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A Model of Political Judgment: An Agent-Based Simulation of Candidate Evaluation

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Abstract

This paper advances Kim, Taber, and Lodge's work (2010). It is shown here that the psychological model of political judgment named John Q. Public (Kim, Taber, and Lodge 2010) is consistent with a set of well-known empirical regularities repeatedly found in electoral and psychological researches, that the model in general implies motivated reasoning - discounting contradictory information to the prior while accepting consistent information more or less at its face value - under general conditions, and that (prior) evaluative affect towards candidates plays a fundamental role in this process. It is also discussed the implication of motivated reasoning in accounting for the responsiveness, persistence, and polarization of candidate evaluation often observed in elections.

Keywords: Candidate Evaluation, Election, Cognition and Affect, Political Judgment, ACT-r

Introduction

- 1.1 Students of political behavior have long debated about how people form and revise their judgments and beliefs about political objects (candidates, parties, groups, and issues). Two theoretical perspectives have dominated the debates for decades. One view suggests that political beliefs and attitudes are strongly influenced by socialization, develop inertia through time, and thus are not very responsive to contemporary information from the political environment (Campbell, Converse, Miller, and Stokes 1960 ; Niemi and Jennings 1991). An alternative perspective posits that beliefs and attitudes are highly responsive to contemporary information and thus continually change over time responding to changes in the political environment (Downs 1957; Page and Shapiro 1992). These two perspectives have been repeatedly mapped onto various controversies over whether news and campaigns matter or whether party identification is stable.
- 1.2 In a recent study, however, Kim, Taber, and Lodge (2010) provided an alternative perspective. According to them, ordinary citizens often engage in motivated reasoning - discounting information contrary to priors while accepting consistent information more or less as it is - and thus their political attitudes and beliefs are inherently both responsive and persistent.
- 1.3 Using National Annenberg Election Survey (NAES) 2000^[1], they showed that voters' candidate evaluations changed responding to campaign information (responsive), but only within relatively small ranges constrained by priors (persistent), and became more extreme over time (polarized). Applying a psychological model and a general Bayesian learning model (Gerber and Greene 1998), they showed that motivated reasoning is a key factor to account for these dynamics of candidate evaluation.
- 1.4 Specifically, they showed via simulations that: their model named John Q. Public (JQP) can account for the responsiveness, persistence, and polarization of candidate evaluation while the Bayesian model has a

fundamental difficulty accounting for the persistence and polarization; and motivated reasoning is a key factor for this discrepancy, that is, JQP implies motivated reasoning but the Bayesian model does not and this is why their performance differed in a fundamental way.

- 1.5 However, they have not fully investigated whether and how JQP in fact implies motivated reasoning. In other words, they have not fully established the internal validity of the study (Galán, Izquierdo, Santos, Olmo, López-Paredes, and Edmonds, 2009). Also, they have not examined whether the model is consistent with other well-established empirical regularities found in electoral and psychological research.
- 1.6 The purpose of this study is to advance Kim, Taber, and Lodge's (2010) work. Specifically, this paper examines whether and how JQP implies motivated reasoning and also investigates whether the model is consistent with such well-known empirical phenomena as spreading activation (Neely 1976), affective priming effect (Fazio 2001), survey order and wording effects (Tourangeau, Rips, and Rasinski 2000), on-line processing (Lodge, Steenbergen, and Brau 1995), and memory-based processing (Zaller and Feldman 1992). It also discusses the implication of motivated reasoning in accounting for the responsiveness, persistence, and polarization of candidate evaluation.
- 1.7 The paper is organized as follows. The next section describes the model. The third section explains experimental setup. The fourth section presents and discusses simulation results. The last section concludes. Appendix provides the source code of the model and information about how to replicate the results reported in this paper.



Model

- 2.1 Kim, Taber, and Lodge (2010) proposed a psychological model of political judgment (JQP) that integrates contemporary theories in political behavior, most notably the on-line (Lodge, Steenbergen, and Brau 1995) and memory-based information processing (Zaller and Feldman 1992; Tourangeau, Rips, and Rasinski 2000), based on the classic cognitive paradigm embedded in the ACT-R cognitive architecture (Anderson et al. 2004)^[2].
- 2.2 Specifically, the model integrates cognitive and affective structures and mechanisms into one framework^[3]: (1) an associative network representation of knowledge and attitudes in long-term memory (LTM), (2) activation and decay mechanisms for concepts in LTM, which determine what information is accessible for retrieval into conscious working memory (WM), (3) processes for the construction of attitudes from accessible information in memory, and (4) processes for updating attitudes.

Knowledge and Attitude Representation

- 2.3 The theoretical framework for knowledge and attitude representation of the model is based on the classic node-link associative network framework built-into ACT-R. However, it also differs from the classical framework in that it incorporates attitudes towards objects. In particular, the model brings evaluative affect center stage: one's likes and dislikes for "objects" in memory (e.g., leaders, groups, and issues) play a central role in the model.
- 2.4 There is strong evidence that virtually all social concepts in memory are affectively charged. With repeated co-activation socio-political concepts become positively or negatively charged and this affective evaluation - positive, negative, or both, strong or weak - appears to be linked directly to its conceptual representation in long-term memory (Abelson 1963; Lodge and Taber 2005). Moreover, these evaluative feelings of political parties, candidates, and issues come into play automatically on exposure to new information (Lodge and Taber 2000).
- 2.5 Figure 1 illustrates the theoretical framework for memory processes, using part of the knowledge structure about George W. Bush of a typical, liberal voter. Each node or concept in LTM is represented by an oval, the border-thickness of which varies to indicate differences in their base level accessibility. For the conflicted liberal shown in the figure, the traits such as honest, hypocritical, and trustworthy are all quite accessible, while policy issues such as tax cut and pro-life are less accessible.
- 2.6 Associations (or implicational relations) between pairs of nodes are represented by connecting lines of varying thickness, which indicates difference in the strength of association. So conservative, Republican, hypocritical, and pro-life are more closely associated with Bush in this liberal voter's belief system than are Bush's other traits and issues. Such nodes as bumbler and gays-in-military are not associated with Bush, implying that their associations with Bush have not been experienced yet.

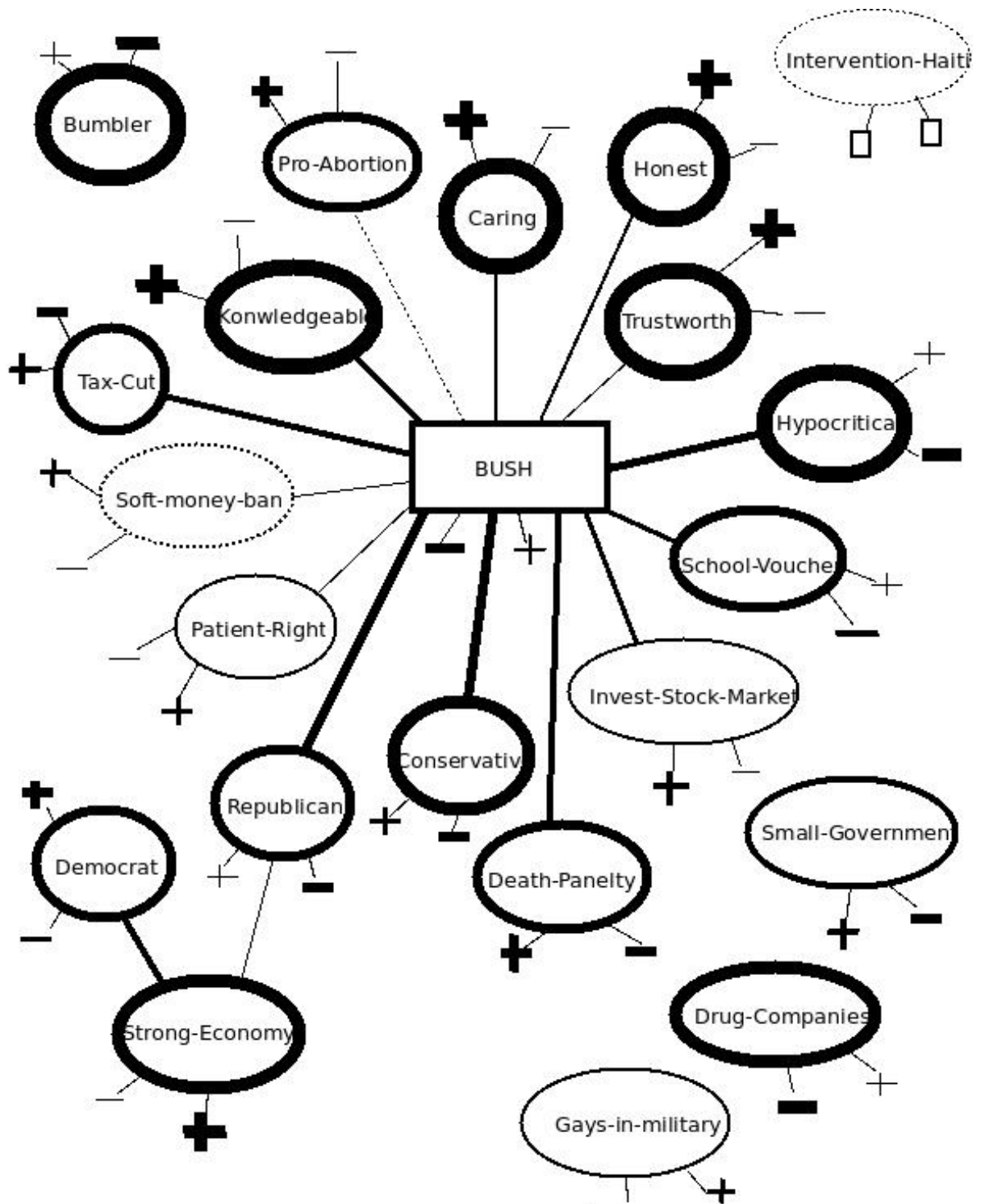


Figure 1. Knowledge Structure about Bush for a Liberal Voter

- 2.7 Plus and minus signs (evaluative tags) linked to the nodes represent positive and negative affect about the memory objects. A summary evaluative judgment of an object may be obtained by combining the positive and negative valences. Finally, every aspect of the knowledge structure - the base level accessibility, the strength of associations between nodes, and the valence and strength of evaluative affect - changes as this liberal voter encounters new information about Bush.

Accessibility of Memory Objects

- 2.8 Objects in long term memory (LTM) vary in their accessibilities (how easily and quickly they may be retrieved into conscious working memory (WM)) as a function of (1) the frequency and recency of past retrievals, (2) activation spread to the node from associated concepts currently being processed (spreading activation, as when thinking about Barack Obama facilitates the retrieval of an associated concept, "President"), (3) the affective congruency between the node and information currently being processed (affective priming effect, as when thinking about a negative concept like "terrorism" activates other negative concepts), and (4) the decay of

accessibility through time and disuse. All of these effects occur spontaneously and automatically, largely outside of conscious awareness.

- 2.9 These influences on accessibility, with the exception of affective priming, are part of the classic cognitive paradigm and are built into the ACT-R. Affective priming effect, however, requires further elaboration and development of additional procedure for the model.
- 2.10 Hundreds of experiments document that affect towards an attitude object (e.g., a negative feeling about George W. Bush) automatically comes to mind even upon a mere exposure to stimuli (e.g., the word 'George W. Bush' in a newspaper headline) with little or no pre or post conscious appraisal. Moreover, not only can affect be triggered automatically but it is also primary in the sense that it enters information-processing stream before cognitive appraisals (Zajonc 2000).
- 2.11 In addition, experimental studies on affective priming show that once retrieved affect automatically influences the accessibility of other objects in LTM such that those affectively congruent with it become more accessible while those incongruent less accessible, regardless of semantic associations between them. This affective priming effect has been demonstrated for ordinary words, simple line drawings, real life color pictures, and odors (Bargh et al. 1992 ; Hermans et al. 1994 ; Giner-Sorolla, Garcia, & Bargh 1999 ; Hermans, Baeyens, & Eelen 1998).
- 2.12 JQP's accessibility (or activation) mechanism, which determines the accessibility of a concept node in LTM at a given moment in time, is an operationalization of these influences. More precisely,

$$A_i = B_i + \sum_{j=1}^n W_j [(S_{ji} - \ln(F_j)) + \gamma C_{ji}] + N(0, \sigma^2) \quad (1)$$

where A_i is the accessibility or activation level of node i , B_i is the base level accessibility of node i (given in Equation 2), node j is the information currently being processed (held in WM), W_j is the attention weight for node j , S_{ji} is the strength of association between nodes j and i , F_j is the number of nodes linked to node j , $\gamma > 0$ is a parameter governing the magnitude of affective priming effect, C_{ji} is a trichotomous indicator of affective congruency between nodes j and i , and $N(0, \sigma^2)$ is normally distributed noise with mean 0 and standard deviation σ .

- 2.13 The baseline accessibility (B_i) includes the residual effects on the accessibility of node i of past processing and memory decay. Specifically,

$$B_i = \ln \left(\sum_{m=1}^M T_m^{-d} \right) \quad (2)$$

where B_i is the baseline accessibility of i , M is the number of times i has been retrieved into WM in the past, T_m is the elapsed time since i was retrieved m -th time, d is a parameter representing the rate of memory decay. So B_i increases with the number of times i has been retrieved and with the recency of those retrievals, and it decays through time and disuse.

- 2.14 The term following the summation sign in Equation 1 represents the cumulative effects of nodes currently being processed (j s), which consists of spreading activation, $S_{ji} - \ln(F_j)$, and affective priming effect, γC_{ji} . S_{ji} represents the strength of association between node j and i , which is an increasing function of incidents where an association between j and i has been experienced (associative learning, Anderson 1993).^[4] Both spreading activation and affective priming effects are limited by the amount of focus (W_j) that may be given to node j , which is normally set at $1/n$ to represent the diminishing influence of any given concept when the number of concepts currently held in WM increases. Another cognitive limitation built into Equation 1 is the fan effect, $\ln(F_j)$, which restricts the amount of activation that spreads from node j to i when j is linked to a large number of nodes in LTM.
- 2.15 Given the mechanism, observe that the accessibility of a node in LTM depends on which information is currently held in WM. For instance, if the liberal voter in Figure 1 reads "George W. Bush" in a newspaper headline, node Bush along with the evaluative affect associated with it in LTM will be immediately retrieved into WM. And once

retrieved, it will automatically influence the accessibility of the other nodes in LTM through spreading activation and affective priming effect. Specifically, activation will spread from Bush to the nodes associated with him in LTM (e.g., Republican and conservative) making them more accessible. And those affectively congruent with him (e.g., Republican, hypocritical, bumbler) will become more accessible while those incongruent (e.g., honest, knowledgeable, pro-abortion) get less accessible. These influences from node Bush, however, will disappear as soon as it is cleared from WM.

Memory-Based Attitude Construction

- 2.16 Given the automaticity and primacy of affect, it is clear that an evaluation of attitude object will be first influenced by the evaluative affect attached to the object. However, studies on survey response suggest that the evaluation is likely to be further influenced by the considerations that come to mind at the time of judgment (Zaller and Feldman 1992; Tourangeau, Rips, and Rasinski 2000). That is, an evaluation of attitude object (e.g., George W. Bush) appears to be constructed on the spot, reflecting different and often conflicting considerations (e.g., Bush is Republican, Bush is hypocritical, Bush is knowledgeable) that happen to come to mind at the moment.
- 2.17 Equation 3 provides a mechanism for this evaluation construction process.

$$CA_i = (1 - \delta) OL_i + \delta \left[\sum_{j=1}^n a_j OL_j \right], \text{ for } j \neq i \quad (3a)$$

$$a_j = \frac{A_j}{\sum_j A_j}, \text{ for } A_j > 0 \quad (3b)$$

where CA_i is the constructed evaluation of node i , OL_i is the existing evaluative tag for node i , OL_j is the existing evaluative tag for node j that is accessible ($A_j > 0$) at the time of attitude construction, a_j is the normalized accessibility of j , and δ is a parameter that controls the influence from other considerations (the node j s) on the constructed evaluation relative to its existing evaluative tag. Note that nodes that are not currently accessible ($A_j \leq 0$) would not influence the evaluation at all.

On-line Processing of Attitudes

- 2.18 There is substantial evidence that attitudes are routinely updated on-line, at the time when relevant information is encountered (Hastie and Pennington 1989; Lodge, Steenbergen, and Brau 1995). Specifically, when an individual encounters new information about an attitude object, she brings its evaluative affect into WM, updates it using the information, and then stores it back to memory. Moreover, after updating the evaluation, the individual may forget the information used to update the evaluation. In this way, individuals maintain a running, on-line tally for an attitude object in memory.
- 2.19 Equation 4 provides a specific mechanism for on-line processing:

$$OL_i = \sum_{k=1}^K \rho^k CA_{jk}, \text{ for } j \neq i \quad (4)$$

where OL_i is the evaluative tag for node i after processing K pieces of information, ρ is a parameter that governs the weight of new relative to old information, and CA_{jk} is the attitude toward object j (constructed by Equation 3) associated with node i at processing stage k . Notice that $0 < \rho < 1$ implies the evaluative affect would become more persistent as more information is learned about an object.

- 2.20 It is the *constructed implication* (CA_{jk}) of information that is integrated into the evaluative tag for an attitude object. For instance, when the liberal voter shown in Figure 1 encounters a campaign message, "Bush is honest", such negative concepts as "hypocritical", "Republican", and "conservative" in memory are likely to come to mind to influence the perception of the information^[5]. The resulting, perceived implication of the information is then integrated into the evaluative affect of Bush.



Simulation

- 3.1 The simulation was conducted in the following way. First, average knowledge structures for 5 self-identified ideological groups - strong conservatives, conservatives, moderates, liberals, and strong liberals - were identified based on the same empirical data used in Kim et al. (2010). Second, five agents were initialized each with one of the five ideological belief structures. Third, the agents then processed a set of information about two fictitious candidates, James (Democrat) and Edward (Republican). The information consisted of two parts: basic information about the candidate's party affiliation, issue stances, and personality and campaign information that mimic the typical flow of campaign information in real elections. Fourth, the agents were asked to evaluate the candidates twice, after processing the basic information and after processing the campaign information. Finally, the order in which the information was presented and wordings of the information were manipulated to examine information order and wording effects. Also, an additional simple experiment was conducted to examine motivated reasoning.

Initial Knowledge Structure

- 3.2 Knowledge structures of the agents were generated in the same way as in Kim et al. (2010) using primarily the cross-sectional data from NAES 2000 (Romer, Kenski, Waldman, Adasiewicz, and Jamieson 2003). Specifically, for each of the 5 self-identified ideological groups among the NAES 2000 survey respondents, the mean and variance for ratings of parties, groups, and issues as well as the item response rates were obtained.
- 3.3 Five agents' initial knowledge structures were then generated using one of these ideological belief structures. First, memory objects (nodes in Figure 1) were created for each political (e.g., Republican party, pro-life, tax cut, etc.) and trait concept (e.g., honest, trustworthy, etc.). The evaluative tags for political concepts were assigned according to the mean ratings for the given ideological subgroup. Their initial attitudinal stability (k in Equation 4) and baseline accessibility were set using item response rates for the given ideological subgroup as a proxy for the frequency and recency of use.
- 3.4 The evaluative tags for trait concepts were assigned consulting Affective Norms for English Words (Bradley and Lang 1999), which provide means and standard deviations of ratings for a large number of trait concepts. Their attitudinal stability and baseline accessibility assumed to be high^[6], since voters are likely to use these concepts more often than political concepts.
- 3.5 No prior knowledge about the candidates was included in the initial knowledge structure because they were fictitious. In terms of Figure 1, node Edwards and James were included in LTM with no evaluative tags, no association with any other nodes, and lower baseline accessibility than others.

Campaign Information

- 3.6 Table 1 lists the information used in the simulation experiment. First 16 statements provide basic information about the candidates, including their party affiliations, stances on major policy issues, and personality traits. The remaining 18 statements mimic the flow of typical campaign information in real elections. As such, they include both positive and negative information about the candidates. Candidates' issue stances are setup to be largely consistent with their party affiliations.
- 3.7 The statements were coded in a format accessible to JQP: a simple statement attributable to some known actor. Each of these statements represent the gist meaning of a campaign message. Though many subtleties are certainly smoothed away in this process, as Kim et al. (2010) pointed out, there are also benefits. In particular, there is some evidence that citizens in fact process the gist meaning of campaign statements and ignore even not-so-subtle qualifications (Hamill and Lodge 1985; Lodge, Steenbergen, and Brau 1995)^[7].

Table 1: Information used in the Simulation

Order Statements

Basic Information

- 1 (Edwards says) Edwards is a Republican
- 2 (Edwards says) Edwards supports tax-cut

- 3 (Edwards says) Edwards opposes abortion-rights
 - 4 (Edwards says) Edwards supports school-voucher
 - 5 (Edwards says) Edwards supports defense-spending-increase
 - 6 (Edwards says) Edwards opposes partisan-politics
 - 7 (Edwards says) Edwards is trustworthy
 - 8 (Edwards says) Edwards is sympathetic
 - 9 (James says) James is a Democrat
 - 10 (James says) James opposes tax-cut
 - 11 (James says) James supports affirmative-action
 - 12 (James says) James supports abortion-rights
 - 13 (James says) James supports gays-in-military
 - 14 (James says) James is experienced
 - 15 (James says) James is trustworthy
 - 16 (James says) James is intelligent
 - Campaign Information
 - 17 (Edwards says) Edwards is a Republican
 - 18 (James says) James is a Democrat
 - 19 (Edwards says) Edwards supports tax-cut
 - 20 (Edwards says) tax-cut is reasonable
 - 21 (James says) James opposes tax-cut
 - 22 (James says) tax-cut is risky
 - 23 (Edwards says) James is dishonest
 - 24 (James says) Edwards is dishonest
 - 25 (Edwards says) James is a squanderer
 - 26 (James says) Edwards is a bumbler
 - 27 (Edwards says) Edwards opposes affirmative-action
 - 28 (James says) James opposes school-voucher
 - 29 (Edwards says) Edwards opposes gays-in-military
 - 30 (James says) James opposes defense-spending-increase
 - 31 (Edwards says) Edwards supports gun-control
 - 32 (James says) James supports gun-control
 - 33 (Edwards says) Edwards supports death-penalty
 - 34 (James says) James supports death-penalty
-

Parameter Values

- 3.8 The parameter values used in the experiment were $\gamma = 2$, $\delta = 0.67$, $\rho = 0.91$, and $\sigma = 0$. The random noise was set at 0 to make the presentation clearer. The parameters specific to ACT-R were set to their default or common values (e.g. $d = 0.5$. For details, see Appendix). As we will see, however, particular parameter values do not really matter for the results reported in this study; qualitatively the same results can be obtained under wide ranges of parameter values.

Result and Discussion

Integration of information into Candidate Evaluation:

On-line and Memory-based Processing

- 4.1 Figure 2 and 3 show how JQP integrates information into candidate evaluation. Figure 2 plots the evaluative affect for Edwards as the five agents processed the basic information (first 16 statements) in Table 1.
- 4.2 As can be seen, the agents developed evaluative affect towards Edwards over time responding to the information. For each agent, the evaluative affect became more positive (or less negative) whenever positive information was encountered and less positive whenever negative information was received. And it remained unchanged when no relevant information was processed (from 9th to 16th statements, which were about not Edwards but James). This is precisely what the on-line processing model would predict.
- 4.3 Also, the information encountered earlier had a greater impact than those encountered later, implying that the evaluative feeling becomes more resistant to change as the agents learn more about Edwards. In the end, the liberal, moderate, and conservative agents developed negative, somewhat positive, and positive feeling about Edwards respectively.

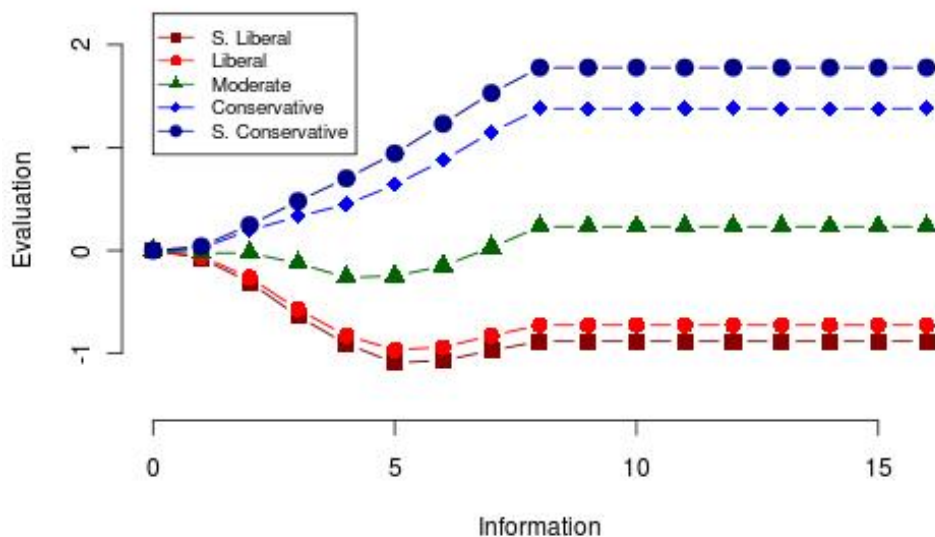
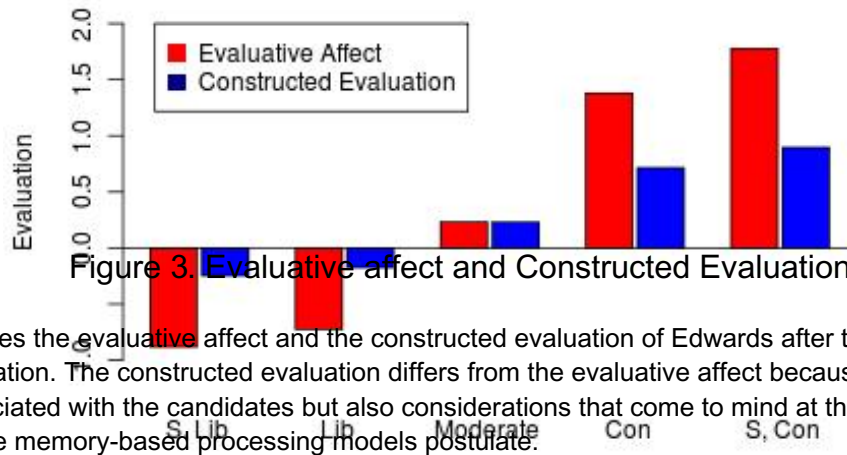


Figure 2. Changes in Evaluative Affect of Edwards over time

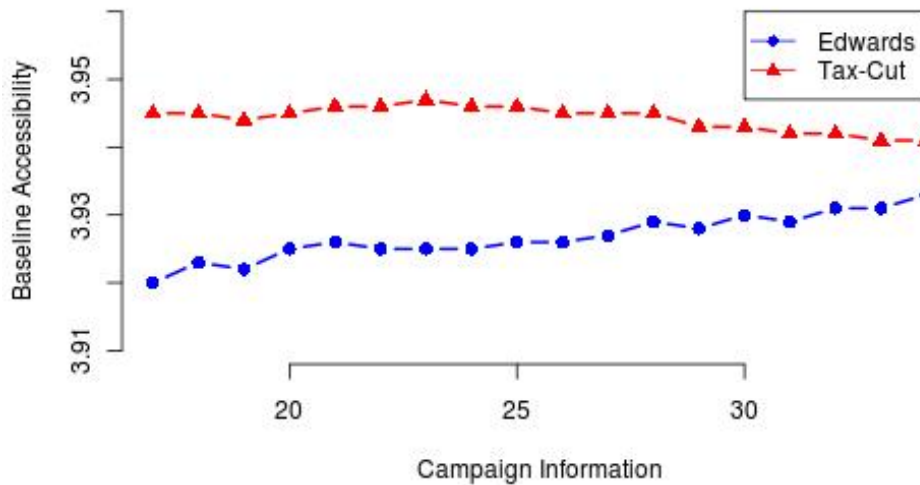


- 4.4 Figure 3 compares the evaluative affect and the constructed evaluation of Edwards after the agents processed the basic information. The constructed evaluation differs from the evaluative affect because it reflects not only the feeling associated with the candidates but also considerations that come to mind at the time of evaluation, which is what the memory-based processing models postulate.

Practice and Recency, Spreading Activation, and Affective Priming Effect

- 4.5 Figure 4 and 5 examine how the accessibility mechanism of JQP works. Figure 4 (a) plots the baseline accessibility of node Edwards and tax-cut as liberal JQP processed the campaign information (the last 18 statements) in Table 1. Since "Edwards" appeared quite often in the statements, the baseline accessibility of Edwards gradually increased over time with occasional declines due to memory decay. By contrast, because "tax cut" appeared only a couple of times in the information, that of tax-cut gradually decreased (except when 19th through 22nd statements were processed).
- 4.6 Figure 4 (b) plots the full accessibility - the sum of baseline accessibility, spreading activation, and affective priming effect - of node Edwards as the agent 'read' 17th through 24th statements. Since spreading activation and affective priming effect depend on the concept node momentarily held in WM, the full accessibility of Edwards quickly changes as different concepts are retrieved into and cleared from WM processing the statements. This is why we see many upward and downward spikes in the graph.

(a) Baseline Accessibility Over Time



(b) Full Accessibility of Edwards in Memory

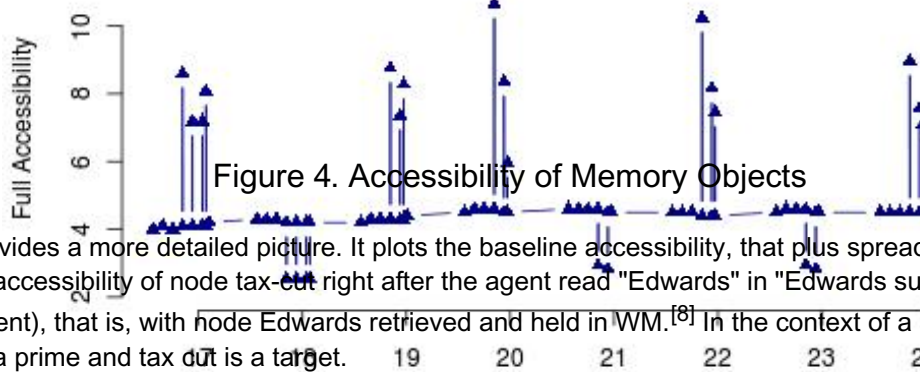
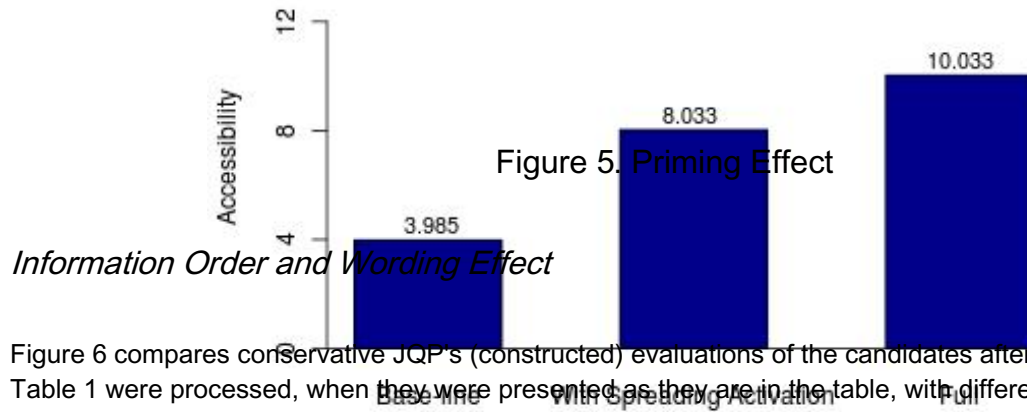


Figure 4. Accessibility of Memory Objects

4.7 Figure 5 provides a more detailed picture. It plots the baseline accessibility, that plus spreading activation effect, and the full accessibility of node tax-cut right after the agent read "Edwards" in "Edwards supports tax cut" (the 19th statement), that is, with node Edwards retrieved and held in WM.^[8] In the context of a priming experiment, Edwards is a prime and tax cut is a target.

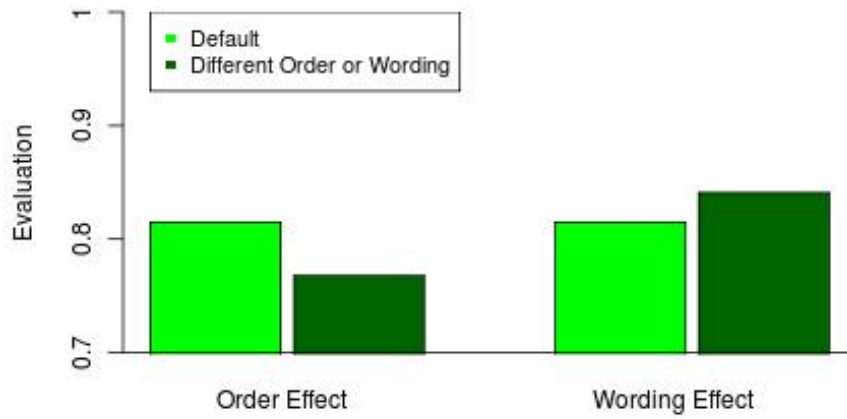
4.8 As one can see, the accessibility of tax-cut got a boost from both spreading activation and affective priming effects since it was semantically associated and affectively congruent with Edwards at the time of processing the information: tax-cut was associated with Edwards after processing the 2nd statement in Table 1 and both were negatively charged due to the processing of first 18 statements given the agent's liberal belief structure. The full accessibility of tax-cut will change when Edwards, the source of spreading activation and affective priming effect, is cleared from WM. The accessibility of all other memory objects are determined in the same way.



Information Order and Wording Effect

- 4.9 Figure 6 compares conservative JQP's (constructed) evaluations of the candidates after all 34 statements in Table 1 were processed, when they were presented as they are in the table, with different order, and with different wordings respectively. For order effect, the presentation order of two negative statements "Edwards says James is dishonest" and "James says Edward is dishonest" were changed from 23rd and 24th to 33rd and 34th respectively. For wording effect, the wordings of the 8th and 16th statement changed from "sympathetic" and "intelligent" into "warm-hearted" and "smart" respectively.
- 4.10 With changed order, the evaluations of both James and Edwards somewhat decreased. It is because now the negative information were presented more recently thus exerted more influence on the evaluation. This is precisely what Zaller and Feldman (1992) argued; the more recently is a piece of information encountered, the stronger will its impact on the evaluation be.
- 4.11 More generally, the order effect in JQP is determined by two opposing forces. A change in information order influences both its accessibility and the order it is integrated into the evaluative affect of an attitude object. If a piece of information about an attitude object were presented later, then all else being equal its accessibility would become higher thus exert a greater impact on the evaluation, while its impact on the evaluative affect of the object would get weaker (on-line updating in Equation 4 with $0 < \rho < 1$). the overall order effect will be determined by the net of these two opposing effects (Anderson 1965).
- 4.12 When different wordings were used, the evaluation of Edward increased while that of James decreased. It is because "warm-hearted" is more positive than "sympathetic" while "smart" is less positive than "intelligent" (Bradley and Lang 1999). Though this wording effect can get quite complicated if we consider higher-order spreading activation effect, only simple wording effects were considered here.

(a) Edwards



(b) James

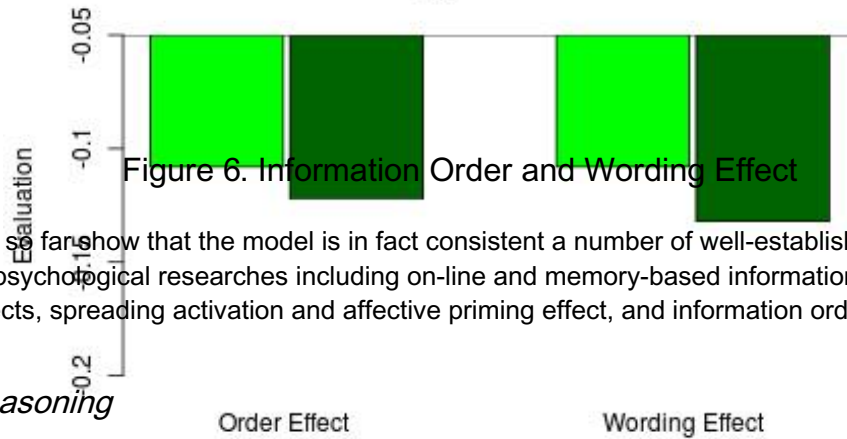


Figure 6. Information Order and Wording Effect

4.13 In all, the results so far show that the model is in fact consistent a number of well-established empirical findings in electoral and psychological researches including on-line and memory-based information processing, practice and recency effects, spreading activation and affective priming effect, and information order and wording effects.

Motivated Reasoning

4.14 In order to examine whether and how JQP models motivated reasoning, an additional simple experiment was conducted. Specifically, after the 5 ideological agents read the statements in Table 1, two additional pieces of information about each candidate were presented to them. These two pieces of information were set up to be identical across candidates and have opposite valences with equal strength; the first information was negative, the second was positive, and the sum of their valence was equal to zero.^[9]

4.15 The same information were also presented to 5 Bayesian agents, which were set up to be identical with the JQP agents in all aspects except that they update candidate evaluations according to Bayes' rule^[10]. A particular weight given to new information in Bayes' rule is not important here. What is important is that this updating rule, in fact Bayesian principle in general, does not distinguish information based on its consistency with priors. That is, it gives the same weight to information whether it is consistent or contradictory to the prior.^[11] Consequently, it provides a baseline case for a comparison with motivated reasoning.

4.16 Figure 7 compares the conservative JQP's evaluations of James and Edwards with those of corresponding Bayesian agent as they process the information. The other ideological agents' responses were essentially the same and are not shown here.

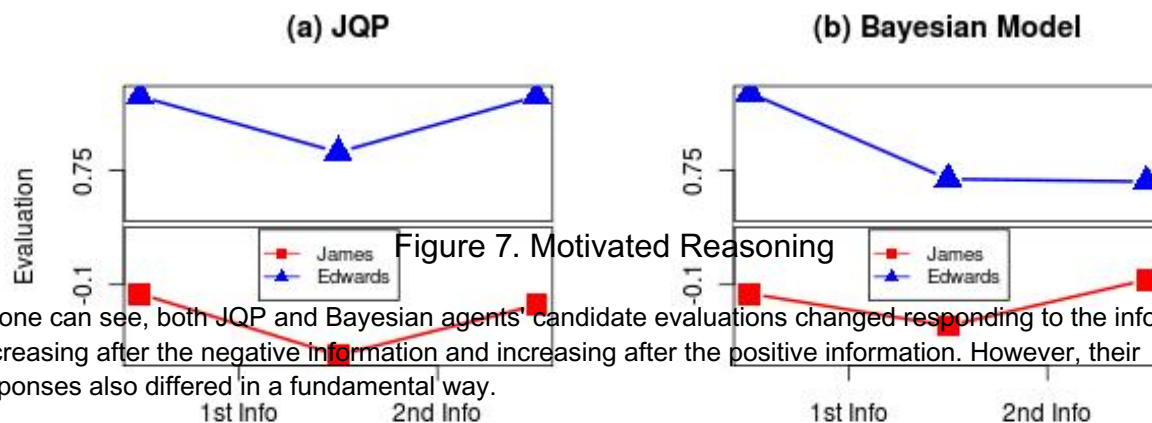
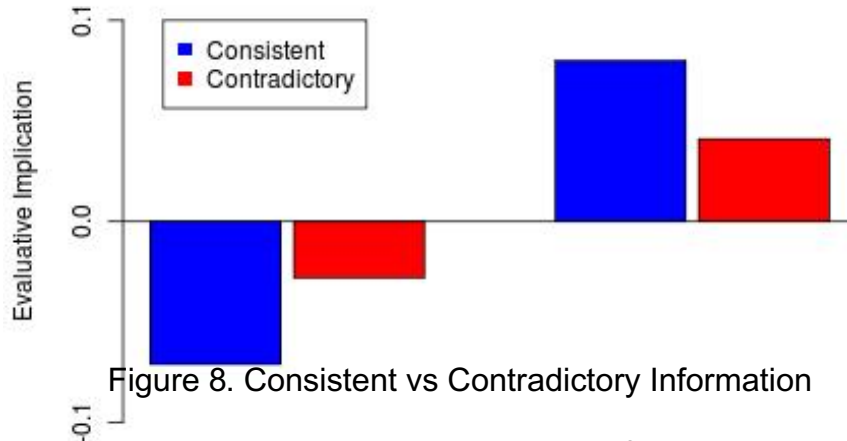


Figure 7. Motivated Reasoning

As one can see, both JQP and Bayesian agents' candidate evaluations changed responding to the information, decreasing after the negative information and increasing after the positive information. However, their responses also differed in a fundamental way.

- 4.17 For the conservative Bayesian agent, the impact of negative information was far greater on the evaluation of Edwards than James, and that of positive information was greater on James than Edwards. In other words, the effect of attitudinally contradictory information was greater than that of consistent information (since this conservative Bayesian agent's prior evaluations of James and Edwards were negative and positive respectively). As a result, the evaluations got moderated over time.
- 4.18 For the JQP agent, conversely, there was little difference between consistent and contradictory information in terms of their impacts on the evaluation. Consequently, the evaluations of James and Edwards moved more or less in parallel (for more discussion about this parallel change, see Bartels (2002)).
- 4.19 This result directly shows that JQP models motivated reasoning. Since the Bayesian model gives the same weight to incoming information and any difference between the two models must come from the difference in their updating mechanism by setup, JQP must have put less weight on contradictory information than consistent information, which is motivated reasoning.
- 4.20 Why would this be the case? In effect, it is because the prior knowledge structure in JQP is not merely an anchor as in Bayesian updating but influences *the ways* information is processed and used. Specifically, when JQP encounters a piece of campaign information the prior beliefs and attitudes influence how the information will be perceived; and when JQP evaluates a candidate they affect how information will be used to form the evaluation.
- 4.21 Figure 8 compares the perceived implications (CA_j in Equation 4) of the information presented to the agent when it was attitudinally congruent and when it was contradictory. As can be seen, the same information was discounted when it was attitudinally contrary to the prior compared to when it was consistent. To be specific, the first (negative) information was perceived less negatively when it was about Edwards than when it was about James, and the second (positive) information was perceived less positively when it was about James than when it was about Edwards.
- 4.22 It is because the prior beliefs and attitudes about the candidates, which the agent developed from processing the information in Table 1, come into play when the information was processed. For instance, when this conservative JQP encountered a positive information, say, "James is trustworthy", such negative concepts as "Democrat", "dishonest", and "pro-choice" would come to mind to make the information seem less positive than it actually is. Conversely, if the agent encountered a negative information, "Edwards is trustworthy", positive considerations like "Republican", "honest", and "pro-life" would be retrieved, but these positive considerations would not necessarily make the information seem less positive. In fact, they may make it look more positive than it is.
- 4.23 Though not shown here, the prior knowledge structure influences how information is used in evaluation construction process as well. In general, when JQP is asked to evaluate a candidate the information in memory that favors priors will be weighted more heavily.



4.24 Evaluative affect plays a critical role in these processes - both when information is processed and when a candidate is evaluated - via affective priming effect, that is, by facilitating the retrieval of congruent information while inhibiting incongruent information. In general, the stronger is affective priming effect, the stronger will be motivated reasoning and the more persistent will be candidate evaluation.

4.25 Figure 9 compares the difference in evaluation of Edwards and James before and after the conservative JQP processed the 4 pieces of information, when the degree of affective priming effect was varied. Without affective priming effect ($\gamma = 0$), the candidate evaluations got moderated. With affective priming effect, however, the difference got polarized and the degree of polarization increased as affective priming effect gets stronger.

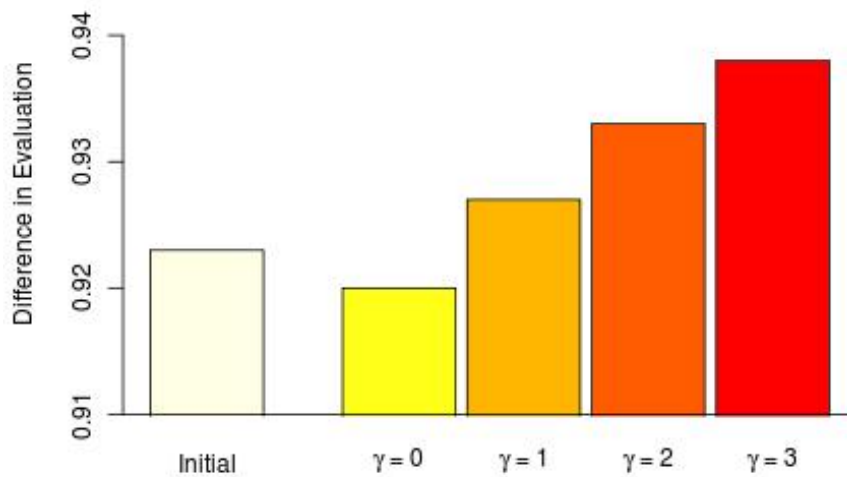


Figure 9. Affective Priming Effect and Candidate Evaluation

- 4.26 It is important that the model's behavior discussed so far do not depend on particular parameter values; that is, qualitatively the same behavior can be produced under wide ranges of parameter values. In particular, JQP will be a motivated reasoner roughly when $\gamma > 0$, $0 < \delta < 1$, $0 < \rho < 1$ and its (prior) belief structure is reasonably consistent. different parameter values within these ranges would not alter this fundamental tendency but influence only its magnitude.

Motivated Reasoning and The Dynamics of Candidate Evaluation

- 4.27 The results in the above suggest that motivated reasoning is critical to account for both responsiveness and persistence of candidate evaluation. A fundamental difference between motivated reasoning models like JQP and standard models like Bayesian learning model is that JQP is not a passive learner but a motivated skeptic that 'actively' reacts to the environment.
- 4.28 JQP does not just passively receive information and swayed by it. Rather, it distinguishes contradictory information from consistent information and reacts to them differently, depreciating information that challenges priors but accepting consistent information more or less at its face value. By contrast, a Bayesian learning model does not distinguish information on the basis of consistency with priors and gives the same weight whether it is contradictory or consistent to priors. Rather, it updates the prior to make it a more accurate estimate of the objective character of an attitude object (Gerber and Green 1998).
- 4.29 Consequently, for any set of campaign information, JQP's candidate evaluations will be responsive to the information but at the same time tend to be persistent over time. Given the same set of campaign messages, however, the Bayesian model's evaluations will fluctuate, being pushed one way and then the other by each piece of new information, and likely moderate over time. Figure 7 illustrates these differences in a simplest possible setting.
- 4.30 To be precise, the discrepancy between JQP and the Bayesian learning model will also depend on the nature of campaign information. If campaign information contains only consistent information, the difference between motivated reasoning and passive learning would be minimal. By contrast, if campaign information contains both consistent and inconsistent information, the difference will be significant. However, as also noted by Bartels (2002), there is little doubt that real campaigns often involve hotted debates and attacks between candidates and thus provide a mix of pro and con information about each candidate. There are generally reasons to both like and dislike all candidates in a typical election.



Conclusions

- 5.1 This paper examined via agent-based simulations the psychological model of candidate evaluation proposed by Kim, Taber, and Lodge (2010). The results show that the model is consistent with a set of well-known empirical regularities repeatedly found in electoral and psychological research, including priming effect (spreading activation effect), affective priming effect, information order and wording effects, and the on-line and the memory-based processing of information.
- 5.2 It is also shown here that the model generally implies motivated reasoning and that evaluative affect towards candidate plays a central role in this process. In effect, the cognitive/affective mechanisms built-into the model together make the prior knowledge more than an anchor in Bayesian updating; it influences the ways information is processed and used to form a judgment. As a result, information contrary to priors tends to be challenged and discounted while consistent information are taken more or less at its face value.
- 5.3 Empirical data show that voters' candidate evaluations in elections are often responsive to campaign information but at the same time tend to be persistent and polarized over time. Without motivated reasoning, it will be

difficult if not impossible to simultaneously explain these dynamics.



Appendix: Information for Replication

- 6.1 All results reported in this paper can be replicated using the model and information available at <http://www.openabm.org/model/2466/version/2/view>.
- 6.2 In the simulation, all ACT-R parameters were set at their default or common values. Specifically, they were set as follows:

```
(sgp-fct :rt 0 :bll 0.5 :ans 0 :pas 0 :pm t)
```

Here, :rt 0 sets the retrieval threshold at 0 so that memory objects whose accessibility is less than 0 become inaccessible. :bll 0.5 sets the memory decay parameter at 0.5 ($d = 0.5$), which has emerged as a common value from many applications (for more details, see Anderson et al. (2004)). :ans 0 and :pas 0 are equivalent to setting the noise parameter at 0 ($\sigma = 0$). Finally, :pm t enables partial matching for procedural knowledge, which is common in most ACT-R applications. All other parameters not specified here were set at their default values.



Notes

¹ NAES 2000 is the first survey conducted daily for more than a year to cover the entire span of US presidential election.

² ACT-R is a leading theoretical and modeling framework used in cognitive science for a wide range of behaviors, among them language comprehension, the recognition and recall of information, inferencing, the formation of beliefs, and the learning of complex skills. However, while ACT-R provides comprehensive sets of cognitive mechanisms for learning, it lacks affective mechanisms, which are essential for the models of political judgment.

³ For details, see Kim, Taber, and Lodge (2010).

⁴ There is also a separate equation for it. For details, see Anderson (1993).

⁵ More specifically, the evaluative implication of "Bush is honest" is constructed with the node 'Bush' and 'honest' held in WM and thus influencing the accessibilities of other objects in LTM via spreading activation and affective priming effect. As a result, 'hypocritical', 'stubborn', and "pro-life" are likely to become most accessible. For details, see Kim, Taber, and Lodge (2010).

⁶ The initial attitudinal stability and baseline accessibility of trait concepts were uniformly set at the maximum of those for political concepts (i.e., when survey response rate is 100%).

⁷ Potential information source effect was ignored for simplicity. To be specific, "James says Edwards supports tax-cut" is equivalent to "Edwards says Edwards supports tax cut" in this experiment. But this simplifying restriction does not change the major results of the study.

⁸ On reading "Edwards", node Edwards is retrieved into WM. Here "support" does not play any significant role. For more details about the internal processes, see Kim et al. (2010).

⁹ The valences of the information were -0.67 and 0.67 respectively, which was the same across James and Edwards for all ideological agents.

¹⁰ The updating rule was $Eval_t = (1 - a) * Eval_{t-1} + a * info_t$ where $a = 0.1$.

¹¹ Kim et al. (2010) also considered a more general version of Bayesian learning model (Gerber and Green, 1998). However, it does not make any difference. The general model does not distinguish consistent and contradictory information either, which is what matters for the result of this study.



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