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Event-related potential evidence suggesting voters remember political events that never happened

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Voters tend to misattribute issue positions to political candidates that are consistent with their partisan affiliation, even though these candidates have never explicitly stated or endorsed such stances. The prevailing explanation in political science is that voters misattribute candidates' issue positions because they use their political knowledge to make educated but incorrect guesses. We suggest that voter errors can also stem from a different source: false memories. The current study examined event-related potential (ERP) responses to misattributed and accurately remembered candidate issue information. We report here that ERP responses to misattributed information can elicit memory signals similar to that of correctly remembered old information—a pattern consistent with a false memory rather than educated guessing interpretation of these misattributions. These results suggest that some types of voter misinformation about candidates may be harder to correct than previously thought.

Keywords: political; false memories; event-related potentials; misinformation

INTRODUCTION

Election Day provides voters the opportunity to hold politicians accountable for their actions and promises. They can reward politicians who have supported or proposed what the voter believes are good policies and punish those who have endorsed views with which the voter disagrees. Under this view of democratic elections, political accountability requires that voters possess accurate memories of what elected officials accomplished in office and what promises such politicians made during their campaigns. However, voter memory is far from perfect, and voters make consistent errors in recalling and using relevant political information about candidates.

In particular, voters tend to misattribute issue positions that are consistent with candidates' party affiliation (e.g. attribute a pro-life view to a Republican candidate), even when these candidates have never endorsed such views (Lodge and Hamill, 1986; Lodge *et al.*, 1989; Norpoth and Buchanan, 1992). For example, during the 1988 presidential election, most Americans believed incorrectly that it was Michael Dukakis, and not his opponent, George H.W. Bush, who promised to be the 'education president'. Likewise, most thought that it was Bush, not Dukakis, who favored making a build-up of conventional military forces the top defense priority (Norpoth and Buchanan, 1992). Such issue misattribution is a well-documented phenomenon among voters, who have been found to make systematic errors when performing memory-based evaluations of political candidates. These misattributions also distort voter evaluations of candidates, such as character judgments (Lodge *et al.*, 1989; McGraw *et al.*, 1990).

Currently, there is not a good understanding of how and why such errors arise. Therefore, the aim of this study is to examine the psychological mechanisms underlying errors in issue attribution. We will first describe the prevailing view in political science that points to educated guessing as the source of issue misattributions. We propose an alternative account and suggest that these errors can also be due to the formation of false memories. We then test this alternative account by using event-related potential (ERP) measures of memory to examine whether issue misattributions are associated with brain activity indicative of false memories.

Potential sources of issue position misattribution

The prevailing view in political science is that voters misattribute candidates' issue positions because they make educated but incorrect guesses (Feldman and Conover, 1983; Lodge and Hamill, 1986; Conover and Feldman, 1989). According to this account, voters who are queried about a candidate's stance on a particular issue may recognize that they have no memory of whether or not that candidate has endorsed a particular position. They therefore use general knowledge about the candidate, such as his or her party affiliation, to make an educated guess about the candidate's likely position on that issue. For example, voters might reason that since George H.W. Bush is a Republican, and Republicans have traditionally been associated with a 'pro-military' stance, then Bush must have been the candidate in favor of expanding conventional military forces. A critical feature of this account is that voters lack a memory representation of a specific candidate–issue pairing. Thus, they rely instead on decision-based strategies, such as educated guessing.

However, an alternative explanation for voters' mistakes, which has not been explored in political science, is that they arise from false memories. False memories refer to the vivid recollection of an event that did not occur or to familiarity-based errors of commission (for reviews, see Brainerd and Reyna, 2005; Gallo, 2006). An extensive body of theoretical and empirical work has examined the mechanisms by which false memories are generated. One theory, the *activation-monitoring* account, provides an explanation for voter issue misattributions. This account suggests that false memories arise from a combination of schema-based activations during encoding and source monitoring errors during retrieval. According to this account, information is stored in the form of schemas, consisting of an organized network of semantically related nodes, representing concepts. For example, in the domain of politics, concepts such as 'conservative', 'pro-life', 'against gun control' and 'supports tax cuts' might be linked together to comprise one's schema of a 'Republican'.

When a concept is encountered, its corresponding node becomes active and that activation spreads to surrounding nodes within the

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network (Collins and Loftus, 1975). Therefore, particularly when several related concepts are activated, incidental activation of the related, non-encountered items could summate and form a long-lasting memory representation. A false memory occurs when an individual retrieves this memory representation and misattributes its source, mistakenly thinking that they encountered information that was, instead, internally activated (Johnson *et al.*, 1993).

The activation-monitoring account has been used to explain experimentally induced false memories in the laboratory. For example, in the Deese–Roediger–McDermott (DRM) procedure (Deese, 1959; Roediger and McDermott, 1995), participants are presented with a list of words that are all semantically related to a non-presented critical lure word. For instance, the words 'sick', 'medicine', 'hospital' and 'stethoscope' are all associated with the word 'doctor'—the critical lure. Later, when participants are asked to recall or recognize words from the studied list, they have a strong tendency to retrieve incorrectly the critical lure (Roediger *et al.*, 2001b; McDermott and Watson, 2001) and report it as 'old', often with a high level of confidence (Miller and Wolford, 1999; Roediger and McDermott, 1999).

Educated guessing and false memories are distinct mechanisms that might engender issue misattributions in voters. Understanding the processes that underlie issue position misattributions is crucial given that the degree to which such misattributions affect political decisions could very well be contingent upon the processes that led to their creation. For example, evidence suggests that people may treat false memories the same as veridical memories (Pezdek and Hodge, 1999; Geraerts *et al.*, 2008): they report similar subjective experiences for (Roediger and McDermott, 1995; Payne *et al.*, 1997) and similar levels of confidence in (Miller and Wolford, 1999; Roediger and McDermott, 1999) real and falsely remembered events. Thus, correcting issue misattributions due to false memories could prove difficult given that voters believe that they are recalling something a candidate actually said.

ERP measures of memory

The goal of the present study is to determine whether issue misattributions can arise from false memories. To do this, we took advantage of the functional specificity afforded by ERP measures. In particular, electrophysiological studies of memory have identified brain activity that is sensitive to memory signal strength: the ERP 'Old/New effect'. Across different stimulus types and task conditions, the response to old items classified correctly ('hits') has been found to be more positive than that to new items that are correctly classified ('correct rejections') over posterior scalp electrodes between ~300 and 800 ms post-stimulus onset (for reviews, see Rugg, 1995; Friedman and Johnson, 2000).

The Old/New effect likely reflects multiple subcomponent processes related to memory retrieval, including both non-declarative aspects of memory, in the form of amplitude reductions of the N400 component (for a review, see Voss and Paller, 2008),[1] and more explicit aspects of memory and memory judgments, in the form of amplitude increases in the late positive complex (LPC), which is sensitive to encoding depth (Rugg *et al.*, 1998; Curran, 2004), level of recollective detail (Duzel *et al.*, 1997; Rugg *et al.*, 1998; Curran 2000) and the availability of source information (Donaldson and Rugg, 1998; Curran *et al.*, 2001; Woroch and Gonsalves, 2010).

Taken as a whole, the ERP Old/New effect provides a useful metric of the presence and strength of memory signals activated in response to a stimulus. Indeed, Old/New effects have been successfully used to reveal the nature of errors that occur in memory tasks, including those that typically elicit false memories. Several studies employing paradigms, such as the DRM, that are designed to create schema-based false alarms have found that ERP responses associated with false alarms are similar to those associated with hits—both more positive than responses to correct rejections (Duzel *et al.*, 1997; Johnson *et al.*, 1997). This supports the activation-monitoring account in suggesting that items engendering false alarms in these paradigms do so because they elicit an actual memory signal during the test phase, created by the implicit activation of the lures during encoding (see Urbach *et al.*, 2005, for a discussion of the nature of those encoding effects).

Critically, however, false alarms that are believed to have a different source elicit different effect patterns. For example, in Windmann *et al.* (2002), participants performing a recognition memory task were divided into a high and a low bias group based on their tendency to classify items as 'old' (with the high bias group making more 'old' classifications). The groups did not differ in their recognition accuracy, and both groups showed similar ERP Old/New effects for correctly classified items. However, ERPs to false alarms differed across groups. In the low bias group, false alarms patterned with hits, a pattern similar to that seen in studies eliciting false memories. In contrast, in the high bias group (the group more likely to say 'yes'), false alarms patterned with correct rejections. Thus, ERP patterns can reveal when errors arise from decision processes or response biases, rather than at the level of memory itself.

Predictions

The current study takes advantage of findings from previous ERP studies of memory by measuring ERP responses in the context of memory decisions about political candidates and their issue positions. We do this in order to assess whether memory errors are associated with a strong memory signal, suggesting false memories for those candidate–issue pairings, or without a strong memory signal, suggesting the use of decision strategies such as educated guessing.

We asked participants to read issue positions associated with pictures of fictitious political candidates. Then, in a surprise memory test, they were shown a studied or new issue position followed by a photo of a candidate. They were asked, while looking at a candidate's photo, to indicate whether the preceding issue position was or was not specifically endorsed by that candidate. Among the new issue positions were lure items, which were never studied in any form but were consistent with the candidate's general partisan schema (i.e. Democrat or Republican). We examined ERP responses to the candidates' photos to determine whether participants elicited memory signals for candidate–issue pairs. We expect that if the candidate's photo matches the memory representation activated by the issue position, responses will be more positive than if the photo does not match, creating an Old/New effect pattern for comparisons between candidates that are correctly identified by participants as associated with an old issue position (hits) as compared with those correctly identified as not being associated with a new issue position (correct rejections).

Critically, the educated guessing and false memory accounts make distinct predictions regarding what the ERP signals should look like to candidate photos that are incorrectly endorsed as having been previously associated with an issue position (false alarms). The false memory account predicts that false alarms to *new partisan consistent issue positions* should resemble ERP responses to hits, as in the studies by Duzel *et al.* (1997) and Johnson *et al.* (1997). Such an outcome would indicate that schema-based activations at encoding create a memory signal that is erroneously associated with the candidate, as opposed to being recognized as internally generated. Importantly, however, this account predicts a different pattern for false alarms to *new partisan* ***in****consistent issue positions*, as these are unlikely to be subject to schema-based activations. These false alarms, therefore,

[1]The N400 is sometimes termed 'FN400' in the memory literature; see Voss and Federmeier, 2011, for a discussion.

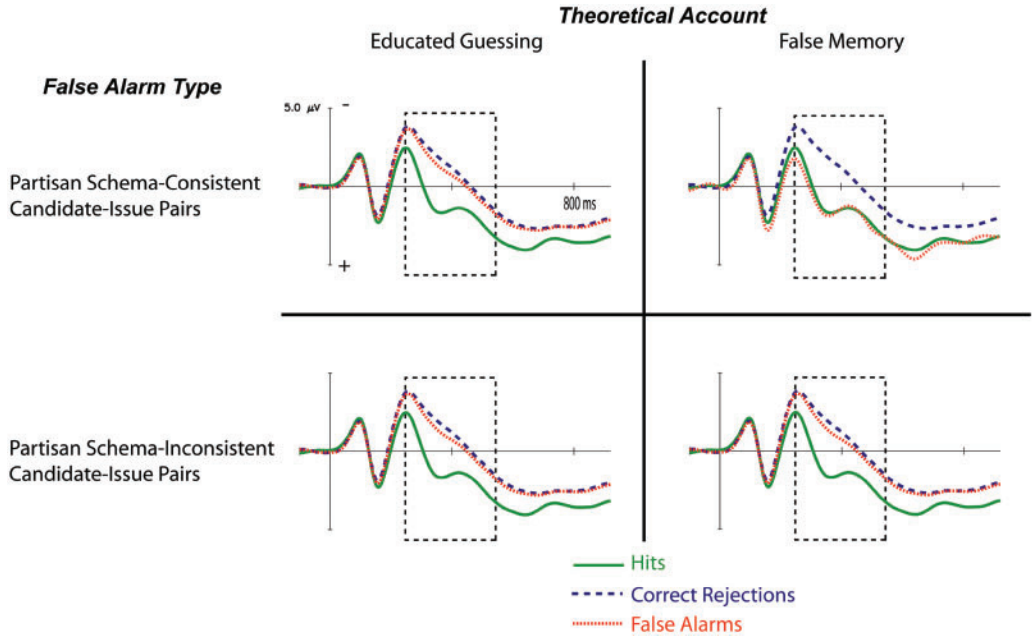

Fig. 1 ERP predictions to false alarm items. The N400 timewindow (250–550 ms) is highlighted.

should pattern instead with correct rejections. The current paradigm, therefore, allows a very specific test of the false memory account, as different ERP patterns are predicted for the same behavioral error (i.e. false alarms to candidates paired with new issue positions) in the context of different item types (Figure 1). In contrast to the predictions of the false memory account, the educated guessing account predicts that ERP responses associated with false alarms to either a *new partisan consistent* or a *new partisan inconsistent* issue position should pattern with correct rejections (as in Windmann *et al*., 2002), since no memory signal should exist for any of these items (Figure 1).

METHODS

Participants

We analyzed data from 57 participants (30 females, mean age 21 years, age range 18–32 years) who were recruited from the University of Illinois and compensated with money or course credit; we did not use data from seven additional participants due to excessive artifacts in the electroencephalogram (EEG). We recruited participants from upper level political science and from introductory psychology courses, thereby representing a range of background knowledge about politics. All participants, by self-report, had no history of psychiatric or neurological disorders and none was using psychoactive medications. Two of the participants were left handed. Fifty-five participants were native speakers of English, while two learned English as a second language.

Materials

The stimuli consisted of 205 policy statements. The statements were pre-tested in order to determine which were most strongly associated with either the Democratic or Republican Party. Of the 205 policy statements that passed criteria from the pre-testing data and expert post-check, 103 were judged to be associated with the Democratic Party and 102 with the Republican Party (see the Online Supplementary Material for a full description).

Issue positions were paired with four different fictitious candidates. Each candidate was represented by a single color photograph of a Caucasian man of middle age, obtained from the websites of law firms. Candidates were also paired with a total of 24 items that described personal information, such as wife's name and children's names. These were included in order to vary the types of information presented about each candidate, thus mirroring more closely real-world informational environments.

Experimental procedure

The main study employed a standard study-test design, with incidental encoding. Before the start of the experiment, participants were presented with a sheet that contained a list of all the issue positions that were used in the experiment. Participants were instructed to state the extent to which they agreed or disagreed with each position and to identify issue positions with which they were unfamiliar; on average participants considered 9% of the issue positions to be initially unfamiliar. In order to familiarize participants with all the issue positions and thus to prevent them from using simple item-based familiarity as a means of discriminating between the items during the test phase of the experiment, participants were taught about any issue positions with which they were not familiar.

Participants were tested in a single experimental session conducted in an electrically shielded, sound attenuating chamber. During the study phase, participants learned about four political candidates. Each candidate was paired with 19 issue positions and six personal facts. Two of the candidates were 'Democrats' (15 of their issue positions were ones that were generally associated with the Democratic Party, while the remaining 4 were generally associated with the Republican Party). The other two candidates were 'Republicans' (15 of their issue positions were ones that were generally associated with the Republican Party, while the remaining 4 were generally associated with the Democratic Party). However, participants were *not* given explicit information about each candidate's partisan identification since we wanted to determine whether participants would spontaneously use their knowledge of political parties despite not being cued or instructed by the experimenter to do so.

Participants were instructed to pay attention to each of the four candidates' issue positions and personal information, as they would be asked to 'vote' for one of the candidates after the study phase.

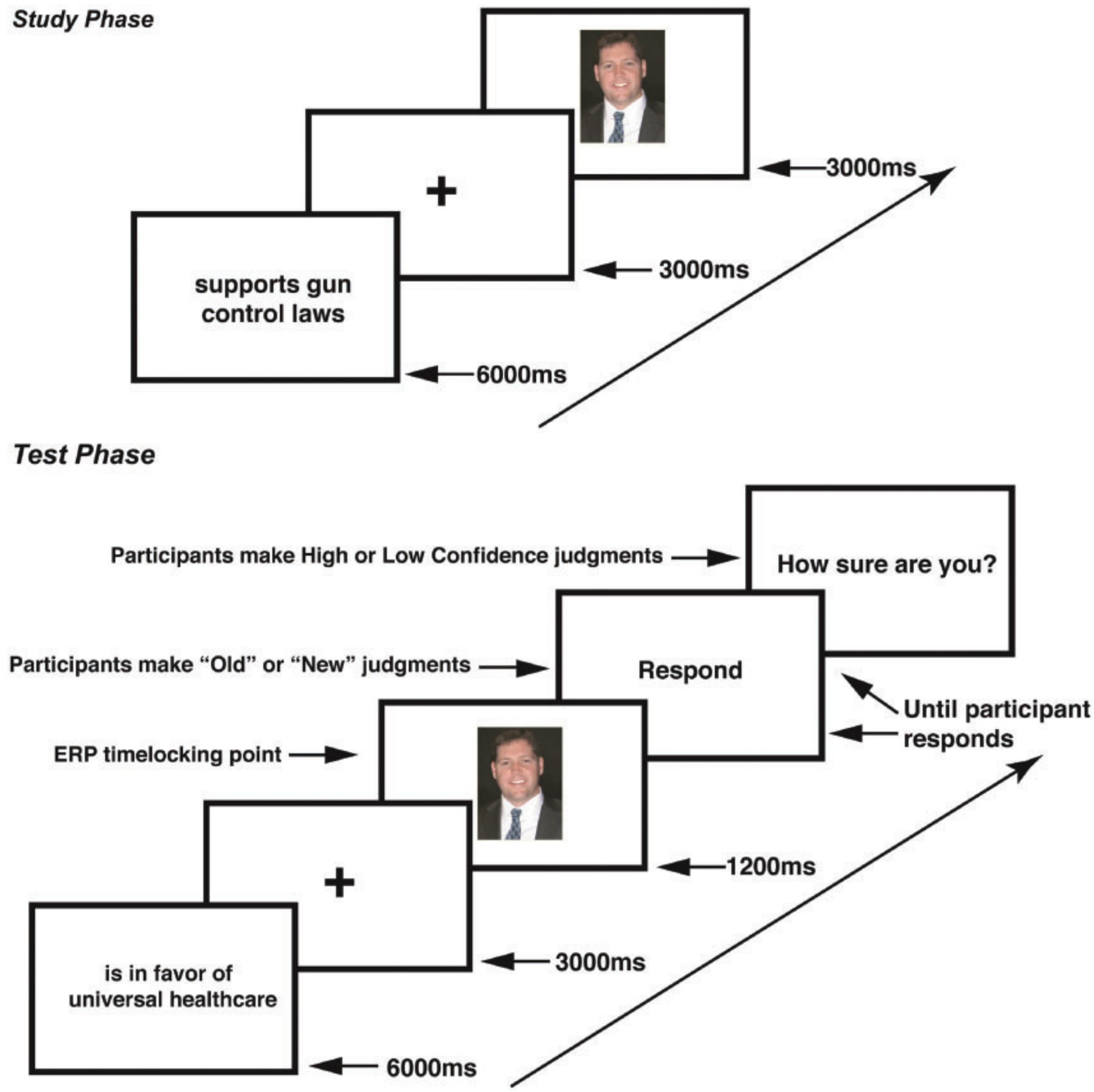

Fig. 2 Schematic of the experimental design.

They were not informed that there would be a memory test for the candidates' issue positions.

During the study phase, a trial consisted of an issue position or personal fact shown in the middle of the screen, followed by a fixation cross, and then a photo of one of the four candidates (Figure 2). The study phase was divided into four blocks. Participants had the option of taking a 2- to 5-min break between blocks. Issues were randomly assigned to candidates for each participant. Each issue was paired with only one candidate for a given participant, thus ensuring that each of the four candidates had unique issue stances, and each issue was viewed only once during study. In order to allow a consistent schema to be established for each candidate, issue positions that were inconsistent with a candidate's partisan identification were not shown until the third and fourth blocks.

After the study phase, participants were given a sheet containing photos of the four candidates and were asked to vote for one. They were also asked to rate each candidate on a likeability scale. The participants were then given a 10- to 15-min break (sitting in the recording chamber) before the test phase. They were then informed that their memory for the candidates' issue positions would be tested. In the test phase, each of the four candidates was paired with the same 19 issue positions as in the study phase (old pairs) as well as with 18 new issue positions not presented during the study phase (new pairs). Of the new pairs, 14 were consistent with the candidate's partisan identification ('schema consistent' or SC) and 4 were inconsistent ('schema inconsistent' or SI).

As shown in Figure 2, each trial began with an issue position presented the middle of the screen. A fixation cross was shown next, followed by a photo of a candidate. Once the participants saw the photo, they were instructed to report, via a button press, whether the pairing between the issue position and the candidate was 'old' or 'new'—that is, whether or not they had been shown that particular pairing during the study phase. Immediately following each old/new decision, participants also made a confidence judgment ('somewhat sure' or 'very sure') on their recognition decision. Participants were told to make their old/new and confidence judgments as quickly but as accurately as possible. The hands used for the old/new and confidence judgments were counterbalanced between subjects. ERPs were timelocked to the candidate photos.

EEG recording parameters

The EEG was recorded from 26 evenly spaced silver/silver chloride electrodes (see head icon in Figure 3). These sites were referenced online to the left mastoid and then re-referenced offline to the average

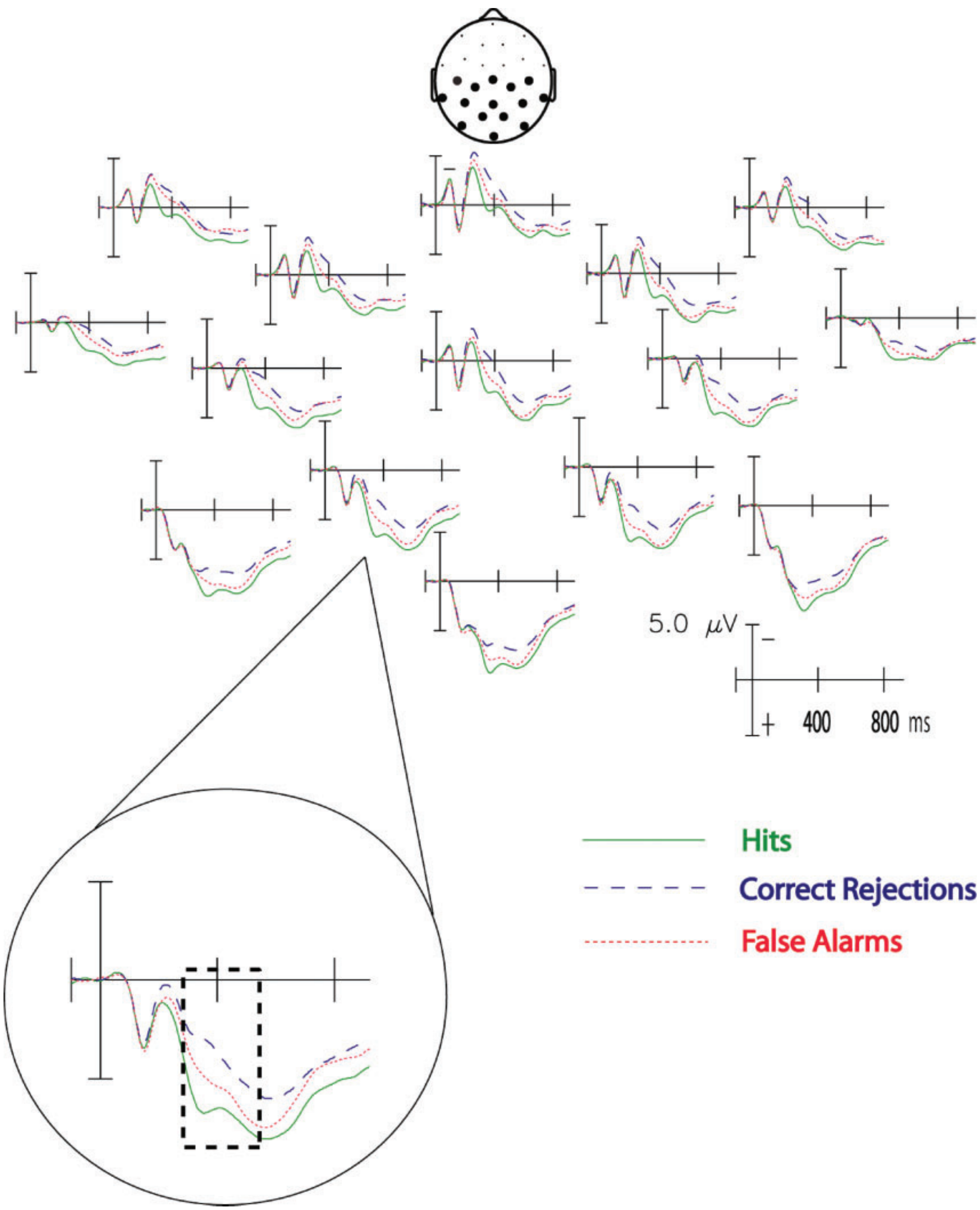

Fig. 3 ERP responses to partisan schema-consistent items. False alarms are intermediate between hits and correct rejections in the 250–550 ms (N400) timewindow (highlighted).

of the left and right mastoids. Blinks and eye movements were monitored via electrodes placed on the outer canthus of each eye and the infraorbital ridge of the left eye. Electrode impedances were kept below 5 kΩ. EEG was processed through Sensorium (Charlotte, VT) amplifiers set at a bandpass of 0.02–100 Hz. EEG was continuously digitized at 250 Hz and stored on hard disk for later analysis.

Data analyses

ERPs were computed from EEG epochs consisting of 100 ms prior to picture onset to 920 ms after. Epochs containing artifacts from amplifier blocking, signal drift, excessive eye movements or muscle activity were rejected offline before averaging. On average, 11% of trials were lost due to artifacts. Averages of artifact-free ERPs were created for each picture classification during recognition, after subtraction of the 100 ms prestimulus baseline. Prior to measurement, ERPs were digitally filtered with a bandpass of 0.2–20 Hz. Main effects of electrode site are not reported, as they were of no theoretical significance. All statistical tests are repeated measures analyses of variance (ANOVAs), with degrees of freedom adjusted by the Huynh–Feldt correction for the violation of sphericity. Reported *P*-values for all *t*-tests are based on two-tailed tests.

RESULTS

Behavioral performance

Raw hit and false alarm scores from the recognition memory test for both partisan schema consistent (SC) and inconsistent (SI) items are

Table 1 Raw hit and false alarm scores

	Partisan schema-consistent	Partisan schema-inconsistent
Hit		
High confidence	0.28 (0.14)	0.32 (0.18)
Low confidence	0.35 (0.11)	0.27 (0.14)
All	0.63 (0.11)	0.59 (0.15)
False alarm		
High confidence	0.09 (0.09)	0.05 (0.08)
Low confidence	0.19 (0.07)	0.13 (0.11)
All	0.28 (0.13)	0.18 (0.14)

Participants had higher rates of false alarms for partisan schema-consistent candidate–issue pairs than partisan schema-inconsistent pairs, $P < 0.001$ (highlighted). Means and standard deviations of raw hit and false alarm scores are shown for each category of items.

presented in Table 1. Participant memory performance was assessed using the discriminability index d'. General recognition memory was robust. As a group, participants demonstrated above-chance performance on recognition memory for both SC, $t(56) = 19.8$, $P < 0.001$, and SI candidate–issue pairs, $t(56) = 15.75$, $P < 0.001$. Mean recognition d' was 0.99 ± 0.05 s.e.m. for SC pairs and 1.26 ± 0.08 s.e.m. for SI pairs. There were no differences between high confidence SC (mean $d' = 0.96 \pm 0.06$ s.e.m.) and SI items (mean $d' = 1.06 \pm 0.08$ s.e.m.), $t(56) = -1.11$, $P = 0.27$, or between low confidence SC (mean $d' = 0.51 \pm 0.05$ s.e.m.) and SI items (mean $d' = 0.54 \pm 0.08$ s.e.m.), $t(56) = -0.46$, $P = 0.65$. In the context of overall good memory for candidate–issue pairings, however, we nevertheless observed relatively high rates of false alarms for partisan schema-consistent lures (mean = 28%).

In addition, we measured response bias with response criterion *c*. Participants were more likely to classify SC items as 'old' (mean c was 0.14 ± 0.30 s.e.m.) compared with SI items (mean c was 0.39 ± 0.33 s.e.m.), $t(56) = -5.35$, $P < 0.001$. There were no differences between high confidence SC (mean $c = 1.14 \pm 0.06$ s.e.m.) and SI items (mean $c = 1.06 \pm 0.05$ s.e.m.), $t(56) = 1.34$, $P = 0.19$. Participants were more likely to classify low confidence SC items (mean $c = 0.65 \pm 0.03$ s.e.m.) as 'old' compared with SI items (mean $c = 0.96 \pm 0.05$ s.e.m.), $t(56) = -8.21$, $P < 0.001$.

ERPs

Old/New effect

This study obtained an Old/New effect that is similar in timecourse and distribution to ones reported in previous work (for reviews, see Rugg 1995; Friedman *et al.*, 2000); see Online Supplementary Material for a figure showing the response at all channels. In this dataset, the Old/New effect is larger in the earlier (250–550 ms; N400) than in the later (550–800 ms; LPC) timewindow, $F(1, 56) = 39.09$, $P < 0.001$, and over the 15 posterior as compared with the 11 anterior sites, $F(1, 56) = 20.26$, $P < 0.001$. Therefore, subsequent analyses will be constrained to these posterior electrodes and focused within the 250–550 ms interval; however, patterns in the LPC timewindow were consistent with (albeit often reduced relative to) those in the N400 timewindow.

Partisan schema-consistent items

The false memory account predicts that false alarms to new partisan schema-consistent issue positions should resemble ERP responses to hits, whereas the educated guessing account predicts that these responses should pattern with correct rejections. To test this, we measured ERP amplitudes between 250 and 550 ms over 15 centro-posterior channels (see bold points on head icon in Figure 3) from 57 participants. We analyzed ERP responses with a two-factor repeated measures ANOVA with three levels of Condition [hits, correct rejections (CRs), false alarms (FAs)] × 15 levels of electrode sites. There was a main effect for Condition, $F(2, 112) = 19.57$, $P < 0.001$. Hits (mean 4.00 μV) elicited more positive voltages than CRs (mean 1.93 μV), $t(56) = 7.29$, $P < 0.001$. FAs (mean 3.00 μV) were intermediate between hits and CRs, as they were less positive than hits, $t(56) = 2.44$, $P = 0.01$, but more positive than CRs, $t(56) = -3.54$, $P < 0.001$ (Figure 3).

FAs may have been intermediate between hits and CRs because they were a mix of response types, some generated by guessing and others the product of false memories. In order to explore this possibility, we separately examined FA responses across confidence levels, as high confidence judgments are often considered a hallmark of false memories.

Partisan schema-consistent items by confidence

Nine of the 57 participants had no data in one of the critical subconditions. We analyzed data from the remaining 48 participants with a three-factor repeated measures ANOVA with three levels of Condition (hits, CRs, FAs) × two levels of Confidence (high, low) × 15 levels of Electrode sites. There were main effects for Condition, $F(2, 94) = 12.91$, $P < 0.001$, and Confidence, $F(1, 47) = 10.03$, $P = 0.03$. There was also a significant Condition × Confidence interaction, $F(2, 94) = 4.75$, $P = 0.01$ (Figure 4).

There was an Old/New effect for high confidence items. High confidence hits (mean 4.98 μV) elicited more positive voltages than high confidence CRs (mean 1.86 μV), $t(47) = 5.37$, $P < 0.001$. Critically, high confidence FAs (mean 5.01 μV) did not significantly differ from high confidence hits, $t(47) = -0.12$, $P = 0.90$, and were more positive than high confidence CRs, $t(47) = 3.89$, $P < 0.001$.

There was also an Old/New effect for low confidence items. Hits (mean 3.2 μV) were different from CRs (mean 2.27 μV), $t(47) = 2.38$, $P = 0.02$. Low confidence FAs (mean 2.86 μV) were not different from low confidence hits, $t(47) = -0.75$, $P = 0.46$, or from low confidence, CRs $t(47) = -1.28$, $P = 0.20$.

Partisan schema-inconsistent items

Because it was important not to change the partisan schema associated with the candidates during the test block, only a few partisan schema-inconsistent items could be included for each candidate. There were thus not enough trials to split into high and low confidence responses. Overall, most (71%) false alarm responses to partisan schema-inconsistent items were endorsed with low confidence.

Five of the 57 participants had no FAs to partisan schema-inconsistent items. We subjected ERPs for the remaining 52 participants to a two-factor repeated measures ANOVA with three levels of Condition (hits, CRs, FAs) × 15 levels of Electrode sites. There was a main effect of Condition, $F(2, 102) = 5.79$, $P = 0.004$. Hits (mean 4.8 μV) were associated with more positive voltages than CRs (mean 2.47 μV), $t(51) = 4.44$, $P < 0.001$. Critically, FAs (mean = 2.49 μV) were less positive than hits, $t(51) = -2.38$, $P = 0.02$, and were indistinguishable from CRs $t(51) = -0.03$, $P = 0.99$ (Figure 5).

DISCUSSION

The goal of the present study was to determine whether issue misattributions could be due to the formation of false memories. Based on prior literature (Duzel *et al.*, 1997; Johnson *et al.*, 1997), we expected false alarms based on false memories to be more likely for unstudied (lure) positions that matched the partisan schema for a given candidate and to be reported with high confidence. Such misattributions would then be expected to elicit ERP responses that have been linked to memory, patterning similarly to the response for hits. In contrast,

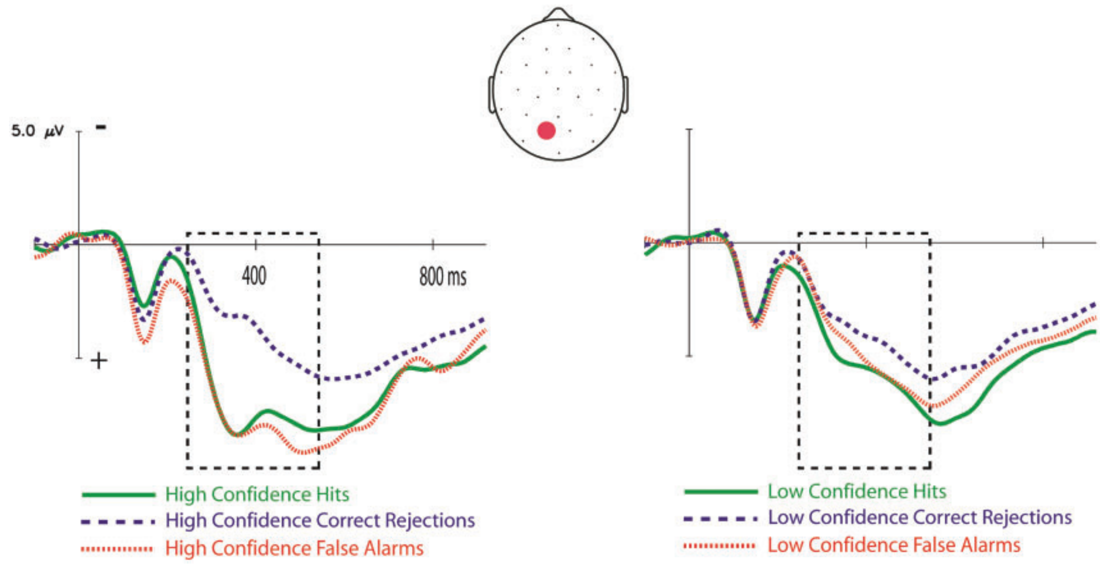

Fig. 4 ERP responses to partisan schema-consistent items by confidence. High confidence false alarms are identical to high confidence hits for partisan schema consistent candidate–issue pairs in the 250–550 ms (N400) timewindow (highlighted). In contrast, low confidence false alarms are indistinguishable from low confidence hits and correct rejections.

false alarms based on educated guessing—or other errors at the decision/response stage, as distinct from memory—should elicit instead ERP responses that pattern with correct rejections (as in Windmann *et al.*, 2002).

Our test phase ERP data replicated previous findings in the memory literature in that hits to candidate–issue pairs were consistently more positive going than correct rejections; that is, we observed the well-established ERP Old/New effect. As predicted, different patterns emerged for different categories of false alarms. High confidence false alarms to partisan schema-consistent items, in particular, clearly showed the pattern expected of false memories, eliciting Old/New effects that were statistically identical to responses to high confidence hits. In contrast, false alarms to partisan schema-***in***consistent items, which we did not expect to be activated during encoding, were indistinguishable from correct rejections. This suggests that these errors were not based on the presence of a memory signal and were thus likely the product of guesses. This is consistent with the observation that these false alarms were also more likely to be given a low confidence judgment.

Although this study was not designed to tease apart the contributions of non-declarative and declarative memory processes to these errors, the fact that effects were strongest in the early window suggests the possibility that such false memories arise implicitly, through spreading activation in the conceptual network, as suggested by the activation-monitoring account (Roediger *et al.*, 2001a). As mentioned previously, the early part of the Old/New effect has been linked to modulations of the N400 component (particularly when this effect has a posterior distribution), which, in turn, has been associated with implicit activation in long-term semantic memory (Kutas and Federmeier, 2011).

The evidence provided here thus suggests, for the first time, that misattributions of political information are not exclusively the product of educated guesses, as they can be associated with memory signals that are similar to those elicited by repetitions of events that were actually previously experienced. This finding provides several contributions to research on false memories and political behavior.

First, this work expands the pool of real-world domains by which to study the impact of false memories. A substantial body of research has already examined false memories in a variety of real-world domains, such as eyewitness testimony (for a review, see Wells and Loftus, 2003), and this study introduces politics as another rich domain for false memory research. Misinformation, in the form of a demonstrably false belief, is a prevalent phenomenon among American voters (Kuklinski *et al.*, 2000; Logan and Sheagley, 2013), and such false beliefs tend to be held in high confidence by voters and are highly resistant to corrective information (Kuklinski *et al.*, 2000; Nyhan and Reifler, 2010). The results of this study establish that at least some types of political misinformation could be due to the formation of false memories, making politics a compelling natural environment for testing and refining theories of false memories.

The political realm also provides a rich environment in which to study the intersection of false memories and decision making. Politics is a critical societal domain in which people employ memory during decision making and in which important, large-scale outcomes arise through the aggregation of many individual decisions. Confidently held misinformation that systematically affects the decisions of a large number of voters could have a profound impact on elections and public policies. Thus, politics provides a useful and important arena for studying how true and false memories shape decisions at both the individual and collective level.

For political science, this study makes two direct contributions. The first is methodological. Political scientists have generally been interested in examining how explicit and implicit aspects of memory interact and how such interactions affect voter decisions and evaluations of policy issues and candidates. However, most studies in this area rely exclusively on verbal self-reports as a means of measuring what are theorized to be implicit or non-declarative memory processes. This study illustrates how ERPs can be used to investigate the contribution of more implicit aspects of memory on political belief formation.

Finally, and most critically, this study expands our conceptual understanding of the nature and source of political misinformation. Political scientists have traditionally thought about misattributions of issue positions as well as other forms of erroneous political knowledge and beliefs, primarily through the lens of decision-based strategy theories such as educated guessing. This study provides evidence for the importance of an alternative mechanism for the formation of false beliefs in the political realm.

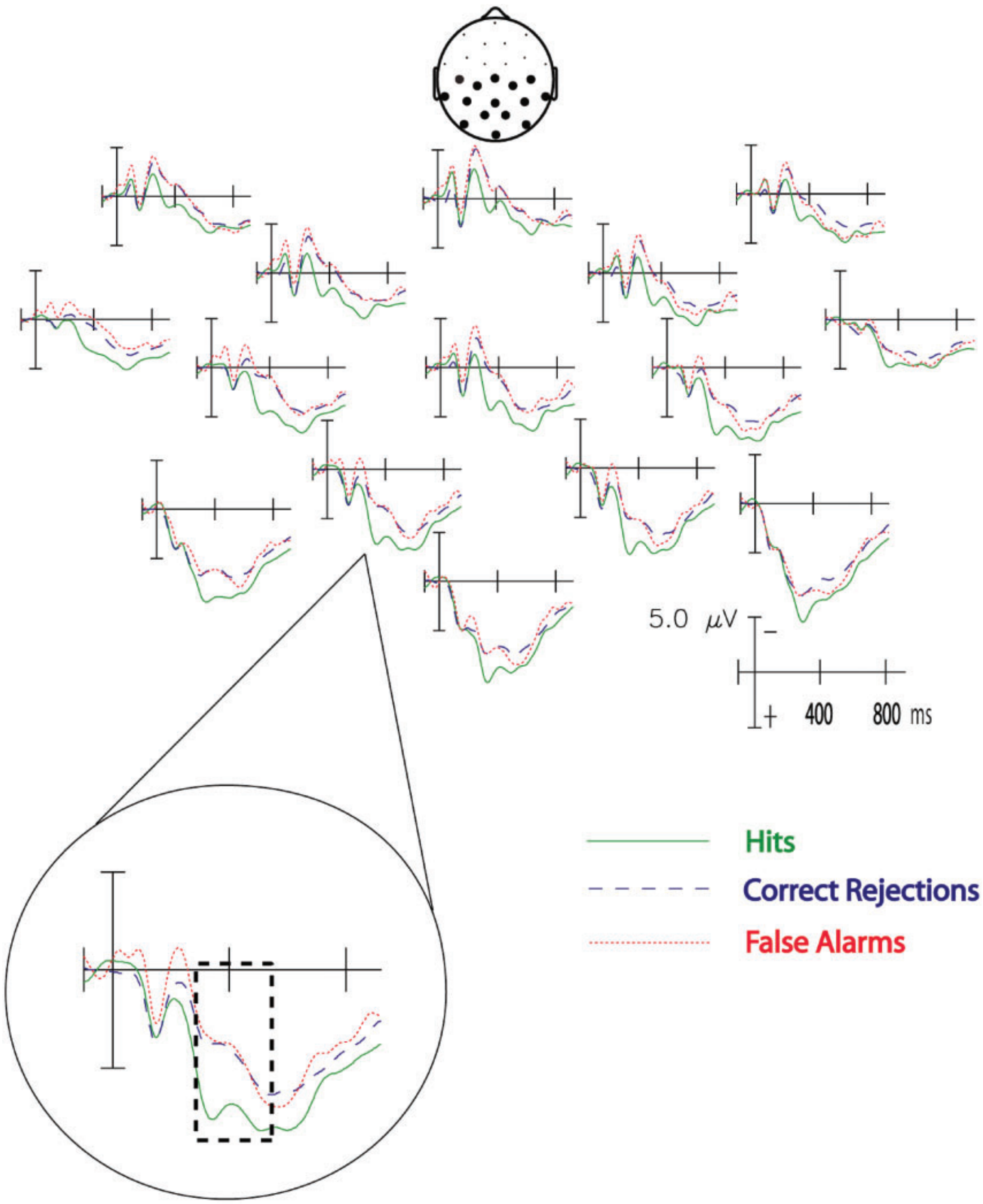

Fig. 5 ERP responses to partisan schema-inconsistent items. False alarms are identical to correct rejections and different from hits in the 250–550 ms (N400) timewindow (highlighted).

SUPPLEMENTARY DATA

Supplementary data are available at *SCAN* online.

Conflict of Interest

None declared.

REFERENCES

Brainerd, C.J., Reyna, V.F. (2005). *The Science of False Memory*. New York: Oxford University Press.

Collins, A.M., Loftus, E.F. (1975). A spreading activation theory of semantic processing. *Psychological Review*, *82*, 407–28.

Conover, P., Feldman, S. (1989). Candidate perception in an ambiguous world: campaigns, cues, and inference processes. *American Journal of Political Science*, *33*, 912–40.

Curran, T. (2000). Brain potentials of recollection and familiarity. *Memory & Cognition*, *28*, 923–38.

Curran, T., Schacter, D.L., Johnson, M.K., Spinks, R. (2001). Brain potentials reflect behavioral differences in true and false recognition. *Journal of Cognitive Neuroscience*, *13*, 201–16.

Curran, T. (2004). Effects of attention and confidence on the hypothesized ERP correlates of recollection and familiarity. *Neuropsychologia*, *42*, 1088–106.

Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of Experimental Psychology*, *58*, 17–22.

Donaldson, D.I., Rugg, M.D. (1998). Recognition memory for new associations: electrophysiological evidence for the role of recollection. *Neuropsychologia*, *36*, 377–95.

Duzel, E., Vargha-Khadem, F., Heinze, H.J., Mishkin, M. (2001). Brain activity evidence for recognition without recollection after early hippocampal damage. *Proceedings of the National Academy of Sciences*, *98*, 8101–6.

Feldman, S., Conover, P. (1983). Candidates, issues, and voters: the role of inference in political perception. *Journal of Politics*, *45*, 810–39.

Friedman, D., Johnson, R. (2000). Event-related potential (ERP) studies of memory encoding and retrieval: a selective review. *Microscopy Research and Technique*, *51*, 6–28.

Gallo, D.A. (2006). *Associative Illusions of Memory: False Memory Research in DRM and Related Tasks*. New York, NY, US: Psychology Press.

Geraerts, E., Bernstein, D.M., Merckelbach, H., Linders, C., Raymaekers, L., Loftus, E.F. (2008). Lasting false beliefs and their behavioral consequences. *Psychological Science*, *19*, 749–53.

Johnson, M.K., Hashtroudi, S., Lindsay, D.S. (1993). Source monitoring. *Psychological Bulletin*, *114*, 3–28.

Johnson, M.K., Nolde, S.F., Mather, M., Kounis, J., Schacter, D.L., Curran, T. (1997). The similarity of brain activity associated with true and false recognition memory depends on test format. *Psychological Science*, *8*, 250–7.

Kuklinski, J.H., Quirk, P.J., Jerit, J., Schweider, D., Rich, R. (2000). Misinformation and the currency of democratic citizenship. *Journal of Politics*, *62*, 790–816.

Kutas, M., Federmeier, K.D. (2011). Thirty years and counting: finding meaning in the N400 component of the event-related brain potential (ERP). *Annual Review of Psychology*, *62*, 621–47.

Lodge, M., Hamill, R. (1986). A partisan schema for political information processing. *American Political Science Review*, *80*, 505–20.

Lodge, M., McGraw, K.M., Stroh, P. (1989). An impression-driven model of candidate evaluation. *American Political Science Review*, *83*, 399–419.

Logan, D., Sheagley, G. (2013). Heuristics behaving badly: party cues and voter knowledge. *American Journal of Political Science*, *57*(2), 312–25.

McDermott, K.B., Watson, J.M. (2001). The rise and fall of false recall: the impact of presentation duration. *Journal of Memory & Language*, *45*, 160–76.

McGraw, K., Lodge, M., Stroh, P. (1990). Order effects in the evaluation of political candidates. *Political Behavior*, *12*, 41–58.

Miller, M.B., Wolford, G.L. (1999). Theoretical commentary: the role of criterion shift in false memory. *Psychological Review*, *106*, 398–405.

Norpoth, H., Buchanan, B. (1992). Wanted: the education president. Issue trespassing by political candidates. *Public Opinion Quarterly*, *56*, 87–90.

Nyhan, B., Reifler, J. (2010). When corrections fail: the persistence of political misperceptions. *Political Behavior*, *32*, 303–30.

Payne, D.G., Neuschatz, J.S., Lampinen, J.M., Lynn, S.J. (1997). Compelling memory illusions: the phenomenological qualities of false memories. *Current Directions in Psychological Science*, *6*, 56–60.

Pezdek, K., Hodge, D. (1999). Planting false childhood memories in children: the role of event plausibility. *Child Development*, *70*, 887–95.

Roediger, H.L., McDermott, K.B. (1995). Creating false memories: remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *4*, 803–14.

Roediger, H.L. III, McDermott, K.B. (1999). False alarms about false memories. *Psychological Review*, *106*, 406–10.

Roediger, H.L. III, Balota, D.A., Watson, J.M. (2001a). Spreading activation and arousal of false memories. In: Roediger, H.L. III, Nairne, J.S., Neath, I., Surprenant, A.M., editors. *The Nature of Remembering: Essays in Honor of Robert G. Crowder*. Washington, DC: American Psychological Association, pp. 95–115.

Roediger, H.L. III, Watson, J.M., McDermott, K.B., Gallo, D.A. (2001b). Factors that determine false recall: a multiple regression analysis. *Psychonomic Bulletin & Review*, *8*, 385–405.

Rugg, M.D. (1985). The effects of semantic priming and word repetition on event-related potentials. *Psychophysiology*, *22*, 642–7.

Rugg, M.D. (1995). ERP studies of memory. In: Rugg, M.D., Coles, M.G.H., editors. *Electrophysiology of Mind: Event-related Brain Potentials and Cognition*. Oxford University Press, pp. 132–70.

Rugg, M.D., Fletcher, P.C., Allan, K., Frith, C.D., Frackowiak, R.S.J., Dolan, R.J. (1998). Neural correlates of memory retrieval during recognition memory and cued recall. *Neuroimage*, *8*, 262–73.

Urbach, T.P., Windmann, S.S., Payne, D.G., Kutas, M. (2005). Mismaking memories: neural precursors of memory illusions in electrical brain activity. *Psychological Science*, *16*, 19–24.

Voss, J.L., Federmeier, K.D. (2011). FN400 potentials are functionally identical to N400 potentials and reflect semantic processing during recognition testing. *Psychophysiology*, *48*, 532–46.

Voss, J.L., Paller, K.A. (2008). Brain substrates of implicit and explicit memory: the importance of concurrently acquired neural signals of both memory types. *Neuropsychologia*, *46*, 3021–9.

Wells, G.L., Loftus, E.F. (2003). Eyewitness memory for people and events. In: Goldstein, A.M., editor. *Handbook of Psychology: Forensic Psychology*. New York: Wiley, pp. 149–60.

Windmann, S., Urbach, T.P., Kutas, M. (2002). Cognitive and neural mechanisms of decision biases in recognition memory. *Cerebral Cortex*, *12*, 808–817.

Woroch, B., Gonsalves, B.D. (2010). Event-related potential correlates of item and source memory strength. *Brain Research*, *1317*, 180–91.