Communication Monographs
Vol. 79, No. 2, June 2012, pp. 160–180

Routledge
Taylor & Francis Group

Sequential Information Integration and Belief Trajectories: An Experimental Study Using Candidate Evaluations

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Using an extended model of information integration theory, the sequential information integration model (SIIM), the effects of initially presented information on belief trajectories were investigated. SIIM predicts (a) damped oscillatory trajectories when congruent information and incongruent information are presented alternately; and (b) smaller amplitudes of trajectories when initial beliefs have greater weight. An experiment was conducted that utilized a hypothetical election ($N = 201$). Participants initially received specific (vs. no) information about candidates' positions on issues and then indicated their evaluation of the candidates 11 times in response to additional pieces of information that were provided over time. As predicted, belief trajectories were found to have damped oscillatory patterns. The amplitude of the trajectories was smaller for participants with strong party identification than for those with weak party identification. Implications of these findings for theories of persuasion and political decision-making are discussed.

Keywords: Information Integration; Belief Trajectories; Sequential Information Integration Model; Candidate Evaluation

Attitudes and beliefs are often formed or changed after processing multiple pieces of information.[1] For example, in a political campaign, people are typically exposed to a

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ISSN 0363-7751 (print)/ISSN 1479-5787 (online)
http://dx.doi.org/10.1080/03637751.2012.673001

series of pieces of information about candidates. As Anderson (1971) indicated, final attitudes or beliefs are based on the accumulation of pieces of information that the person receives. Thus, how information is integrated into a unitary judgment is a fundamental problem in the study of attitude and belief change. To account for belief change as a result of processing multiple pieces of information, Anderson (1965) proposed information integration theory (IIT; see Anderson, 1971, for a review). IIT has been supported in a number of studies (Anderson, 1965, 1973; Anderson, & Farkas, 1973; Himmelfarb & Anderson, 1975; Kaplan & Anderson, 1973; Sawyers & Anderson, 1971). Key ideas of IIT have been applied to different communication phenomena (e.g., the effect of message discrepancy: Fink, Kaplowitz, & Bauer, 1983; Kaplowitz & Fink, 1997; polarization in group communication: Boster, Mayer, Hunter, & Hale, 1980). In addition, Littlejohn (1989) described IIT as "one of the most credible models of the nature of attitudes and attitude change" (p. 84).

One of the important assumptions of IIT is that people modify their beliefs as they process new pieces of information (Anderson, 1971; Eagly & Chaiken, 1993), which implies that beliefs evolve over time. However, previous studies of IIT have focused on the structural relationship between information and beliefs but have not systematically investigated the dynamic aspects of information integration (i.e., how beliefs evolve over time as new pieces of information are processed). The present study extends Anderson's (1971, 1981) information integration theory to account for this evolution of belief change. Using an extended model of information integration for sequentially presented information, our proposed sequential information integration model (SIIM), this study investigates how initially presented information affects the processing of subsequent new pieces of information. The evolution of belief change is examined with belief trajectories, which consist of belief positions at different time points (Anderson & Farkas, 1973; Chung & Fink, 2008; Chung, Fink, & Kaplowitz, 2008). This study uses the context of a political campaign and political information as its framework.

Sequential Information Integration

According to IIT, the effect of a piece of information on attitudes or beliefs is expressed in terms of the weight (importance) of the information, w, and its scale value (signed magnitude), s. When multiple pieces of information are integrated, the relative weight (i.e., $w_i/\Sigma w_i$, where w_i is the weight of the ith piece of information) is used in the model (the averaging model; Anderson, 1965). Thus, the final belief after processing multiple pieces of information is a function of the sum of the products of the relative weights and scale values. IIT has received substantial support from several studies and has been considered one of the fundamental models of persuasion (Eagly & Chaiken, 1993; Littlejohn, 1989; Petty & Cacioppo, 1996; Stiff & Mongeau, 2003). IIT's notion of the evaluation of information as a product of the weight and the scale value has been used in studying the effect of message discrepancy on beliefs (Anderson & Hovland, 1957; Fink et al., 1983; Kaplowitz & Fink, 1997). IIT's idea of

integration as the composite of belief changes from individual messages was used in Boster et al.'s (1980) linear discrepancy model of polarization shift.

While studying information integration, Anderson and his colleagues focused on the static relationship between the two properties of input information—the weight and the scale value of the information—and the final belief adopted by an individual. However, the process of information integration can also be dynamic in that (a) pieces of information are often processed at different time points, and beliefs can be developed over time (Chung & Fink, 2008; Chung et al., 2008); and (b) beliefs that are developed based on initially processed pieces of information may affect the processing of later-presented pieces of information (e.g., due to cognitive inertia; see Nelson, 1968; Pitz, 1969; and Saltiel & Woelfel, 1975). Anderson and Farkas (1973) pointed out the importance of the dynamic aspects of information integration: "Serial position curves are important for tracing out the buildup of the attitude" (p. 88). However, to trace belief positions at different time points while pieces of information are being processed, information integration theory must be used sequentially, and if information regarding the weight and scale value of new information is lacking, IIT must be simplified; SIIM is the application of IIT in these circumstances.

Assuming one piece of information is processed at a time, the averaging model of information integration suggested by Anderson (1971) can be extended to predict belief position at different time points:

$$P_\tau = \frac{w_0 s_0 + \sum_{i=1}^{\tau} w_i s_i}{w_0 + \sum_{i=1}^{\tau} w_i}, \tag{1}$$

where P_τ is the belief position after processing τ pieces of information, w_0 and s_0 are the weight and the scale value of the recipient's initial belief, and w_i and s_i represent the weight and scale value of the ith piece of information (see Chung & Fink, 2008; Fink et al., 1983; Kaplowitz, Fink, Armstrong, & Bauer, 1986). Equation 1 allows for the prediction of belief trajectories as a function of the information on which the initial belief is based. Depending on the number and properties of the initial information (i.e., the information on which the initial belief is based), the weight of the initial belief, w_0, varies, and the curves of belief trajectories differ even if the same series of additional pieces of information is processed.

Different curves of belief trajectories are shown in the following examples. Assume there are three voters and one political candidate. At the beginning of the campaign, suppose the three voters have the same evaluation of the candidate (i.e., they have equal s_0s) but each s_0 is based on different initial information. For the first voter, the initial candidate evaluation is based on the candidate's positions about issues, which the voter believes to be very important; as a result, this voter has a relatively high w_0. For the second voter, the candidate's issue positions are unknown but the candidate's general ideological perspective is available; therefore, a moderate w_0 is expected for the second voter as compared to the first voter. For the last voter, neither the

information about the candidate's issue positions nor about the candidate's ideological perspective is known, so a relatively low w_0 is expected as compared to the w_0s of the first two voters. Suppose all three voters receive a series of pieces of information about the candidate. They first receive positive information about the candidate and then negative information about the candidate; subsequently, positive information and negative information about the candidate alternate. For candidate evaluation responding to this kind of information, Equation 1 predicts oscillatory evaluation trajectories for all three voters. However, the model predicts that the characteristics of the oscillatory trajectories differ.

A belief trajectory is plotted with time as the *x*-axis and the level of belief or evaluation as the *y*-axis. One of the basic properties of oscillatory trajectories is their amplitude, "the magnitude of the maximum displacement" on the *y*-axis (Halliday & Resnick, 1974, p. 226). If the weight and the scale value of the new pieces of information (i.e., all new w_is and all new s_is) are known, the amplitude of the trajectory can be derived from Equation 1. Even if all w_i s and all s_i s are not known, the basic pattern of the trajectories can be predicted with a simplified version of Equation 1. If the values of w_i in Equation 1 are not available, the expected value of w_i, w, can be used for all w_i. If the absolute values of s_i, $|s_i|$, are not available, the expected absolute value of s_i, $|s|$, can be used for all $|s_i|$. In this case, all s_i s in Equation 1 will be $|s|$ for positive information and $-|s|$ for negative information. Then,

$$\sum_{i=1}^{\tau} w_i s_i = w|s| - w|s| + w|s| - w|s| + \ldots + w_\tau(|s|)$$

$$\sum_{i=1}^{\tau} w_i s_i = w|s| \text{ if } \tau \text{ is odd; } \sum_{i=1}^{\tau} w_i s_i = 0 \text{ if } \tau \text{ is even.}$$

Thus, Equation 1 can be written as

$$P_\tau = \frac{w_0 s_0 + w|s|}{w_0 + w\tau} \text{ if } \tau \text{ is odd; } P_\tau = \frac{w_0 s_0}{w_0 + w\tau} \text{ if } \tau \text{ is even.} \qquad (2)$$

Equation 2 is represented in Figure 1, which depicts candidate evaluation trajectories for the three hypothetical voters with equal initial evaluations of a candidate (i.e., equal s_0s) but with different initial weights, w_0s.[2] Equation 2 and Figure 1 indicate that when positive and negative information are presented alternately to individuals who have different weights for their initial evaluation about a target person, (a) the evaluation trajectories have an oscillatory pattern; (b) the amplitudes of the evaluation trajectories decrease over time; and (c) the amplitude of the evaluation trajectories is smaller for those with greater weights for their initial evaluation than for those with smaller weights for their initial evaluation.

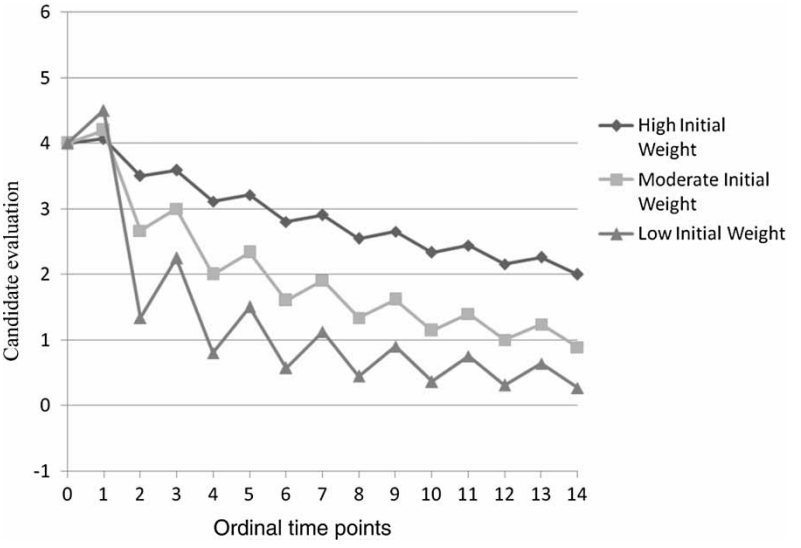

Figure 1 Hypothetical candidate evaluation over time responding to alternating congruent and incongruent messages based on the sequential information integration model ($s_0 = 4.00$, $w_i = 0.50$, for all conditions; $s_i = 3.00$ for congruent information and $s_i = -3.00$ for incongruent information; $w_0 = 7.00$ for strong initial evaluation, 2.00 for moderate initial evaluation, 0.50 for weak initial evaluation).

Candidate Evaluation Trajectories

In actual elections, the public is typically exposed to many messages about candidates at different times throughout a campaign. Sequential information processing, reflecting the changes in candidate evaluation over time, is typical in political campaigns (Brody, 1991). The kinds of information that affect candidate evaluation can be grouped into five categories: party, issues, person information, hoopla and horse race, and endorsement (Lau & Redlawsk, 2006). *Party* refers to each candidate's party affiliation. *Issues* refer to each candidate's stand on political and social issues. *Person information* refers to each candidate's background, personality, face, and judgment about their current job performance. Person information, including morality and competence, is one of the important short-term factors affecting the voter decision (Lau & Redlawsk, 2006). *Hoopla and horse race* refers to poll results and reports on candidates' campaign strategies, and *endorsement* refers to reports of endorsements by political interest groups.

The present study uses candidates' party-affiliation information and issue-position information as initial information on which initial candidate evaluation is based and investigates how initial information and initial candidate evaluation affect the processing of subsequent person information (i.e., the morality and competence of candidates; see De Bruin & van Lange, 2000; Rosenberg, Nelson, & Vivekananthan, 1968, regarding these issues). After an initial candidate evaluation, subsequent person information can be divided into two categories: congruent information (either

positive information about an initially preferred candidate or negative information about an initially disapproved candidate) and incongruent information (either positive information about an initially disapproved candidate or negative information about an initially preferred candidate). When alternating kinds of information (congruent information followed by or preceded by incongruent information) are systematically presented, belief trajectories can be predicted, and the effect of initial information on belief trajectories can be tested. The present study investigates these trajectories using party-affiliation information and issue-position information.

Party identification and candidate evaluation trajectories. Party identification, a sense of emotional attachment to a political party, has been found to be one of the major predictors of political beliefs and behaviors (Campbell, Converse, Miller, & Stokes, 1960; Goren, 2005; Kelley & Mirer, 1974). The strength of party identification affects both candidate evaluation (Meffert, Chung, Joiner, Waks, & Garst, 2006) and voting and participating in campaign activities (Finkel & Opp, 1991). When person information about candidates is presented following the presentation of candidates' party affiliation information, the effect of the person information on candidate evaluation depends in part on the voters' strength of party identification. When candidates' party affiliation information is initially given, voters with strong party identification will put a greater weight on the party affiliation information in their initial candidate evaluation and will be less affected by later-presented person information, as compared to participants with weak party identification. Applying Equation 2 to candidate evaluation trajectories, the following hypothesis is proposed regarding the effect of strength of party identification on candidate evaluation change:

> H1: When congruent person information and incongruent person information are presented alternately after candidates' party affiliation information is presented, the amplitude of the candidate's evaluation trajectory is smaller for those with greater weight for party identification than for those with less weight for party identification.[3]

Initial issue-position information and candidate evaluation trajectories. Research has shown that the similarity of voters and candidates on salient issues is one of the three most important short-term factors affecting voter decisions (along with candidates' personal characteristics and performance evaluations of the candidates; see Campbell et al., 1960; Cook, Jelen, & Wilcox, 1994). Candidates' stands on key political issues (e.g., abortion and gun control) are major factors in evaluating candidates (Campbell et al., 1960; Cook et al., 1994). Furthermore, many studies of issue voting (e.g., Carmines & Stimson, 1980; Conover, Gray, & Coombs, 1982) suggest that candidates' positions on one or two issues are key determinants of voting decisions. When issue position information is given, the weight of the recipient's initial belief, w_0, will be greater as compared to when no issue position information is given. As a result, when person information is presented after issue position information, candidate

evaluation is less affected by subsequently presented person information as compared to when no issue position information is initially given. Thus,

H2: When congruent person information and incongruent person information are presented alternately, the amplitude of evaluation trajectories is smaller when specific issue position-information is initially given than when no issue-position information is initially given.

Patterns of candidate evaluation trajectories. In Equation 2, as τ increases, the denominator of the predictor (on the right-hand side of the equation) increases and therefore the value of P_τ, the belief position after processing τ pieces of information, decreases, which means that the amplitude of the trajectories decreases as the number of additional pieces of information increases. This means that the oscillation is damped (Kaplowitz & Fink, 1982). Therefore, it is hypothesized that:

H3: When congruent information and incongruent information are presented alternately, candidate evaluation trajectories have an oscillatory pattern.
H4: When congruent information and incongruent information are presented alternately, the amplitudes of the evaluation trajectories decrease over time.

Method

An experiment was conducted to test the sequential information integration model with candidate evaluation trajectories. The experiment utilized a hypothetical election situation in which participants played the role of voters. Information about candidates' party affiliations and candidates' positions on several political issues was used to create initial candidates' evaluations. Then congruent messages and incongruent messages about candidates' competency and morality were provided alternately, and candidate evaluations were measured several times, which generated the evaluation trajectories. This study used a repeated-measures experimental design in which the dependent variable is measured multiple times (Jones & Kenward, 2003; Shaughnessy, 2006). In the experiment, provision of initial issue-position information (no initial issue-position information vs. specific initial issue-position information) was manipulated, and strength of party identification (strong party identification vs. weak party identification) was measured and used as an independent variable. Candidate evaluation was measured 11 times and was the main dependent variable.

Participants

Participants were recruited from communication courses at a state university in the US. The participants received course credit for their participation. Two-hundred and one individuals participated in the experiment, 114 of whom were female (57%) and 166 of whom were Caucasian (83%). The number of self-identified Republicans was 57 (28%), and the number of self-identified Democrats was 95 (47%). The average age of the participants was 21.76 years ($SD = 4.33$, $Mdn = 21.00$, $Min = 18$,

Max = 52). Thirty-three (16.4%) participants were randomly assigned to a *no pre-election poll condition*. For hypothesis testing, only cases in the *pre-election poll conditions* were analyzed, $N = 168$.

Procedure

Using a computer program (Chung, Meffert, & Park, 2005), participants played the role of a voter in a hypothetical congressional election. The computer program presented instructions and experimental materials, randomly assigned participants in terms of the provision of initial issue-position information and pre-election-polls (see below), and measured candidate evaluations and other relevant variables. After signing a consent form, participants were first presented with brief biographical information about two candidates, which included the candidates' party affiliation and issue positions. They were then asked to indicate their initial candidate choice and evaluation. Then congruent information and incongruent information about the two candidates were presented. A pre-election poll was given after participants processed a valenced article; however, no pre-election poll was given after the last valenced article. In all, there were nine pre-election polls. After presentation of the last valenced article, participants were asked to cast a final vote. After the final vote, participants answered questions about their political dispositions (e.g., party identification) and some demographic information. Participants were then debriefed.

Initial Candidate Information

After being presented with general information about the hypothetical election, participants were presented with short biographies and personal statements about two hypothetical candidates for a hypothetical congressional election, Democrat Daniel Johnson and Republican Robert Wilson. Participants then indicated their initial preference between these two candidates (their initial vote) and their initial evaluation of the candidates. Biographical information provided basic information about the candidates, such as their party affiliation, ideological perspectives, issue positions, current occupation, previous work experience, education, age, hometown, marital status, number of children, and military experience. Specificity of issue position information varied depending on the experimental condition (see below).

Campaign Information and Pre-Election Polls

After indicating an initial preference, participants read 12 newspaper-style articles about the two candidates.[4] The 12 articles consisted of five pieces of congruent information (three positive articles about their initially preferred candidate and two negative articles about their initially disapproved candidate), five pieces of incongruent information (three negative articles about their initially preferred candidate and two positive articles about their initially disapproved candidate), and two neutral articles. The articles described the target candidate either positively

or negatively based on the candidate's competence or morality. A pilot study ($N = 57$) confirmed that the positive articles were perceived as significantly positive and different from the neutral scale value of 0, and the negative articles were perceived as significantly negative and different from the neutral value (see Table 1). The two neutral articles were perceived as not significantly different from the neutral scale value; $M = 0.19$ for school prayer policy, and $M = 0.32$ for energy plan (on an 11-point scale, in which $-5 =$ *completely negative* and $+5 =$ *completely positive*). The first article was a positive article regarding crime issues in reference to the initially preferred candidate (congruent). The title of the first article for participants who initially picked Daniel Johnson was "Johnson's Crime Plan Endorsed by Police." The article was as follows:

> The Benevolent Order of Police (BOP) announced their support for congressional candidate Daniel Johnson yesterday at a press conference at the courthouse. "Daniel Johnson has always been, and always will be committed to decreasing crime in our neighborhoods and communities. People want to know that criminals are being kept off the street, and that's exactly what Johnson's plan will do," said BOP President Lance Williams.

After the first article, 11 more articles about various social issues were sequentially presented with the valence of the articles alternating.[5] Participants were told that the presented articles had been randomly selected from a large pool of articles that were published and that covered the last congressional election in the area where the (hypothetical) election was to take place. All the articles had a headline and were three to five sentences in length. The articles used for both candidates were identical except for the candidates' names. Instructions indicated that participants might be asked, by a random process, to participate in pre-election polls once or several times; in fact, a pre-election poll was given every time participants processed an article that was positively or negatively valenced except for the last valenced article (i.e., there were nine pre-election polls). After presentation of the last valenced article, participants were asked to cast a vote in the hypothetical election. In both the pre-election polls and the final vote, the participants were asked to indicate the degree

Table 1 Perceived Scale Values of Positive and Negative Articles, by Article Topic (Pilot Study, $N = 57$)

	Article valence			
	Negative		Positive	
Article topic	*M*	*SD*	*M*	*SD*
Balancing the federal budget	−2.54	1.76	3.12	1.38
Tax cuts	−3.37	2.11	3.21	1.87
Increasing funding for tuition assistance	−3.02	1.92	3.00	2.15
Fighting against crime	−3.46	1.54	3.56	1.47
Fighting against terrorism	−3.21	1.72	3.30	1.70

Note. An 11-point scale was used ($-5 =$ completely negative; $+5 =$ completely positive). All means are significantly different from zero, $p < .001$, one tailed.

to which one candidate was preferred over the other as the right person for the position.

Initial Issue-Position Information

Two levels of the provision of initial issue position information were compared. In the *no initial issue-position information condition*, no information about candidates' positions on political issues or ideological perspectives was given in the candidates' biographies or personal statements. For the *specific initial issue-position information condition*, specific information about candidates' positions on abortion, prayer in schools, and gay rights was presented. In this condition, the Democratic candidate allegedly stated, "I strongly support a liberal political agenda. Specifically, I oppose restrictions on abortions and prayer in schools but support expanded gay rights."[6] The Republican candidate allegedly stated, "I strongly support a conservative political agenda. Specifically, I support restrictions on abortions and prayer in schools but oppose expanded gay rights."

Evaluation of the Initially Preferred Candidate

Evaluation of the initially preferred candidate was the main dependent variable. Evaluation of the initially preferred candidate was created based on evaluations of the two candidates. On a computer screen, participants were presented the following instructions:

> We would like you to indicate the degree to which you prefer one candidate over the other for the position. The scale you will find on the following screen presents a continuum where: 50%/50% indicates no preference for any of the candidates or equal preference for both candidates. 100% indicates complete preference of one candidate over the other candidate.

On the following screen, participants were presented a slide bar; the right end of the bar was labeled "100% Preference for Robert Wilson," and the left end of the bar was labeled "100% Preference for Daniel Johnson," and the middle of the bar was labeled "No Preference (50%/ 50%)." Participants were asked to move the slider with a computer mouse. When participants moved the slider, the preference appeared for each candidate below the bar. There were 101 points on the slide bar. Candidate evaluation was recorded for each candidate and candidate evaluation for the initially preferred candidate was the dependent variable. Meffert et al. (2006) used a very similar question and method to measure evaluations about two competing candidates and found systematic and predicted patterns of evaluation change depending on the messages processed by participants, which supports the construct validity of this measure. Participants provided evaluations for the two candidates 11 times (labeled "ordinal time"); these evaluations were their initial evaluation, the evaluations based on the nine pre-election polls, and their final evaluation. The evaluations used to create the trajectories were those based on each participant's initially preferred candidate.

Strength of Party Identification

Strength of party identification was created based on participants' self-reported party identification. Participants identified their party by choosing one of the following eight categories: strong Republican; Republican; Independent, leaning toward Republican; Independent; Independent, leaning toward Democrat; Democrat; strong Democrat; and don't know (Campbell et al., 1960; Lewis-Beck, Jacoby, Norpoth, & Weisberg, 2008). The strong party-identification group was created by combining four groups: strong Republican, strong Democrat, Republican, or Democrat; $n = 93$, which was 46% of the participants. The weak party-identification group consisted of those who were self-categorized as independent, leaning toward Republican; independent, leaning toward Democrat; independent; or don't know ($n = 108$; 54% of participants).

Amplitude of Evaluation Trajectories

For regular sinusoidal trajectories, the amplitude is half of the difference between the maximum point and the minimum point (on the *y*-axis) of a cycle (Halliday & Resnick, 1974). Because candidate evaluation trajectories are not regular sinusoids, an analogue to amplitude was used to measure each trajectory's amplitude: half of the difference between the maximum and the minimum values (on the *y*-axis) of the evaluation trajectory, which is here labeled the *pseudo-amplitude* (see Fink, Kaplowitz, & Hubbard, 2002).[7]

Because amplitudes of trajectories vary over time, the pseudo-amplitude was obtained for three time periods. The pseudo-amplitude for the first period was obtained from the first four candidate evaluations (initial evaluation, poll 1, poll 2, and poll 3); the pseudo-amplitude for the second period was obtained from candidate evaluations at poll 4, poll 5, poll 6, and poll 7; and the pseudo-amplitude for the last period was obtained from poll 8, poll 9, and the final candidate evaluation. Because the pseudo-amplitudes in all three periods were significantly skewed, they were transformed by taking the natural logarithm after adding a constant of 2. After the transformation, the skewness of those variables was not statistically significant ($N = 168$, skewness $= 0.01$ and *SE* of skewness $= 0.19$ for the first period, skewness $= 0.02$ and *SE* of skewness $= 0.19$ for the second period, and skewness $= 0.22$ and *SE* of skewness $= 0.19$ for the third period).

Results

In all the analyses that follow, the alpha level was set at .05, two tailed.

Effect of Pre-Election Polls on Evaluation

To examine the effect of participation in the pre-election polls on final judgment, candidate choice change and evaluation change between the initial and final voting were compared between the no pre-election condition and the pre-election

condition.[8] Thirteen percent of participants in the pre-election poll condition and 14% of participants in the no pre-election poll condition changed their preferred candidate, $\chi^2(1, N = 95) = 0.02$, $p = .912$. The average evaluation change from initial evaluation to final evaluation for the initially preferred candidate, $\Delta P_{f(0)}$, was 0.45 ($SD = 13.92$; 95% CI = −2.95, 3.84) in the pre-election poll condition and −3.64 ($SD = 11.37$; 95% CI = −8.05, 0.77) in the no pre-election poll condition, $F(1, 93) = 1.89$, $p = .173$, $\eta^2 = .02$. These findings suggest that results from the pre-election poll conditions can be generalized to situations in which no pre-election polls are used.

Hypothesis Testing

Effect of party identification on pseudo-amplitude. Figure 2 shows the average candidate evaluation over time by strength of party identification, and Figure 3 shows the average candidate evaluation over time by initial issue-position information. H1 concerned the effect of strength of party identification on the pseudo-amplitude of the candidate evaluation trajectories. To test H1, a repeated-measures analysis of variance was conducted in which (transformed) pseudo-amplitude was predicted by strength of party identification, time period (three levels), and initial issue-position information. Strength of party identification had a significant main effect on pseudo-amplitude, $F(1, 164) = 12.79$, $\eta^2 = .08$, $p < .001$: Those with weak party identification exhibited a greater pseudo-amplitude ($M = 2.41$, $SD = 0.94$ for the first period;

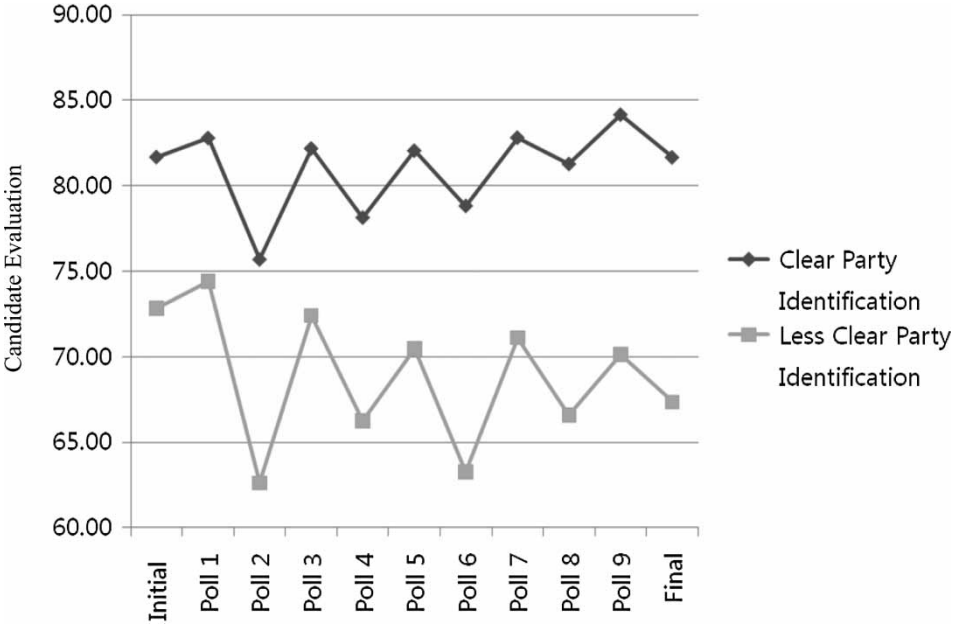

Figure 2 Observed candidate evaluation trajectories responding to alternating congruent and incongruent information by strength of party identification.

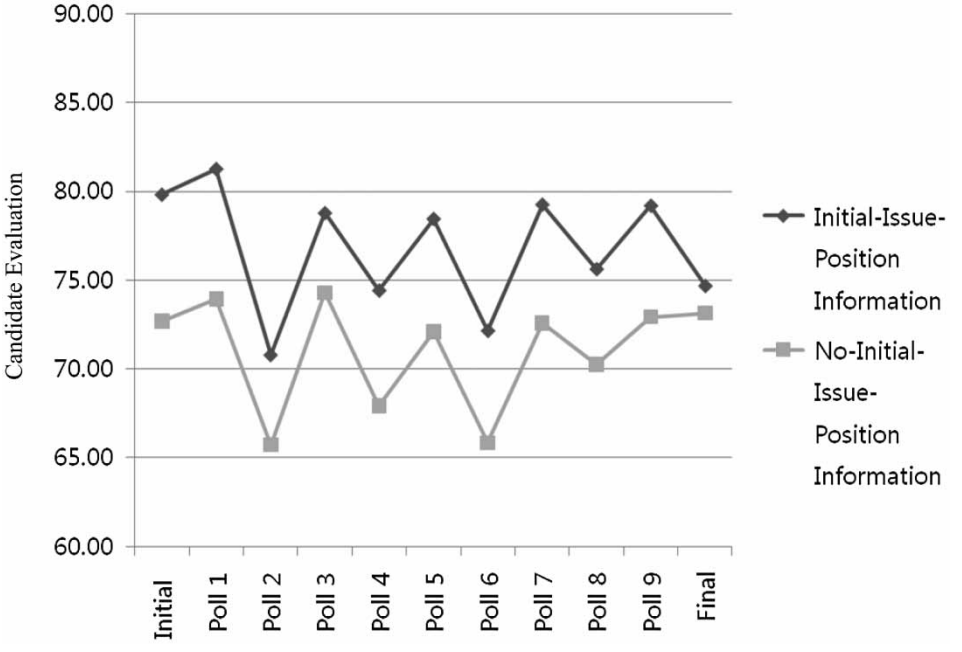

Figure 3 Observed candidate evaluation trajectories responding to alternating congruent and incongruent information by initial issue position information.

$M = 2.43$, $SD = 0.83$ for the second period; $M = 2.13$, $SD = 0.90$ for the third period) than those with strong party identification ($M = 2.09$, $SD = 0.91$ for the first period; $M = 2.12$, $SD = 0.80$ for the second period; $M = 1.67$, $SD = 0.86$ for the third period), which is consistent with H1.

To further investigate the effect of strength of party identification on candidate evaluation trajectories responding to alternating congruent and incongruent information, candidate evaluation changes induced by incongruent information and evaluation changes induced by congruent information were examined. The average amount of evaluation change induced by incongruent information, which was presented immediately before P_2, P_4, P_6, P_8, and the final evaluation, was significantly less negative for participants with strong party identification ($M = -4.07$, $SD = 6.52$) than for those with weak party identification ($M = -6.50$, $SD = 6.81$), $F(1, 164) = 5.04$, $\eta^2 = .03$, $p = .026$, which is consistent with H1. However, the average amount of evaluation change induced by congruent information did not significantly differ between those with strong party identification ($M = 4.07$, $SD = 6.31$) and those with weak party identification ($M = 5.40$, $SD = 5.89$), $F(1, 164) = 1.97$, $\eta^2 = .01$, $p = .162$. These results clarify the findings above; H1 is supported.

Effect of initial issue-position information on pseudo-amplitude. Regarding the effect of initial issue-position information on pseudo-amplitude, H2 was proposed.

The same analysis used in H1 was used for H2. Results showed that provision of initial issue information had no statistically significant effect on pseudo-amplitude, $F(1, 164) = 0.16$, $\eta^2 < .01$, $p = .688$. As an additional analysis, candidate evaluation changes induced by incongruent information and evaluation changes induced by congruent information were examined. Results showed that initial issue information had no effect on either on the average amount of evaluation change induced by incongruent information, $F(1, 164) = 0.63$, $\eta^2 < .01$, $p = .429$, or on the average amount of evaluation change induced by congruent information, $F(1, 164) = 0.008$, $\eta^2 < .01$, $p = .927$. H2 is not supported.

Oscillation. H3 predicts an oscillatory pattern of candidate evaluation over time. Both Figure 2 and Figure 3 exhibit oscillatory patterns. To examine how candidate evaluation changes as a function of the number of pieces of information processed, a repeated-measures analysis of variance was conducted in which candidate evaluation was a repeated measure, and the strength of party identification (a dichotomy), the provision of initial issue position information (a dichotomy), and the ordinal position of the pieces of information provided (τ) were the independent variables. The results showed that τ^2 (a quadratic function of τ), τ^3, τ^5, τ^6, τ^7, τ^8, and τ^{10} had significant effects on candidate evaluation. Among these effects, τ^{10} explained the most variance of candidate evaluation, $\eta^2 = .35$, $F(1, 165) = 88.90$, $p < .001$ ($\eta^2 = .29$ for τ^8, .14 for τ^7, .10 for τ^6, .03 for τ^5, .05 for τ^3, and .11 for τ^2). The linear function of τ was not significant, $F(1, 165) = 0.39$, $\eta^2 < .01$, $p = .53$. These results showed that the best-fitting function of τ predicting the trajectory is τ^{10}, which represents oscillation with nine changes of direction. Consistent with H3, these results indicate that the candidate evaluation trajectories had an oscillatory pattern with nine directional changes.

Damping. H4 predicts that when congruent information and incongruent information are presented alternately, the amplitude of the evaluation trajectories decreases over time. To test H4, the analysis for H1 and H2 was used. The results showed that ordinal time had a statistically significant effect on pseudo-amplitude, with the linear function of ordinal time being significant $F(1,164) = 20.35$, $\eta^2 = .12$, $p < .001$. The pseudo-amplitude for the last period, $M = 1.91$, $SD = 0.91$, was smaller than that of the first period, $M = 2.29$, $SD = 0.83$, $t(167) = -4.77$, Cohen's $d = 0.43$, $p < .001$, and than that of the second period, $M = 2.26$, $SD = 0.94$, $t(167) = -5.60$, Cohen's $d = 0.38$, $p < .001$. H4 is supported.

Discussion

The present study tested a model of the sequential process of information integration, the sequential information integration model (SIIM), which is based on Anderson's (1971, 1981) information integration theory. The proposed model predicts different patterns of belief trajectories depending on the scale values and weights of new pieces

of information, and the scale value and the weight of initial beliefs. In particular, the proposed model was used to investigate the effect of initial beliefs with different weights on the patterns of belief trajectories while receiving new pieces of information. The observed belief trajectories generally supported predictions of SIIM. As predicted, when congruent information and incongruent information were presented alternately, belief trajectories showed an oscillatory pattern, with the amplitude of the belief trajectories decreasing over time. Consistent with the proposed model, participants who were assumed to have a greater weight for their initial beliefs (i.e., those with strong party identification) generated belief trajectories with a smaller amplitude than those who were assumed to have lower weight for their initial beliefs (i.e., those with weak party identification). The difference in amplitudes was also expected for those with initial beliefs with important initial information (i.e., candidates' issue position information) versus those with initial beliefs without those pieces of information, but that difference was not statistically significant.

Implications for Theories of Information Processing and Belief Change

Information integration theory (Anderson, 1971, 1981, 1991) has received substantial support from various studies and has been considered an important theory of persuasion (Eagly & Chaiken, 1993; Littlejohn, 1989; Petty & Cacioppo, 1996; Stiff & Mongeau, 2003). However, because the information integration often evolves over time (Anderson & Farkas, 1973), time-series data for belief change, showing responses to new pieces of information, are needed to provide a rigorous test of this theory. Anderson and Farkas (1973) measured belief position at four time points and obtained serial position curves (i.e., belief trajectories). However, they did not make any predictions about these curves and used only final positions to test information integration theory. The most important contribution of the present study is the development of a model of the temporal and sequential process of information integration. The present study converted the static model of information integration theory into a temporal one, one that predicts belief positions at different time points. Observed patterns of belief change were generally consistent with SIIM, which extends and supports information integration theory. Indeed, this is the first time that information integration theory received support with time-series data.[9]

One important issue concerning information integration was whether the integration process is additive or averaging (Anderson, 1965). Anderson (1965) tested these two models and the results were mixed. Anderson (1965) pointed out that the crucial difference between the two models lies in the effect of the weight of initial beliefs. The present study indirectly manipulated different weighs of initial beliefs and tested the effect of these initial beliefs on belief trajectories. The observed belief trajectories differed depending on the weight of the information that was used to form the initial beliefs, which is consistent with the averaging idea. Thus, the present study provides strong support for the averaging version of IIT.

The effect of the weight of initial beliefs on belief change or the resistance induced by disconfirming information has been studied in terms of cognitive inertia (Nelson,

1968; Pitz, 1969; Saltiel & Woelfel, 1975) or attitude strength (Petty & Krosnick, 1995). In general, when initial beliefs have more links to other beliefs (Nelson, 1968; Saltiel & Woelfel, 1975), especially to important values (Petty & Krosnick, 1995; Rokeach, 1968), they tend to be more resistant to disconfirming information (but cf. Himmelfarb, 1974). The present study found that when initial beliefs are related to important values (e.g., party identification), beliefs were less affected by new information, especially by disconfirming information. Most of the previous studies examining this issue have the target presented with one or two pieces of disconfirming information. Here many pieces of disconfirming information were presented; the effect of multiple pieces of disconfirming information on resistance to change due to the weight of initial beliefs was tested for the first time. Furthermore, the present study found that the resistance provided by the weight of initial beliefs is not limited to a single belief change; it can be found throughout belief trajectories that represent the responses to many persuasive attacks.

Implications for Information Processing and Evaluation in Political Contexts

SIIM can be applied to information processing and evaluation in political contexts. When congruent information and incongruent candidate information were alternately presented, the participants who were assumed to put greater weight on the information about candidates' party affiliations (i.e., those participants with strong party identification) created candidate evaluation trajectories with smaller amplitudes than those who were assumed to put less weight on candidates' party affiliations (i.e., those participants with weak party identification). Party identification and candidates' positions on political issues are known to play key roles in candidate evaluation (Campbell et al., 1960; Goren, 2005). Many models have been proposed to predict candidate evaluation with party identification, issue positions, and other relevant political variables (Campbell et al., 1960; Conover et al., 1982; Hastie & Dawes, 2001; Lau & Redlawsk, 2006). However, those models are not concerned with the evolving evaluation of candidates during a campaign. For example, Campbell et al. (1960) found that a voter's party identification influences the processing of a candidate's other personal information (see also Miller & Shanks, 1996). However, Campbell et al. did not examine *how* a voter's party identification subsequently affects the processing of a candidate's other personal information. Several studies have explored changes of public opinion as a function of information given at different times (Brody, 1991; Holbrook, 1996), but those studies analyzed changes in public opinion at the macro (societal) level rather than at the individual level. Furthermore, existing models and studies of candidate evaluation heavily rely on cross-sectional rather than time-series data.

Using experimental methods and belief trajectories, the present study showed that candidate evaluations evolve during a campaign as voters receive multiple pieces of information about candidates. The present study also found that the patterns of candidate evaluation trajectories differ depending on the information that is used to form the initial evaluation. People with strong party identification were less affected

by candidates' person information than those with weak party identification. The present study also found that the strength of party identification had an ongoing effect on candidate evaluation: The effect is seen over the entire candidate evaluation trajectory.

Limitations and Suggestions for Future Research

The present study has some limitations. According to SIIM, one of the important features of information is its weight or importance. The present study did not measure or manipulate the weight of information. Even though the data were simplified by assuming that all the pieces of information that were provided to the participants had equal weights, the evaluation trajectories had the predicted patterns. However, the fit of the model to the data would likely have been improved had the weight of each piece of information been measured and used to test the model. In addition, information that had similar absolute scale values was used, and equal absolute scale values were assumed in predicting the evaluation trajectories. If information with different scale values were to be used, the proposed model could be more rigorously tested.

In political decision-making, information about candidates' positions on political issues is significant to the decision-making task. In the present study, limited and brief information about candidates' positions on political issues was used as initial information, and person information was used as new information. However, in actual political campaigns, information about candidates' positions on political issues is often available in the midst of a campaign, and voters may change their evaluation of a candidate as a result. How candidate evaluation changes over time when a voter receives several pieces of information about candidates' positions on political issues should be investigated.

Participants in the present study were college students and not representative of the general population. They are younger, better educated, and less likely to vote (e.g., Lau & Redlawsk, 2006; Sears, 1986). However, the present study is not focused on political behavior but rather on testing a model of information processing. Meta-analyses of the effects of negative campaigns (Lau, Sigelman, & Rovner, 2007) and the effect of framing on decision making (Kühberger, 1998) suggest that student samples do not differ in their responses from samples of the general population. Thus, it is reasonable to believe that the model of college students' information processing supported here is likely to be similar to the model that applies to the population at large.

Conclusion

People often process several pieces of information about an issue before they form or change their evaluations. However, how evaluations change over the course of processing multiple pieces of information has been largely unknown. The course of evaluation, the evaluation trajectory, provides vital information not only about the

effect of message characteristics (e.g., scale value and order) on evaluation change but also about the cognitive processes involved. Such trajectories should be used in future studies investigating the processes involved in belief and attitude change.

Notes

[1] In the present study, beliefs refer any propositions in which a person has a given degree of confidence; the content of the proposition can be either nonevaluative or evaluative (Kruglanski, 1989; Rokeach, 1968). For example, the evaluation of a political candidate is an example of an evaluative belief.

[2] A small increase in the first change in Figure 1 is predicted because positive information is used as the first piece of new information in the example. If initial candidate evaluation is positive and the first piece of new information is incongruent with the participant's initial view (here, negative information about the initially preferred candidate), the first shift from the starting point of the trajectory is motion in the negative direction and the amount of absolute change is greater than for the other shifts (with the same weight and same absolute scale value). However, when initial candidate evaluation is positive and the first piece of new information is congruent with the participant's initial view (here, positive information about the initially preferred candidate), the first shift is in a positive direction but the amount of absolute change of the first shift is smaller than the second shift that is induced by incongruent information.

[3] The hypotheses are presented in the framework of political decision making, but it should be noted that each hypothesis can be stated more generally.

[4] The news articles were first developed and used in Meffert et al. (2006).

[5] The second article was a positive article regarding tuition in reference to the initially disapproved candidate (incongruent). The third one was a negative article regarding financial issues in reference to the initially disapproved candidate (congruent). The fourth article was a neutral article about a citizens' discussion about the initially disapproved candidate's school prayer policy; no information about either candidate's actual position on the issue was given. The fifth article was a negative article regarding crime issues in reference to the initially preferred candidate (incongruent). The sixth article was a positive article regarding terrorism issues in reference to the initially preferred candidate (congruent). The seventh article was a positive article regarding taxes in reference to the initially disapproved candidate (incongruent). The eighth article was a negative article regarding taxes in reference to the initially disapproved candidate (congruent). The ninth article was a neutral article about a citizens' discussion about the initially preferred candidate's energy plan policy. The tenth article was a negative article regarding terrorism issues in reference to the initially preferred candidate (incongruent). The eleventh article was a positive article regarding budget issues in reference to the initially preferred candidate (congruent). Finally, the twelfth article was a negative article regarding tuition issues in reference to the initially preferred candidate (incongruent).

[6] The wordings for candidate issue positions should have written more clearly, such as "I oppose restrictions on abortion, and oppose prayer in schools. . . ." However, regardless of issue positions, participants are expected to have stronger initial evaluations with more information about candidates' issue position. Therefore, this ambiguity should not cause a problem for hypothesis testing.

[7] Using the pseudo-amplitude, Fink et al. (2002) tested a hypothesis about a positive relationship between amplitude and final attitude change. They found that the correlation between two variables was .45 ($p < .01$), which provides supporting evidence for the construct validity of this measure. Kaplowitz, Fink, and Bauer (1983) used a similar measure

and found that as predicted, the message that was the most discrepant to the participant produced a trajectory with the greatest amplitude; this finding also demonstrates the validity of this measure.

[8] A computer program was designed to randomly assign 20% of participants to the no pre-election-poll condition for both the no initial issue-position information condition and the initial issue-position information condition. However, only 5% ($n = 5$) of participants with initial issue-position information were actually assigned to the no pre-election poll condition. For those with no initial-issue-position information, 30% were assigned to the no-pre-election poll condition. Because of the very small number of cases in the no pre-election poll condition with initial issue-position information, only cases in the no initial issue-position information condition were used to test the effect of pre-election polls on candidate evaluation ($n = 95$).

[9] An additional test of the effect of the weight of initial information on the amount of change between the initial and the final evaluations revealed that the greater the initial weight, the smaller the evaluation the change (the effect of the strength of party identification, $F[1, 164] = 5.65$, $\eta^2 = .03$, $p = .019$; the effect of issue position information, $F[1, 164] = 4.72$, partial $\eta^2 = .02$, $p = .031$). Even though this static comparison provided supporting evidence for IIT, the observed belief trajectories provide clearer evidence that beliefs evolve through information integration.

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