, the aim of the current study was to determine whether false memories and beliefs have implicit attitudinal effects.

Since implicit attitudes are thought to represent associations in memory that form over time, the extent to which they can be modified by brief, explicit interventions (as would be the case in a typical laboratory study) could be considered questionable. There is, however, evidence that implicit attitudes can be modified through mental imagery exercises. For example, Blair, Ma, and Lenton (2001) found that participants who engaged in counter-stereotypic mental imagery subsequently exhibited weaker implicit stereotypes. Blair et al. argued that imagery was able to affect implicit attitudes because it increased the accessibility of cognitive representations relevant to the attitude object in memory consistent with the imagined scenario. Markland, Hall, Duncan, & Simatovic (2015) recently revived this idea and found that guided mental imagery of a positive exercise-related experience resulted in

more positive implicit attitudes towards exercise. Markland et al. interpreted their results within the framework of Gawronski and Bodenhausen's (2006) Associative and Propositional Evaluation (APE) model. This model suggests that implicit attitude change results from a change in the underlying associative activations triggered upon presentation of the attitude object, which can be dependent on immediately available contextual cues (such as those which might be provided by an imagery exercise).

Following this logic, Markland et al. (2015) suggested that detailed imagery exercises can affect implicit attitudes by creating associations between the attitude object and positively-valenced details generated during imagination (e.g. positive sensory or affective details). In recent years, a line of research has emerged which has emphasised the similarities between episodic memory of past events and imagination of hypothetical future events, both of which can be episodic in nature, containing rich details specific to time and place (Addis, Wong, & Schacter, 2007). There is strong evidence that re-experiencing past events via episodic memory and pre-experiencing hypothetical events via imagination have strong phenomenological similarities (D'Argembeau & Van der Linden, 2004, 2006; Szpunar & McDermott, 2008), as well as shared neural substrates (see Schacter et al., 2012, for a review). Given these similarities, it seems plausible that a false episodic memory may be sufficient to affect implicit attitudes via the same mechanisms as guided imagination exercises. However, it seems unlikely that a false belief of a positive experience involving an attitude object without accompanying recollective experience would generate the detail necessary to affect underlying associative activations generated upon presentation of the attitude object (and therefore be insufficient to elicit implicit attitude change).

In sum, the current study is the first to address the issue of whether false memories and beliefs can affect implicit attitudes towards an object as well as explicit attitudes. A false-feedback paradigm similar to that used in Laney, Morris, et al. (2008) was utilised, with

some procedural modifications designed to maximize usable data and the number of reported false memories and beliefs within the experimental group (*see Method section*). The false suggestion given to the experimental group was that they had enjoyed a certain food the first time they tried it as a child. It was hypothesised that those who formed a false memory or belief of enjoying the food the first time they tried it would report more preferential explicit attitudes towards the attitude object post-suggestion than pre-suggestion. With regards to implicit attitudes, it was hypothesised that participants with a false memory (but not necessarily those with a false belief only) would exhibit significantly more positive implicit attitudes towards the relevant attitude object.

2. Method

2.1 Participants

The overall sample consisted of 120 undergraduate students (101 female, 19 male) at the University of Hull, U.K., who participated in return for course credit or payment. Overall sample size was comparable to that of other experiments using a similar paradigm (Clifasefi, Bernstein, Mantonakis, & Loftus, 2013; Laney, Morris, et al., 2008). The subdivision of the Suggestion group (the experimental group who received the false suggestion of loving a certain food the first time they tried it) in the analyses means that a far higher number of Suggestion group participants are needed relative to control participants. Therefore, allocation of participants to groups was only partially random. The majority of participants (n = 96) were randomly assigned to either the Suggestion or control group at a ratio of two Suggestion group participants to one control participant. Once a sufficient number of control participants had been recruited for analyses (n = 32), all subsequent participants (n = 24) were allocated to the Suggestion group. The final number of participants in the false suggestion group was 88, with 32 in the control condition. Because the study was exclusively interested in *false* memories and beliefs, participants were only included in

analyses if they indicated low baseline confidence in the occurrence of a potential false suggestion event (see Materials and Procedure sections for further details). After applying this exclusion criterion, there were 75 suggestion group participants and 31 control participants, giving a functional overall size for this study of n =106. This sample was made up of 88 females and 18 males, with a mean age of 21.88 years (SD = 6.33). Up to five participants were tested simultaneously in each experimental session.

2.2 Design

A mixed design was employed in which session (Session 1 / pre-suggestion vs Session 2 / post-suggestion) served as a within-subjects factor, with group serving as a between-subjects factor. For initial analyses of false memory/belief formation, the between-subjects group factor refers to the false Suggestion group vs the control group. In later stages of analyses, the Suggestion group is subdivided into "Believers" and "Non-Believers", with the Believers subgroup then being further subdivided in order to compare data for those who formed a false memory and those who formed a false belief only.

The dependent variables differed slightly from previous studies. In past studies, the false suggestion given to the experimental group was identical for each participant; subsequently, the DV has always been attitude measures relating to the attitude object in the false suggestion (e.g., the false suggestion 'You loved asparagus as a child' and the subsequent DV of attitudes towards asparagus in Laney, Morris, et al., 2008). However, a problem with this approach is that all participants who indicate high baseline confidence in the false suggestion item need to be excluded from analyses (since the studies are interested exclusively in *false* memories). In an attempt to maximise the amount of usable data, the current study measured participants' baseline confidence that they had loved a series of different foods the first time they tried them, including four potential critical items which could later be incorporated into the false suggestions given to the experimental group (see

Procedure section for more details on item allocation and how they were incorporated into false suggestions). Subsequently, the DVs for each participant are the explicit and implicit attitude measures pertaining to their specific critical item.

2.3 Materials

This study utilised pen-and-paper questionnaires similar to those used by Laney, Morris, et al. (2008), but with several changes designed to improve the efficiency of the experimental design in terms of data utilisation as well as increasing the likelihood of Suggestion group participants forming false memories. The first session contained eight brief questionnaires. One of these was the "Food History Inventory" (FHI) which lists a series of 24 food related events (e.g. "ate ice cream at the seaside", "helped your parents prepare a meal") and asks the participant to rate on a 1-8 scale how confident they are that the event occurred to them before the age of 12. The critical item which would form the basis of the false suggestion in Session 2 was contained within this questionnaire. One key change to this questionnaire which differentiates it from that used in Laney, Morris, et al. was that instead of the questionnaire containing a singular critical item (such as "You loved asparagus the first time you tried it"), a second section was added to the questionnaire which asked the participants to rate how confident they were (on the same 1-8 scale) that they had loved a series of foods the first time they tried them. Within this list of 20 different foods were four potential critical items; broccoli, carrots, green beans, and cauliflower.

Session 1 also contained the "Restaurant Questionnaire" which asked participants to imagine they were in a restaurant for a special dinner and then assessed (on a 1-8 scale) how likely they were to order a series of 32 dishes assuming price was no object. Included within this list were four different dishes which predominantly featured the critical items; 'stir-fried broccoli', 'carrot salad', 'buttered green beans' and 'roasted cauliflower salad'. There was also a 'Food Preferences' questionnaire which asked participants to rate their general

preference for a series of 64 different food items (including the four potential critical items) on a 1-8 scale. Participants also completed five brief personality questionnaires to gather individual differences data for a related study and to help maintain the cover story that the study investigating the relationship between food preferences and personality.

The second session contained repeats of the FHI, Restaurant and Food Preferences questionnaires, as well as a "feedback" questionnaire. This questionnaire, administered at the start of the session, claimed that it was based on the individual participant's data from the first session, listing four events from the FHI questionnaire that they had ostensibly indicated they were confident had happened to them. For the Suggestion group, only three of the items were events they had confirmed in their Session 1 responses. The fourth was a statement that they loved their critical food item the first time they tried it. For control participants, all four items were events that the participant had confirmed in their Session 1 responses.

The feedback questionnaire then instructed participants to elaborate on two of the events by imagining themselves currently at the scene in which the event may have taken place with as much detail as possible, before listing "any information on sensory details (sights, sounds, etc), thoughts or feelings" associated with the event (for Suggestion group participants, one of these events was always the suggestion regarding the critical item). Participants were instructed to attempt to list "at least 3 details". After doing this, they were asked to rate on a 1-8 scale how vividly they were able to imagine the event, followed by the filler question regarding the extent to which they feel this event influenced their adult personality (to maintain the cover story that the experiment is concerned with the relationship between food attitudes and personality). This feedback questionnaire contained two key alterations from that used in Laney, Morris, et al. (2008). The first change was that participants were given feedback events specifically tailored to them based on their Session 1 answers (three of the four events for the Suggestion group, all four events for the control

group), whereas Laney, Morris, et al. provided every participant with filler events which they assumed would be true of most people. The aim of this change was to increase the credibility of the false suggestion. It has previously been found that participants are more likely to form a false memory of an event if the false suggestion contains personally relevant information (Desjardins & Scoboria, 2007), therefore incorporating events into the false feedback which participants had indicated they were confident had happened to them may increase feedback credibility and potentially boost false memory rates.

The second change to the feedback questionnaire was the imagination instructions. Laney, Morris, et al. (2008) asked participants to imagine the setting in which two of the feedback events might have occurred (one of which was the false suggestion event for experimental group participants) before giving brief details of the place of the event and who they may have been with. In the current experiment, these instructions were adapted to encourage more in-depth imagination of the false suggestion event. Instructions were adapted from Grilli and Glisky's (2010) "self-imagining" technique, which was found to significantly increase recollection of imagined experiences. Participants were instructed to imagine themselves at the scene in which the experience may have occurred in as much detail as possible before listing any information on sensory details, thoughts or feelings associated with the event. Participants were encouraged to try and generate at least 3 or 4 details. It was hoped that these self-imagining instructions would be more effective at boosting false memory rates through imagination inflation than those used by Laney, Morris, et al.

Also included in Session 2 was a 'Food Costs' questionnaire. This was similar to that used in Laney, Morris, et al. (2008) and asked participants to select the maximum price that they would pay for 21 different food items (including the four critical items) in a supermarket setting. Finally, a 'Memory or Belief' questionnaire was included, which listed three FHI events (one of which, for all participants, was that they loved their critical item the first time

they tried it) and asked participants to indicate whether they had a specific memory of the event, a belief that the event occurred but no specific memory of it, or were absolutely certain that the event did not occur. If participants reported a memory of the event, they were encouraged to list as much detail of the memory as possible. In the case of belief only, they were asked to write why they thought the event had happened to them. If they were sure that the event did not happen, they were asked to write why they were sure this was the case.

To measure implicit attitudes, the Single-Target Implicit Association Test (ST-IAT) developed by Karpinski and Steinman (2006) was employed. The ST-IAT is similar to the standard Implicit Association Test procedure (IAT) developed by Greenwald, McGhee, Schwartz, and Jordan (1998) in that it is based on participants' response times in categorising pictures or words representing an attitude object when paired with positively or negatively valenced stimuli (usually words), with the underlying assumption that positive implicit attitudes towards the attitude object should facilitate faster response times when the object is paired with positively valenced stimuli than when the object is paired with negatively valenced stimuli. However, the standard IAT is only effective for measuring the implicit attitudes towards one attitude object relative to another attitude object (e.g., Democrats vs Republicans). The key feature that distinguishes the ST-IAT from the standard IAT is that a comparison category is not necessary, and therefore implicit attitudes measures are more representative of the automatic evaluation of a single object, rather than being relative to an opposing object. The ST-IAT procedure used (*see Procedure section for details*) was based on that of Bluemke and Friese (2008), who over two studies containing several thousand participants found that the test displayed adequate construct and discriminant validity in measuring implicit attitudes to the related but distinct concepts of various political parties. The valenced stimuli used were largely similar, whilst the political party stimuli used by

Bluemke and Friese were replaced with pictorial stimuli of the four critical food items (one ST-IAT for each critical item).

2.4 Procedure

2.4.1 Session 1.

As in Laney, Morris, et al. (2008), participants were falsely informed that they would be participating in a study investigating the relationship between food preferences and personality. Participants completed the FHI, Restaurant and Food Preference questionnaires, interspersed with the five measures of individual differences mentioned in the *Materials* section. Participants were randomly assigned to the Suggestion or Control groups, although for aforementioned reasons a 2:1 ratio of Suggestion to Control participants was maintained, and when a sufficient number of control participants for analysis had been tested, all participants were automatically assigned to the Suggestion group. Participants were then assigned a critical food item which they indicated low baseline confidence in enjoying the first time they tried it (a rating of 4 or less for that item on the Session 1 FHI). When multiple potential critical items were available, preference was given to an item which also had low explicit attitude ratings on the Restaurant and Preference questionnaires. Where multiple items were available which also matched this attitudinal criterion, preference was given to the item which had currently been assigned to the fewest participants (with the aim of balancing the number of participants assigned to each item as far as possible). In the event that a participant gave a Session 1 FHI rating of greater than 4 for all potential critical items, they were assigned whichever critical item they had rated lowest, and where multiple options were rated similarly, they were assigned the critical item which had currently been assigned to the fewest participants (although as previously mentioned, participants who gave a Session 1 FHI rating of greater than 4 for all four potential critical items were excluded from analyses, since low baseline confidence in the false suggestion event was required).

2.4.2 Session 2.

Session 2 took place approximately one week after Session 1. Suggestion group participants received the false feedback questionnaire, including the false suggestion that they had loved their specific critical item the first time they tried it, as well as three filler events which they had indicated they were confident had happened to them based on their Session 1 answers (FHI rating of 6 or higher). Control group participants received the same questionnaires, except with a fourth filler item instead of a false suggestion regarding their critical item. From this point onwards, the questionnaires were identical for both groups. The false feedback questionnaire was followed by the FHI, Restaurant, Food Preferences, Food Costs and Memory or Belief questionnaires.

After the questionnaires were completed, participants proceeded with the ST-IATs, which were run using E-Prime 2.0 (Schneider, Eschman, & Zuccolotto, 2002). Participants were instructed to categorise target category stimuli (pictures of a certain food) and evaluative stimuli (positive or negative words) as quickly and accurately as possible using two different categorisation keys on the keyboard (Z and M). Before each block of trials, participants were informed which key would represent each category, and the categories remained on screen in the top left (Z key) and top right (M key) corners of the screen during the categorisation task as a reminder. The first block of trials was a training block, in which only evaluative stimuli were presented. This was followed by the first ST-IAT, in which stimuli for the first target and positive words were categorised under the Z key whilst negative words were categorised with the M key. This initial block was followed by a "reversed" block, in which positive words were mapped to the Z key, whilst target stimuli and negative words were mapped to the M key. This procedure was repeated for each of the remaining three target items, with positive and negative words swapping category keys each time. The order in which each of the four foods was presented was counterbalanced between

participants. The sides on which target and evaluative stimuli were first presented (Z or M keys) were also counterbalanced, whilst maintaining that target stimuli and positive words were always paired together first. This created 8 different orders in which stimuli were presented, balanced between participants.

Evaluative stimuli consisted of five unambiguously positive and five unambiguously negative words, presented in 24pt black font against a white background in the centre of the screen. The target category stimuli consisted of five different 700x500 resolution pictures of the appropriate foods, displayed uncooked on white plates. For each block of trials, all stimuli were presented at least twice, and in a randomised order. For the initial evaluative block, a total of 20 evaluative stimuli were presented (10 positive, 10 negative). For each of the following initial and reversed blocks, a total of 35 stimuli were presented; 10 being the pictures of the target food, 10 being the words from the evaluative category which *was* currently sharing a categorisation key with the target food, and 15 being the words from the evaluative category which was *not* currently sharing a categorisation key with the target food. Stimuli remained on screen until a categorisation response was received. The interstimulus interval after responses was 300ms, with incorrect responses triggering the word 'Error' which was presented in bold, red 24pt text in the centre of the screen. After each block of trials, participants were instructed to take a self-paced rest if they were fatigued, as well as being given the new categorisation instructions for the next block of trials which they started whenever they were ready. After all ST-IATs were completed, participants were thanked and fully debriefed.

3. Results

3.1 Allocation of False Suggestion Items

Exclusion criteria were applied to ensure that analyses were restricted to participants for whom a *false* suggestion could be generated. Any participants who indicated that they

were confident they had loved all four of the potential false suggestion items (FHI ratings of 5 or more for each one) were excluded from analysis. Fourteen participants were excluded on this basis, giving a functional *N* of 106 (75 Suggestion group participants and 31 controls). The remaining participants were allocated a critical false suggestion item based on criteria discussed in the *Procedure* section. A cross-tabulation showing the numbers of participants assigned to each potential false suggestion item split by group can be found in Table 1.

Table 1.
Cross-tabulation of false suggestion item by group allocation.

	False Suggestion Item			
Group	Broccoli	Green Beans	Cauliflower	Carrots
Control	11 (35.5%)	13 (41.9%)	4 (12.9%)	3 (9.7%)
Suggestion	29 (38.7%)	17 (22.7%)	26 (34.7%)	3 (4%)

Preliminary analyses were conducted to ensure that there were no significant differences between the four false suggestion items in pre-suggestion attitudinal measures confidence in the false suggestion event, and the extent to which these measures changed post-suggestion. A series of one-way ANOVAs found no main effect of false suggestion item on Session 1 FHI, Restaurant or Preferences scores, or on the level of post-suggestion change in these measures (all $p > .05$). These results suggested that all four false suggestion items were suitable for grouping together into a single DV in subsequent analyses.

3.2 Were False Memories and False Beliefs Elicited?

FHI and Memory or Belief questionnaires were analysed to assess whether giving participants a false suggestion of loving their relevant critical food item was successful in eliciting false memories and beliefs of this event. The Suggestion and Control groups both gave similar pre-suggestion confidence ratings for the false suggestion item (see *Fig. 1*); the Suggestion group gave a mean rating of 2.01 (*SD* = 1.11) whilst the control group gave a

rating of 2.23 (*SD* = 1.20). However, after the false feedback was given at the start of Session 2, Suggestion group participants increased their ratings by an average of 3.39 points to a mean of 5.40 (*SD* = 2.54), whilst the ratings of control participants who did not receive the false suggestion at the start of Session 2 reported very similar level ratings as in Session 1 (*M* = 2.29, *SD* = 1.19).

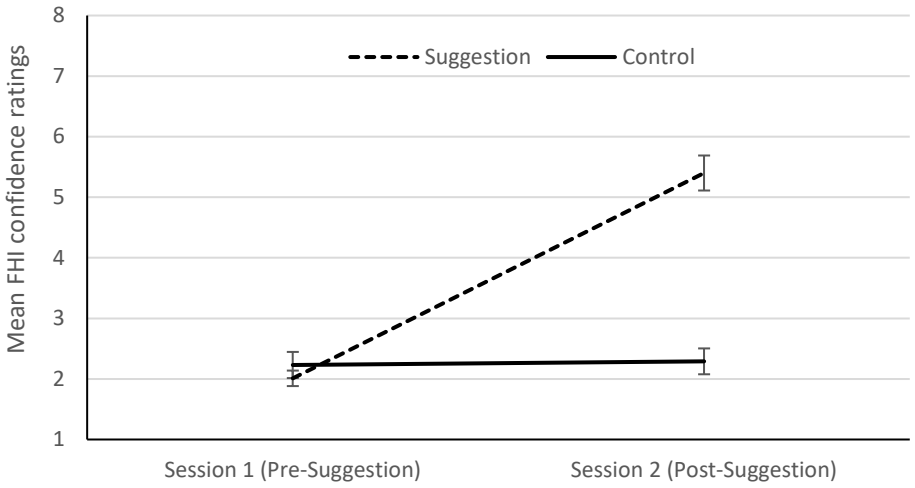

Fig. 1. Mean FHI confidence ratings that participants loved their critical false suggestion item the first time they tried it, both in Session 1 (pre-suggestion) and Session 2 (post-suggestion). Error bars represent standard error of the mean.

A 2x2 mixed-design ANOVA (with group as the between-subjects factor and session as the within-subjects factor) found a significant main effect of group on confidence ratings, $F(1, 104) = 21.52$, $p < .001$, $\eta_p^2 = .17$, a significant main effect of session, $F(1, 104) = 69.37$, $p < .001$, $\eta_p^2 = .40$, and a significant group x session interaction, $F(1, 104) = 64.28$, $p < .001$, $\eta_p^2 = .38$. Post-hoc paired samples t-tests (with a Bonferroni-corrected alpha level of .025) found that Session 2 (post-suggestion) FHI ratings were significantly higher than Session 1 (pre-suggestion) ratings for the Suggestion group, $t(74) = 13.05$, $p < .001$, whilst control group ratings did not significantly differ between sessions, $t(30) = .465$, $p = .645$.

Analysis of the Memory or Belief questionnaire revealed that, within the Suggestion group, 27 participants (36%) reported a false memory of the false suggestion event at the end of the Session 2 questionnaires, whilst an additional 26 (34.7%) reported a false belief only

and 22 (29.3%) reported that they were positive that the event did not happen. Within the control group, no participants reported a false memory, 3 (9.7%) reported a false belief, and 28 (90.3%) were positive that the event did not happen. A Pearson's chi square test found that participants' likelihood of reporting a false memory, false belief, or being positive that the event did not happen differed significantly as a function of group, $\chi^2(2, n = 106) = 33.46$, $p < .001$. Combined with the FHI data, these results indicate that false memories and beliefs were sufficiently generated within the Suggestion group.

3.3 Explicit Attitudinal Consequences of False Memories and Beliefs (Believers vs Non-Believers vs Controls).

Explicit attitudinal consequences of false memories and beliefs were initially compared between participants who formed either a false memory *or* a false belief ("Believers"), participants who received the false suggestion but did not form a false memory or belief ("Non-believers") and control participants. The criteria for determining whether a participant formed a false memory or false belief was the same as that used in Laney, Morris, et al. (2008). Specifically, any participants remaining after the initial exclusion criteria (confidence rating of 4 or lower for their false suggestion item on the FHI) who received the false suggestion at the beginning of Session 2 and subsequently went on to report a higher rating for the relevant FHI item than they did in Session 1 as well as reporting a memory or belief of the false suggestion event in the Memory or Belief questionnaire. Any Suggestion group participants who did not meet the criteria to be classified as Believers were classified as Non-Believers. Of the 75 Suggestion group participants remaining after the initial FHI exclusion criteria was applied, 52 (69.33%) met the criteria to be classified as Believers, with the remaining 23 (30.66%) classified as Non-Believers. Data for these subgroups were compared with the 31 control participants who met the initial FHI criteria.

3.3.1 Restaurant questionnaire.

Participants' desire to eat a dish containing their relevant food in a restaurant setting was assessed on a 1-8 scale. The mean ratings for each subgroup of participants across both sessions are displayed in *Fig. 2*. In Session 1, participants who would go on to be classified as 'Believers' gave a mean rating of 3.38 (*SD* = 2.18), those who would later be classified as 'non-believers' gave a mean rating of 2.13 (*SD* = .1.89) and control participants gave a mean rating of 2.87 (*SD* = 2.09). In Session 2 (post feedback), believers increased their mean rating to 5.12 (*SD* = 2.52), whilst non-believers' ratings increased only marginally to 2.26 (*SD* = 1.82), and control participants' ratings decreased marginally to 2.68 (*SD* = 1.85).

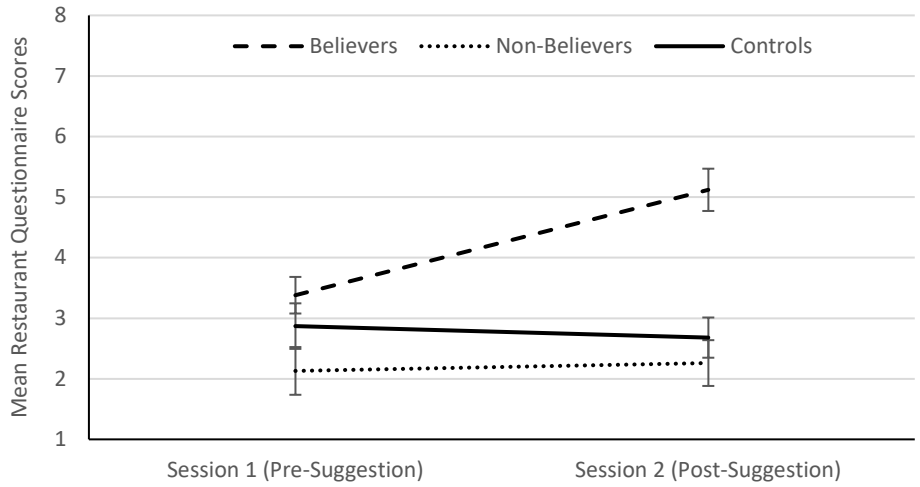

Fig. 2. Mean likelihood of ordering critical food-based dish in a restaurant setting ('Restaurant Questionnaire Scores') for Believers, Non-Believers and Control participants in Session 1 (pre-suggestion) and Session 2 (post-suggestion). Error bars represent standard error of the mean.

A 3x2 mixed ANOVA was carried out to assess whether restaurant questionnaire ratings differed significantly as a function of session (Session 1 vs Session 2, within-subjects factor) and group (Believers vs Non-Believers vs Controls, between-subjects factor). Significant main effects were found for Session, $F(1, 103) = 8.03$, $p = .006$, $\eta_p^2 = .07$, and Group, $F(2, 103) = 11.20$, $p < .001$, $\eta_p^2 = .18$, as well as a significant Session x Group interaction, $F(2, 103) = 11.78$, $p < .001$, $\eta_p^2 = .19$. Bonferroni-corrected post-hoc t-tests (with an adjusted alpha level of .0167) revealed that Session 1 and Session 2 ratings did not

differ significantly for non-believers (p = .672) and controls (p = .351), whilst for believers, Session 2 ratings were found to be significantly higher than Session 1 ratings, $t(51) = 5.23$, $p < .001$.

3.3.2 Food preferences questionnaire.

This questionnaire measured participants' general preference for their false suggestion item (as well as 63 other filler items) on a 1-8 scale, and was completed both pre-feedback (Session 1) and post-feedback (Session 2). The mean ratings for each subgroup are displayed in *Fig. 3*.

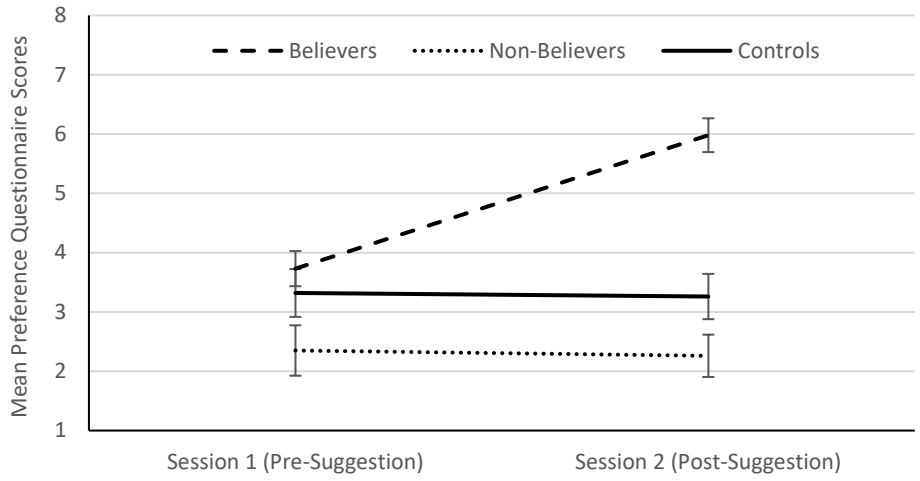

Fig. 3. Mean ratings of general preference for the critical food item given in both Session 1 (pre-suggestion) and Session 2 (post-suggestion) for Believers, Non-Believers and Controls. Error bars represent standard error of the mean.

In Session 1, participants who would later be classified as Believers gave their critical items a mean preference rating of 3.73 (SD = 2.13), participants later classified as Non-Believers gave a mean rating of 2.35 (SD = 2.04), and controls gave a mean rating of 3.32 (SD = 2.24). In Session 2, the mean preference rating given by believers increased to 5.98 (SD = 2.05), whilst mean ratings for non-believers (M = 2.26, SD = 1.71) and controls (M = 3.26, SD = 2.13) remained highly similar to their pre-feedback scores. A 3x2 mixed ANOVA with group (Believers vs Non-Believers vs Controls) as the between-subjects factor and

session (Session 1 vs Session 2) as the within-subjects factor revealed significant main effects of both group, $F(2, 103) = 17.18$, $p < .001$, $\eta_p^2 = .25$, and session, $F(1, 103) = 12.79$, $p = .001$, $\eta_p^2 = .11$, with a significant group x session interaction, $F(2, 103) = 19.73$, $p < .001$, $\eta_p^2 = .28$. Bonferroni-corrected post-hoc paired-samples t-tests (with an adjusted alpha level of .0167) were carried out to assess the differences in preference ratings between Session 1 and Session 2 for each of the subgroups. Whilst no significant differences were found between Session 1 and Session 2 preference ratings for non-believers ($p = .822$) and controls ($p = .782$), Session 2 preference ratings were found to be significantly higher than Session 1 ratings for believers, $t(51) = 7.32$, $p < .001$.

3.3.3 Food costs questionnaire.

This questionnaire was only administered in Session 2, and the unequal intervals meant that a non-parametric test was used to analyse differences between groups. A Kruskal-Wallis H test that there was a significant difference between groups in the maximum amount they were willing to pay for their relevant food, $\chi^2 = 9.70$, $p = .008$, with mean rank scores of 61.93 for believers, 41 for non-believers and 46.53 for controls. Bonferroni-corrected Mann-Whitney U (with an adjusted alpha level of .025) tests revealed that believers gave significantly higher ratings than controls, $z = 2.30$, $p = .021$, and non-believers, $z = 2.70$, $p = .007$.

3.4 Explicit Attitudinal Consequences of False Memories and Beliefs (Memories vs Beliefs vs Controls).

To assess the differences in explicit attitudinal consequences of false memories and false beliefs only, the subgroup of ‘believers’ was further subdivided into those who reported a false memory of the false suggestion event in the Memory or Belief questionnaire, and those who reported a false belief only with no specific memory. The 3 control group participants who claimed to have a belief of the false suggestion event despite not having

received the false suggestion in their feedback were treated as controls for these analyses rather than as participants having false beliefs. After applying this criterion, there were 27 participants who were classified as having a false memory and 25 who were classified as having a false belief, as well as the 31 control participants. Thus, the functional *n* for this set of analyses was 83.

3.4.1 Restaurant questionnaire.

The mean scores for the Restaurant questionnaire across both sessions is displayed in *Fig. 4*. In Session 1, those who later formed a false memory of the false suggestion event gave a mean rating of 3.26 (*SD* = 2.30), those who later formed a false belief only gave a mean rating of 3.52 (*SD* = 2.08) and controls gave a mean rating of 2.87 (*SD* = 2.09). In Session 2 (post-feedback), participants who later reported a false memory increased their mean rating to 5.30 (*SD* = 2.45), those who reported a false belief increased their mean rating to 4.92 (*SD* = 2.63), and the mean rating of controls decreased slightly to 2.68 (*SD* = 1.85).

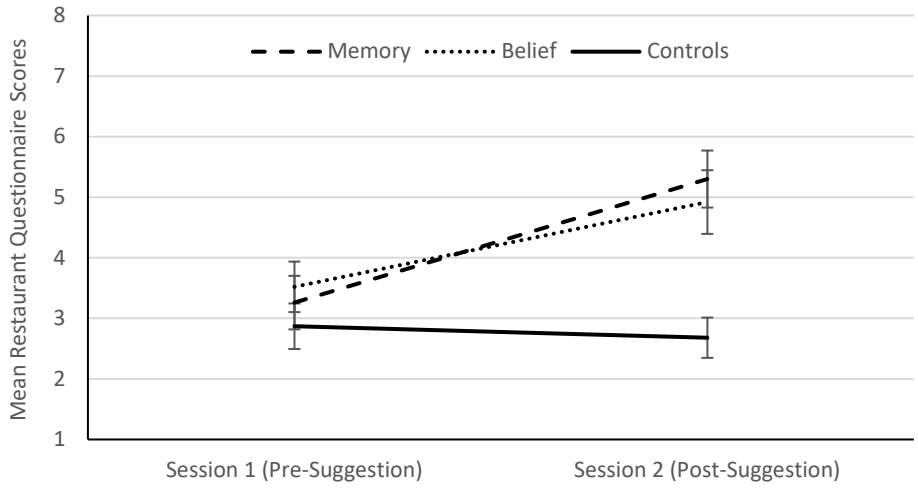

Fig. 4. Mean likelihood of ordering critical-food based dish in a restaurant setting in Session 1 (pre-suggestion) and Session 2 (post-suggestion) for participants who reported a false memory of the false suggestion event, a false belief of the event only, and control participants. Error bars standard error of the mean.

A 3x2 mixed ANOVA using session as the within-subjects variable and group (memory vs belief vs control) as the between-subjects variable found a significant main effect of session, $F(1, 80) = 23.78$, $p < .001$, $\eta_p^2 = .23$, a significant main effect of group, $F(2, 80) = 5.33$, $p = .007$, $\eta_p^2 = .12$, and a significant group x session interaction, $F(2, 80) = 9.54$, $p < .001$, $\eta_p^2 = .19$. Bonferroni corrected post-hoc (with an adjusted alpha level of .0167) t-tests revealed that Session 2 ratings were significantly higher than Session 1 ratings for those with a false memory, $t(26) = 4.51$, $p < .001$, and those with a false belief, $t(24) = 2.88$, $p = .008$, but did not significantly differ for controls ($p = .672$). Ratings for those with a false memory and those with a false belief only did not significantly differ at either Session 1 ($p = 1.00$) or Session 2 ($p = 1.00$).

3.4.2 Food preferences questionnaire.

Mean ratings given for the general preferences questionnaire are displayed in *Fig. 5*. In Session 1, those who would later reported a false memory of the false suggestion event gave a mean rating of 3.89 ($SD = 2.21$), those who would later report a false belief gave a mean rating of 3.56 ($SD = 2.08$) and control participants gave a mean rating of 3.32 ($SD = 2.24$). In Session 2, those who would report a false memory increased their mean rating to 6.37 ($SD = 1.98$), those who reported a false belief increased their rating to 5.56 ($SD = 2.08$) and control participants decreased their mean rating marginally to 3.26 ($SD = 2.13$).

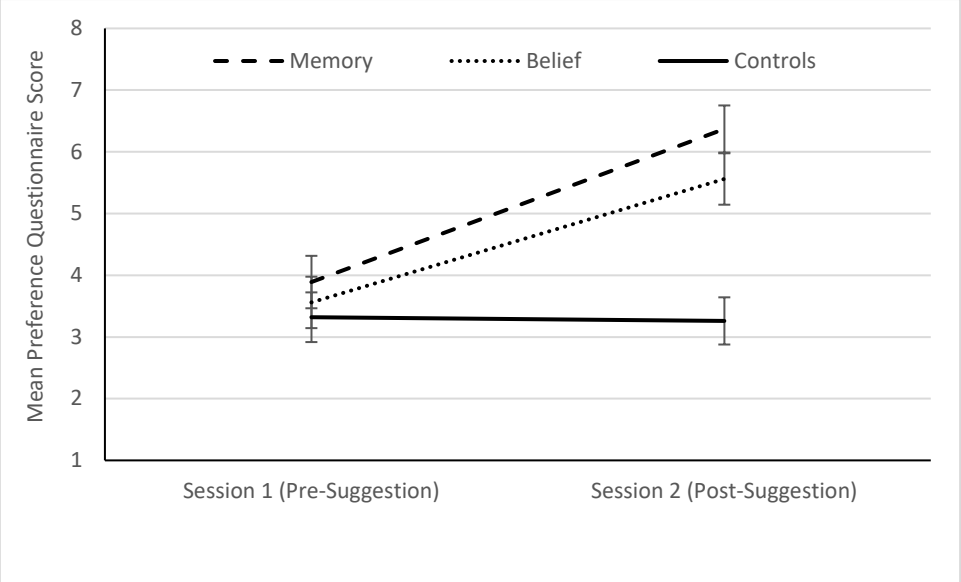

Fig. 5. Mean general preference ratings for critical food items in Session 1 (pre-suggestion) and Session 2 (post-suggestion) given by those who reported a false memory of the false suggestion event, those who reported a false belief, and control participants. Error bars represent standard error of the mean.

A 3x2 mixed ANOVA with session as the within-subjects factor and group (memories vs beliefs vs controls) as the between-subjects factor found a significant main effect of session on preference ratings, $F(1, 80) = 48.15$, $p < .001$, $\eta_p^2 = .38$, a significant main effect of group, $F(2, 80) = 7.20$, $p = .001$, $\eta_p^2 = .15$, and a significant group x session interaction, $F(2, 80) = 14.44$, $p < .001$, $\eta_p^2 = .27$. As for the Restaurant Questionnaire results, Bonferroni-corrected (with an adjusted alpha level of .0167), post-hoc, paired samples t-tests revealed that whilst ratings did not differ significantly between sessions for control participants ($p = .782$), Session 2 ratings were significantly higher in Session 2 than in Session 1 for those who reported a false memory, $t(26) = 5.58$, $p < .001$, and those who reported a false belief, $t(24) = 4.71$, $p < .001$. Again, as with the results for the Restaurant Questionnaire, preference ratings did not differ significantly between those who reported a false memory and those who reported a false belief at either Session 1 ($p = 1.00$) or Session 2 ($p = .486$).

3.4.3 Food costs questionnaire.

As in the previous analyses, due to the unequal intervals between the options given, the data was treated as ordinal and the non-parametric Kruskal-Wallis H test was used. In this case, the difference between groups in terms of the amount that participants were willing to pay for their critical item fell short of statistical significance, $\chi^2 = 5.93$, $p = .052$. However, group differences were still in the expected direction with a mean rank of 44.13 for those who formed a false memory, 49.28 for those who formed a false belief, and 34.27 for controls.

3.5 Implicit Attitudinal Consequences of False Memories and Beliefs (Believers vs Non-Believers vs Controls)

Prior to analyses, reaction time data from the ST-IATs was prepared using the method of Bluemke and Friese (2008), which is itself similar to the *D* algorithm (Greenwald, Nosek, & Banaji, 2003) which is widely used in analyses for the standard IAT. Initially, since the validity of implicit attitude measures relies on participants responding both quickly and accurately in order to facilitate response times via automatic associations, participants with error rates of 20% or more in any block of trials were excluded from analyses (a step which also helps to exclude participants from analyses who have either failed to engage properly with the task or failed to understand the instructions). Trials in which an error was made were not included in analyses, and latencies above 3000ms and below 300ms were recoded as 3000ms and 300ms respectively. The first trial of each block was considered a "training trial" and dropped from analyses. Each individual latency then underwent z-transformation, by subtracting the individual participant's mean overall response time for all 8 blocks of the ST-IATs (excluding the initial block of training trials) from each latency before dividing it by the individual participant's overall response time standard deviation for all 8 blocks of ST-IATs (again, excluding the initial block of training trials). For each ST-

IAT, the measure of a participant's implicit attitude towards the relevant object was calculated by subtracting the mean of transformed latencies in the 'Food + Positive' paired block from the mean of transformed latencies in the 'Food + Negative' paired block. A positive score indicates that participants were quicker in categorising stimuli when the food and positive stimuli were paired together than when the food and negative stimuli were paired together, and thus is representative of a positive implicit attitude towards that item.

ST-IAT results were initially compared between believers, non-believers and controls. Group allocation was based on the same criteria as those used in explicit attitudinal results. After excluding the 16 participants who registered a 20% or higher error rate in one of ST-IAT blocks, as well as additional 5 participants who did not register complete ST-IAT scores due to technical issues during data collection, there were a total of n = 85 participants for these analyses; 42 believers, 18 non-believers, and 25 controls. Believers registered a mean ST-IAT score of -.13 (SD = .34) for their critical item, whilst non-believers had a mean rating of -.36 (SD = .42) and controls had a mean rating of -.22 (SD = .37). These means are displayed in *Fig. 6***.**

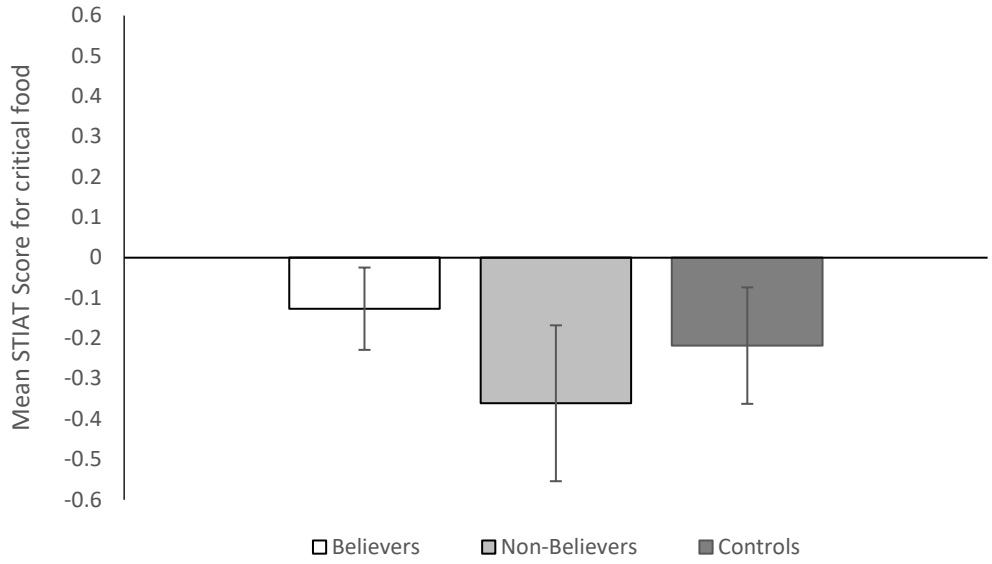

Fig. 6. Mean ST-IAT scores for participants' critical foods, split between Believers, Non-Believers and Controls. *Error bars represent 95% CIs*.

A one-way ANOVA found that ST-IAT scores did not significantly vary as a function of group, $F(2, 82) = 2.63$, $p = .078$. Bonferroni-corrected post-hoc tests did not yield any significant differences between groups (all $p > .05$).

3.6 Implicit Attitudinal Consequences of False Memories and Beliefs (Memories vs Beliefs vs Controls).

ST-IAT scores were also compared between the false memory group, the false belief group, and controls. As in the previous analyses, 5 participants were not included due to incomplete ST-IAT data, and 16 were excluded from analyses due to high error rates. Data were compared for 22 participants who reported having a false memory of the suggested event, 20 participants who reported a false belief only, and 25 controls. Participants who reported a false memory had a mean ST-IAT score of -.01 (*SD* = .24), participants who reported a false belief had a mean score of -.26 (*SD* = .39), and controls had a mean score of -.22 (*SD* = .37). These means are displayed in *Fig. 7*.

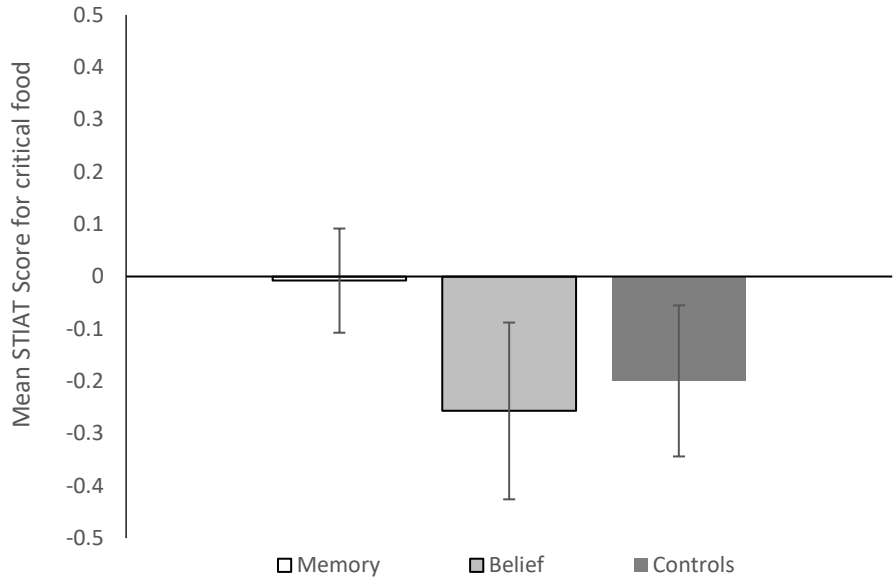

Fig. 7. Mean ST-IAT scores for participants' critical foods, split between those who formed a false memory of the false suggestion event, those who formed a false belief only, and controls. *Error bars represent 95% CIs.*

A one-way ANOVA found that ST-IAT scores varied significantly between those who formed a false memory, those who formed a false belief only and controls, $F(2, 64) = 3.44$, $p = .038$. Planned contrasts compared the ST-IAT scores of those who formed a false memory with the scores of those who formed a false belief and controls (combined), before comparing the scores of those who formed a false belief and controls. Participants who formed a false memory yielded significantly higher ST-IAT scores than those who formed a belief only and controls, $t(64) = 2.61$, $p = .011$. Those with a false belief only and controls did not significantly differ in their ST-IAT scores, $t(64) = -.386$, $p = .701$.

4. Discussion

The results of the current experiment regarding explicit attitudes are consistent with previous studies. In all explicit attitude measures that were taken pre- and post-suggestion, participants who formed a false memory or belief of loving a food the first time they tried it

significantly increased their explicit attitude scores for that item post-suggestion. The only measure which failed to yield a significant effect was the 'Food Costs' measure when compared between those who formed a false memory, those who formed a false belief and controls. This measure did yield significant effects when the data of those with false memories and beliefs (the Believers subgroup) was compared with that of 'non-believers' and controls, but when the Believers data was subdivided into memories and beliefs, the minimal differences between the two contributed to a lessened overall group effect. This result, and the fact that the other explicit attitude ratings increased by similar magnitudes post-suggestion for participants who formed a false memory and participants who formed a false belief only is consistent with the existing consensus that explicit attitudes are similarly affected by false memories and false beliefs (Bernstein et al., 2015). As Bernstein et al. concluded, the driving factor in explicit attitudinal change appears to be belief in the event's occurrence. This is arguably also compatible within the APE framework (Gawronski & Bodenhausen, 2006), in which explicit attitude judgments are said to be based upon syllogistic reasoning regarding judgment-relevant propositional information. Therefore, whether the participant has a memory of the false suggestion event or whether they merely believe in its occurrence, this information may serve effectively identical purposes in a deliberative explicit evaluative judgment.

The most novel and interesting finding from the current study, however, is that participants with false memories exhibited significantly more positive implicit attitudes towards their critical items than controls or those with a belief only. This provides support for the prediction that false memories can affect implicit attitudes, but false beliefs alone may not. This fits with the rationale that, like the guided imagery exercises of Blair et al. (2001) and Markland et al. (2015), the phenomenological qualities of false memories (sensory details, affective components, autonoetic experience, etc) may result in a change in

underlying associative activations triggered by presentation of the attitude object which would not be possible through a belief in occurrence without recollection. This account of how false memories may affect implicit attitudes is consistent with the APE model of implicit attitude change, and also fits with the recent findings highlighting the strong cognitive similarities between memory and imagination (Schacter et al., 2012).

The finding that implicit attitudes may be affected by false memories but not by false beliefs has implications for the dissociation of memories and beliefs in terms of their attitudinal consequences. Studies investigating the attitudinal effects of false memories and beliefs have tended to group data from the two together and have stated that there is little difference between them in terms of their effects. Bernstein et al.'s (2015) findings supported this, leading to the conclusion that the critical factor driving attitude change is not necessarily whether the false suggestion is remembered, but whether it is believed to have occurred. Whilst the results of the current study regarding explicit attitudes are consistent with this conclusion, the differing effects of memories and beliefs on implicit attitudes suggest that belief may not be a critical factor in implicit attitude change. This is perhaps unsurprising given that the associative processes that form the basis of implicit attitudes are widely considered to be independent of conscious endorsement and are activated whether or not the individual considers them to be "true" (Gawronski & Bodenhausen, 2006). Therefore, assuming false memories are able to impact implicit attitudes through the same mechanisms as mental imagery, the individual's belief in the memory should be of little consequence.

It should also be noted that the false-feedback/imagination inflation paradigm used in this study was successful in eliciting a large number of false memories and beliefs; 70.7% of those who received the false suggestion later reported a false memory or belief of the event. A recent review of studies claiming to elicit false memories and beliefs of childhood events by Brewin and Andrews (2016) found the proportion of participants meeting the criteria to be

labelled “believers” in the analysed false feedback studies to range from 18% to 53%. The large proportion of false memories and beliefs in this study may be a result of the modifications made to the standard false feedback procedure used by other studies (multiple potential critical items, personalised false feedback, and modified imagination instructions).

Limitations of the current study include the absence of a baseline measure of implicit attitudes towards the critical item. This was omitted intentionally out of concern that completing a pre-suggestion ST-IAT may have highlighted the four potential critical items as central to the study, and that this would adversely affect the credibility of the false suggestion. The lack of a baseline measure means, however, that it is impossible to determine whether false memories changed implicit attitudes, or whether those who formed a false memory already had more positive implicit attitudes towards their critical items. It should also be pointed out that it is unclear whether similar implicit attitude effects could have been elicited merely through imagination of the false suggestion without the need for a false memory. Since all participants who formed false memories completed the imagination task requiring detailed imagination of the false suggestion event, and since those who formed false memories reported that they were able to imagine the false suggestion event significantly more vividly than those who formed a false belief only (p = .029), it is difficult to disentangle the influence of imagination from that of false memories. However, those who reported a false belief did report a mean vividness rating above the midpoint in the scale (M = 4.10), with those reporting a false memory reporting a mean of only 1.31 points higher (M = 5.41); therefore, whilst statistically significant, it is debatable whether the two subgroups are likely to have differed in their vividness of imagination to such an extent as to be the *sole* cause of the implicit attitudinal effects. One way that this issue could be addressed in any future research investigating implicit attitudinal effects of false memories and beliefs to

include an additional control group which merely imagines the false suggestion event, without it being suggested that the event ever actually occurred to them.

Another limitation to be addressed in future studies would be the lack of complete randomisation to conditions. Although the majority of participants (96 out of 120) were randomly assigned to either the Suggestion group or the control group, after a sufficient number of control group participants had been recruited, the final 24 were assigned directly to the Suggestion group. This was because the subdivisions of the Suggestion group in the analyses means that a far higher number of Suggestion group participants are needed relative to control participants, and whilst it is highly unlikely that this partial lack of randomisation had any impact on our results, future studies should ideally maintain group randomisation random throughout. Additionally, it would be beneficial for future studies to investigate whether negative false memories can result in negative implicit attitude change. Whilst various studies have demonstrated negative false memories and beliefs having a negative impact on explicit attitudes (Bernstein et al., 2005; Clifasefi et al., 2013; Geraerts et al., 2008), the question of whether negative false memories could similarly affect implicit attitudes has yet to be addressed.

4.1 Conclusions

The current study was the first to demonstrate that implicit attitudes can be affected by false memories, as well as finding supporting evidence for the explicit attitudinal effects of false memories and beliefs. The finding that false memories affect implicit attitudes but false beliefs alone does not contrast with the explicit attitudinal effects found both here and in previous research, which have found explicit attitudes to be affected to similar extents by both false memories and false beliefs. However, due to the lack of a baseline measure of implicit attitudes and only partial randomisation of participants, the findings regarding

implicit attitudes require replication in future studies. This could potentially be done using multiple implicit measures; whilst the paradigm used in this study is able to demonstrate the convergence of multiple explicit measures, being able to do likewise with multiple implicit measures would be a good indicator of the reliability of these implicit effects. It would also be beneficial for future research to address whether any implicit attitudinal effects are long-lasting. Previous studies have demonstrated that false memories and beliefs, and their explicit attitudinal and behavioural effects, can persist over time (Geraerts et al., 2008; Laney, Fowler, Nelson, Bernstein, & Loftus, 2008), although there is limited evidence to suggest whether the implicit attitudinal effects are likely to last. As Markland et al. (2015) point out, implicit attitude changes brought about by imagery exercises are likely to be transient and would probably only last if the individual engaged in the mental imagery repeatedly and consistently enough to result in incremental permanent change to underlying associative structures. It is plausible that this sort of change may be more likely through false memories than through mental imagery since a false memory (assuming it persists) is more likely to be repeatedly activated upon later presentations of the attitude object. In addition to replication of the implicit attitudinal effects, it would be beneficial for future research to include longitudinal measures of implicit attitude to determine whether any effects are long-lasting.

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